Real Time Face Detection using DNN with Raspberry Pi 4

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Abstract: The concept of face recognition is in the emerging trends nowadays ,because of its wide application range .Usually ,the face recognition is used in the surveillance ,security and Here, Face recognition is used to allocate attendance for a candidate.Deep neural networks is a group of artificial intelligence entirely based on neural networks, because the algorithm will imitate the human brain, so deep learning can be a kind of imitation of the human brain.Local Binary Pattern (LBP) is a basic but also very advanced creaminess operator that names image pixels through thresholding every pixel's district and considers the outcome as just a binary number.If the recognised face is not authenticated or if unauthorised person is identified by the system ,it immediately alerts the server and the classroom door remains closed. In this project we have created our own database with faculty and students of our section using Logitech C270 HD camera with resolution of 720p/30fps.
IndexTerms: Face recognition,Deep neural network,RPI Cloud,Attendance postage,Motor driver.

I.INTRODUCTION

Face recognition has become one of the foremost necessary user identification methods.Literature survey statistics shows that research add face recognition system for rapid growth of their research,and within the past forty years. Face recognition is trivially performed by humans, even with certain conditions like vary light and change of face by age or covered with accessories and hair present face.

Deep learning techniques are able to search very large number of datasets with faces and learn very accurate and closely matched representation of faces, which allows modern method to perform and later to exceed the face recognition strength of human beings. Face recognition is a well defined process which consists of detection correctness, extraction of feature and a recognition of face.Detection of the face is a wider term than recognition of the face.

The face detection essentially means a model can recognise the presence of a human face in an image or video. ... Identification can be confirmed by face recognition.

Furthermore, it is also used to supervise access to sensitive regions.Face recognition is having a great deal in the present world and also plays a major role for the purpose of security and surveillance. In this paper the method used is deep neural networks (DNN). Profound adapting (otherwise called profound organized learning or various leveled learning) is a piece of a more extensive group of AI techniques dependent on counterfeit neural systems. Learning can be administered, semi-managed or unaided.
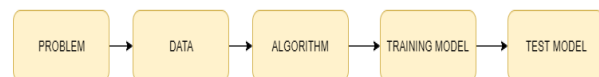

Fig. 1: Fundamental steps of the proposed methodology

Profound learning structures, for example, profound neural systems, profound conviction systems, intermittent neural systems and convolutional neural systems have been applied to fields including PC vision, discourse acknowledgment, normal language handling, sound acknowledgment, informal organization sifting, machine interpretation, bioinformatics, tranquilize plan, therapeutic picture examination, material investigation and prepackaged game programs, where they have delivered results practically identical to and now and again better than human specialists[9].Counterfeit Neural Networks (ANNs) were roused by data preparing and conveyed correspondence hubs in natural frameworks. ANNs have different contrasts from natural cerebrums. In particular, neural systems will in general be static and emblematic, while the natural mind of most living life forms is dynamic (plastic) and simple.

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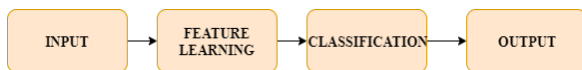

Fig. 2: Convolution Neural Network block diagram.

i)First phase is of applying a non linear transformation of input and create statistics model as output

ii)Second phase is to improvise the neural model with mathematical methodology called as derivative.Feature learning as well as representation learning in machine learning is often a sequence of methods that learn a feature: transforming original data input into a recognition which can be used efficiently in deep learning activities.

II. LITERATURE REVIEW

This area gives a diagram on the significant human face acknowledgment procedures that apply for the most part to frontal faces, favorable circumstances and hindrances of every strategy are likewise given. The strategies considered are eigen faces (eigen features), neural systems, dynamic connection design, shrouded Markov model, geometrical component coordinating, and layout coordinating. The methodologies are investigated as far as the facial portrayals they utilized. Computerized Face detection System Using Face Recognition: Digital attendance process that use Face Recognition suggests that model is based on face recognition and recognition algorithms that are used to automatically identify the face of the student when he / she enters the class and that the system is able to recognize the attendance[1].

Viola-Jones Algorithm was used for face detection using a cascade classifier and PCA to detect human face using cascade algorithm and PCA algorithm to select features and classify SVM. This system saves time when compared to traditional attendance marking and also helps monitor the students.

Attendance system using detection of iris:

The student is asked to stand in front of the camera in this proposed system to detect and recognize the iris for the system to mark the student attendance. Some algorithms are being used to detect the iris, such as Gray Scale Conversion, Six Segment Rectangular Filter, Skin Pixel Detection. It

helps prevent proxy issues and keeps the student attendance in an effective manner, but in one of the time-consuming process for a student or staff to wait until the previous members are finished[2].

III.TEMPLATE MATCHING

A simplified version of the matching template was that a test image is an array of two-dimensional range of frequency values are similar to an equivalent metric, such as Euclidean distance, with a single prototype reflecting the whole body. Several more complex template models suit face recognition. From different points of view, the person can use more than one face recognition model to reflect the face of a person.. This paper's main strategy is to take part in organization etc. for these periods are set after the time period has been completed. This raspberry pi 4 module is stored directly in attendance. Own face algorithm used for high speed operation, but when a number of students face increases the accuracy will decrease[3]. Solve the issue of high image processing speed in this paper. The two views are a face descriptor method for face detection and extraction of features by using deep learning, using raspberry PI to develop the database. It is possible to use the database to suit the input and then display screen output[4]. In this article, an efficient method for determining head pose is proposed. Solve the problem associated with face recognition variation and then the face is detected by using adaboost algorithm. Then the preprocessing of the face is detected.. For this PCA-based face recognition solution, relying on a single –pose face DB. It was proposed that in this paper the technique of capturing images in an embedded system based on raspberry pi 4 an embedded framework in its implementation is very different and unique. In this case, the photo capture and recognition algorithm using Raspberry pi and its peripherals to capture embedded photos using Raspberry pi[5]. In [12], the authors have proposed an example to show use of Raspberry Pi and Pi webcam with Opencv machine vision algorithms. This might gain access to advanced and most popular deep learning algorithms such as face recognition by compiling the latest version of Open CV. He also used a double-acting Stepper motor lock / unlock button following power-off.

Used Neural Network:

Convolution Neural Network, it is used when there is unsymmetric data sets and the user need to draw information from it. Reinforcement Learning: It is part of machine learning in which the models are trained by receiving virtual "rewards" or "punishments", essentially learning by trail and error. Most famous algorithms are: Q-learning,Deep Qnetwork.

Automatic Human Face Recognition:

It is a process that involves 4 steps mainly

1) Detection of face: It identifies one or more faces present before it and mask with rectangular box.

2) Extraction of features: Identifying the geometric structure of captured faces in digital images, and trying to obtain a standard alignment of face upon a translation, scale, and rotation.

3) Alignment: In this task the extraction of features of features from face which is used for the recognition method.
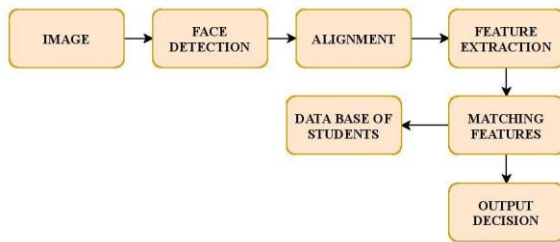4) Recognition: Matching the input face against one or more well known faces present in the prepared database.

Fig. 3: Image Processing Flow Diagram

This system's functionality is described primarily in the following steps: i.Using a webcam attached to the Raspberry Pi panel to enroll and identify face.

ii.To show both the match status on the LCD and the terminal running on the screen of VGA(Video Graphics Array).
iii.Using python language to program for the same.The software imports certain modules that allow for face recognition.
iv.To move the motor in the direction of the clockwise or anti-clockwise when an image is acquired.
An model patch template is used by a simple prototype matching method optimized to a specific search image feature that we need to find. It is easy to perform this technique on gray objects or edge images. In areas where the image structure equals the mask structure, if large image values are combined by small mask values, the cross correlation efficiency will be best. The equation is of following.

$$SAD(x,y) = \sum_{i=0}^{T_{rows}} \sum_{j=0}^{T_{cols}} Diff(X+i, Y+j, i, j)$$

$$\sum_{x=0}^{S_{rows}} \sum_{y=0}^{S_{cols}} SAD(X, Y)$$

Srows and Scols denote the rows and the columns of the identified image and Trows and Tcols denote the rows and the columns of the template image, respectively.
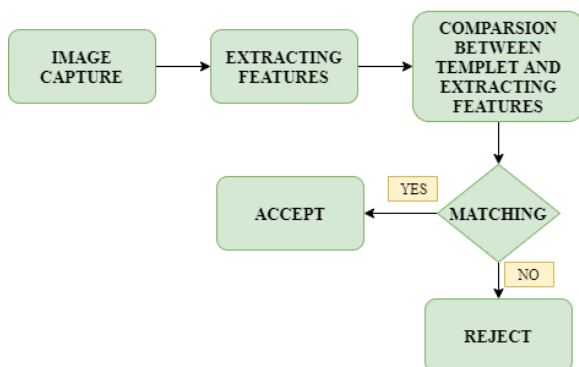

Fig. 4: Process Flow Diagram

Image Capturing:

The system captures a physical or behavioral sample during registration and also during the process of identification or verification. Colour characteristics by use of wavelet transforms (WTs) to facial recognition are generally had to triumph over analysis of characteristics. In WT, the image is signified by a intensity of information in small areas across a variety of dimensions. This outline gives an architecture for the examination of image characteristics, that are often self-contained in dimension and it can be frequently distinguished in frequency domain characteristics. In overall, the feature selection strategies such as principal component analysis and linear discriminant analysis, all sub-bands must be decomposed in both training and testing stages, while in the feature selection of wavelet components, the image could be degraded for only considerable sub-bands[5].

Database Specification:

In this process the database is not ready available. Data base is created by us. For the motivations behind Qt Extended, a social database is characterized as an arrangement of oversaw information stores, which are questioned and refreshed utilizing Data Manipulation Language articulations. The most well known information control standard is SQL, which is institutionalized in ISO/IEC 9075:1999(E) Information innovation - Database dialects - SQL.
A SQL social database framework is composed as:
1. Databases
2. Tables
3. Sections
where each is comprised of the following, ie Databases are comprised of Tables, which are comprised of Columns. Also inside Databases, a Table may have at least one lists. Non-SQL-99 standard expansions, for example, put away methodology, social imperatives and triggers are likewise part of the database[7].

Extracting Features:

The experiment collects image segmentation like eyes, ratio of vertical and horizontal contour and generates a model of that person.

Face Detection With Haar Cascade Classifier:

It is a digital technology that guides the location and weight of human faces in digital images. This distinguishes facial features and completely ignores anything else, including barriers, things, trees and bodies, glass, mask and etc. Face detection is considered a more general case of face localization. The job is to seek location and scale of the known number of faces in face recognition[9]. 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. The algorithm is being trained in this phase. Every histogram generated from the training dataset is used to represent every face image. So, given an input image, for this new image, we perform the steps again and create a histogram that represents the image. So we just need to compare two histograms and return the image with the nearest histogram to find the image that reflects the input face image. For example, we can use different approaches that evaluate histograms: euclidean distance, chi-square, eigenvalues, etc. In this case, based on specific equation, we can also use the Euclidean distance[10].

$$D = \sqrt{\sum_{i=1}^{n}(\text{hist } 1_i - \text{hist } 2_i)^2}$$

Face recognition c270:

The c270hd camera is the module is being used in this project.This camera supports device that working with windows ,linux and mac based operating system This camera c270 module optically scans the face when user stand in front of it or whenever it is activated by faculty in the classroom The c270 gives smoothest Hd images with more frames per second than other Hd webcams and it is easily reliable with raspberry pi embedded operating system.

This camera is found efficient for all types of operating systems, and moreover it is easy to interface with the raspberry pi. The c270 HD camera and digital persona face recognition engine have an equal ability to authenticate with most difficult dim and dull with accurately and rapidly.

Haar Features:

Haar feature is the input to basic classifiers
1. Edge features
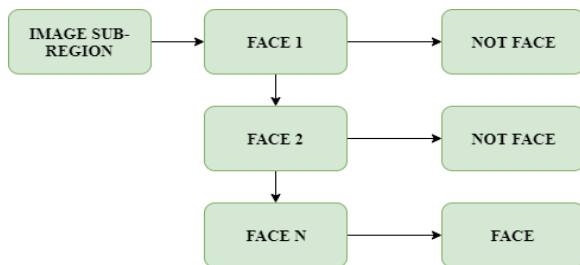2. Line features
3. Center surrounded features

Fig. 5:Block Diagram For Haar Classification

Every feature is a single valve subtracting the sum of pixels with blue rectangle box from sum of pixels under black rectangle. And that is where the issue lies: for face recognition, the process starts from the top left of a image and goes back down through smaller blocks of information, staring at each row, continuously questioning, "Is that a face? Is that a face? Is that a face?"Because there are 6,000 or even more trials for each frame, you may have thousands of measurements to be doing, which will stop your computer even from slogging. The benefit is that some of the image may return negative that in the first few steps, which indicates that perhaps the program would not waste any time evaluating all 6,000 properties on everything[15].

Adaboost Classifier:

After recognizing multiple objects from input, we could incorporate a deep learning facial recognition technology system which further categorizes a person's recognition of given input face.

$$F(x) = \sum_{i=0}^{n}(a_i * f_i(x))$$
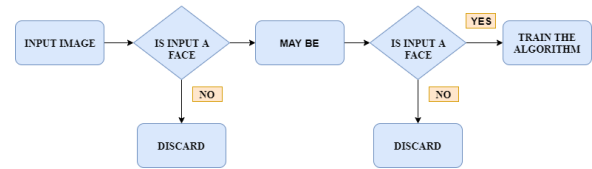
$$a_i - corresponding\ weight\ of\ classifier$$

Fig. 6: Adaboost Classification

Now the code is building the cascade and dynamically allocating this with our face cascade, which loads the face cascade in to the memory so it will be fully prepared for the use. Understand, the cascade is really just an XML file comprising the faces detection information. Then the code interprets the object and transforms it into a gray scale[6].

The deep neural network recognizes the original face and is a key part of this program:

DetectMultiScale is a general feature which senses objects. It will be called an algorithm on a face cascade, that is what it detects.

1.And the first choice is of creating grey scale image.

2.As some heads might have been closer to the camera, they look bigger than even the faces in the rear. This is remunerated by the scale part of the code with in built function scale Factor. The moving window is being used by the identification neural network to monitor objects. MinNeighbors identifies how often objects near the actual one will be identified once the face is stated. In the mean while, minSize clearly shows the dimensions within each window.

3.The face detection neural network returns a number of rectangles under which it actually thinks a face has now been encountered. Thereafter, the program will loop over whether it thinks something had been discovered. The face detection neural net returns 4 values: the x and y position of a rectangle, as well as the width and height of that same rectangle (w, h). The algorithm uses all such values to sketch the rectangle with the help of built-in rectangle() function.

LINEAR DISCRIMINANT ANALYSIS

Direct Discriminant Analysis or Normal Discriminant Analysis or Discriminant Function Analysis is a dimensionality decrease procedure which is regularly utilized for the administered order issues. It is utilized for demonstrating contrasts in bunches for example isolating at least two classes. It is utilized to extend the highlights in higher measurement space into a lower measurement space. For instance, we have two classes and we have to isolate them productively. Classes can have different highlights. Utilizing just a solitary component to order them may bring about some covering as appeared in the underneath figure. Along these lines, we will continue expanding the quantity of highlights for appropriate characterization. Assume we have two arrangements of information guides having a place toward two distinct classes that we need to group. As appeared in the given 2D chart, when the information focuses are plotted on the 2D plane, there's no straight line that can isolate the two classes of the information focuses totally.

Henceforth, for this situation, LDA (Linear Discriminant Analysis) is utilized which lessens the 2D chart into a 1D diagram so as to boost the distinguishableness between the two classes. Here, Linear Discriminant Analysis utilizes both the tomahawks (X and Y) to make another hub and ventures information onto another pivot in an approach to expand the partition of the two classifications and consequently, decreasing the 2D diagram into a 1D chart[14].

IV.APPLICATIONS

Face Recognition: In the field of Computer Vision, face acknowledgment is a mainstream application wherein each face is spoken to by countless pixel esteems. Straight discriminant investigation (LDA) is utilized here to lessen the quantity of highlights to an increasingly sensible number before the procedure of order.

Every one of the new measurements produced is a direct mix of pixel esteems, which structure a format. The straight mixes got utilizing Fisher's direct discriminant are called Fisher faces[24].

Medicial: In this field, Linear discriminant investigation (LDA) is utilized to characterize the patient sickness state as gentle, moderate or extreme dependent on the patient different parameters and the therapeutic treatment he is experiencing. This encourages the specialists to strengthen or lessen the pace of their treatment.

Client Identification: Suppose we need to recognize the kind of clients which are destined to purchase a specific item in a shopping center. By doing a basic inquiry and answers overview, we can accumulate every one of the highlights of the clients. Here, Linear discriminant examination will assist us with identifying and selecting the highlights which can depict the attributes of the gathering of clients that are destined to purchase that specific item in the shopping center.

V.SKETCH OF THE SYSTEM

Hardware design:

The developed kit contains Raspberry pi4 development kit,DC motor, power Transformer, Doorframe, power supply, USB webcam(c270),desktop raspberry pi4.

The heart of pi4 beets a powerful 64-bit quad-core ARM cortex A72(BC72711) central processing unit running at 1.5 GHz and paired with 4 GB RAM.It is considered as one of the few lower power consumption CPU[6].

RASPBERRY PI4 LAYOUT:

1. 4 GB RAM
2. 500 MHz video core v1
Input maybe Discard Discard Is Input a face?
3. dual micro HDMI ports
4. 2*USB 3.0/2*USB 2.0
5. Gigabit ethernet
6. 802.11ac(2.4/5 GHz) Bluetooth 5.0
7.USB type-C

RELAY MODULE:

It is basically a switch which is operated by an electro magnet. It requires less voltage to get activated which will be given from raspberry pi once it is activated it will pull the contact to make higher voltage circuit. Sometimes you would

like to monitor high voltage Raspberry Pi devices. Relays is used for this function on a Raspberry Pi: the "switch" relay is being used by means of the low power pulse. Although the Pi only accepts a limit of 5V (GPIOs maybe only 3.3V) without relays, there is indeed a risk that even the Pi may blow out. However it won't happen if you already have multiple separate circuits. Relays were accessible as 2 *, 4 *, 8 * or even 16 * modules depends entirely on your requirements. To avoid wasting too often GPIOs on a Pi, the acquisition of the GPIO port extender with far more than 4 channels is worth the effort.
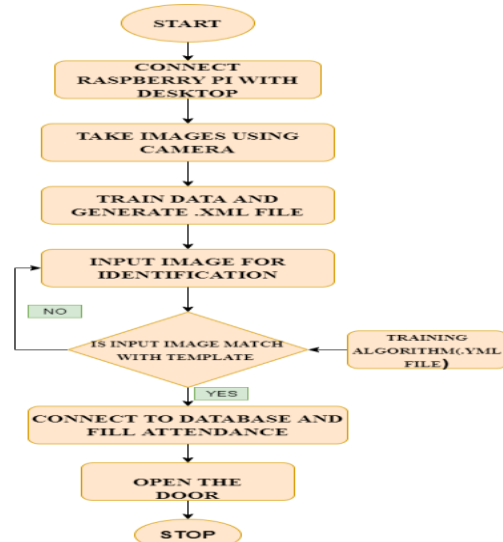

Fig. 1: Proposed Model Flow Diagram

VI.RESEARCH AND DISCUSSIONS

By using the above process the collected database is stored in the raspberry pi desktop direct when we execute the code for register and later on the training process takes place[24]. In this process we create a database of students and lecturer`s with authorized data given at the time of enrollment to the college/university.The input images of current poses creates database of students and stores in pi.Next the camera module intakes current live face of the student.And all this process is done in Raspberry pi 4 module.Creates our own student database and the image stored in folder in training dataset.

VII.RESULTS

To display the results of student attendance, the student attendance system(SAS) website was designed to update the student attendance sheet at the time student comes to class.The student attendance system provided with an authentication system for both student and lecturer and they can check his/her registered course attendance from a mobile phone or personal computer

The below is the database created by the system:
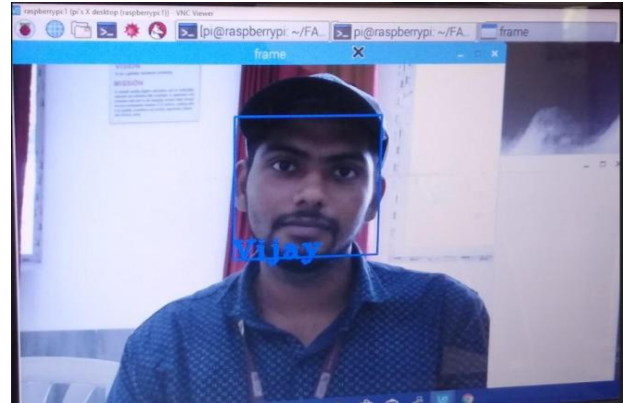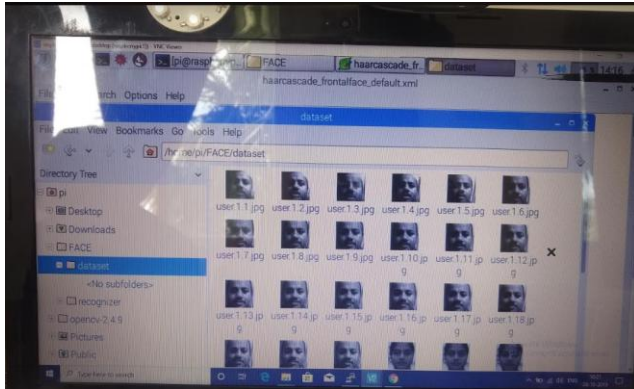
	A	B	C	D	E
	Enrollment ID	Name	Date	Time	
	60101	Sugandhi	05-11-2019	09:05:45	
	41053	Karthik	05-11-2019	09:09:36	
	40240	Vijay	05-11-2019	09:10:53	
	40677	Bhanu	05-11-2019	09:12:42	
	40997	Phani	05-11-2019	09:14:45	
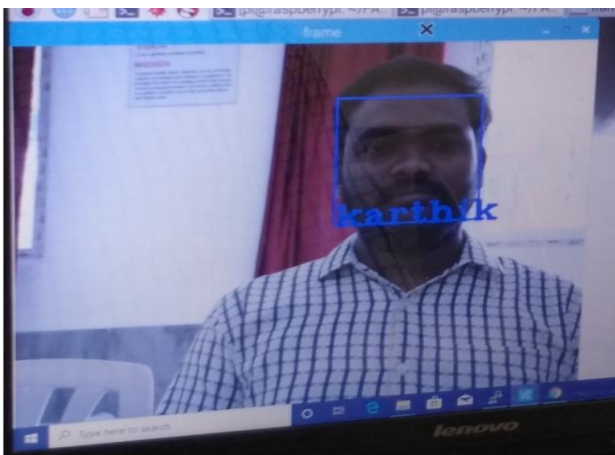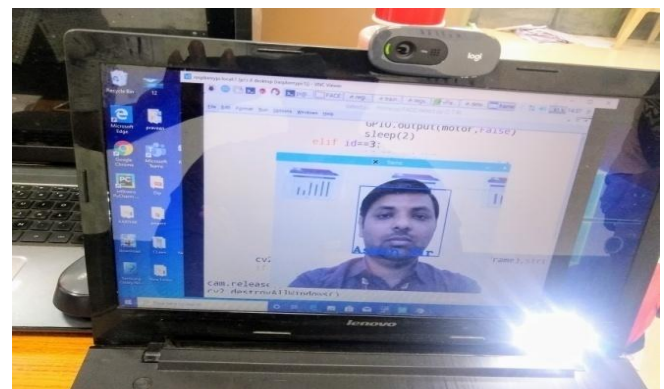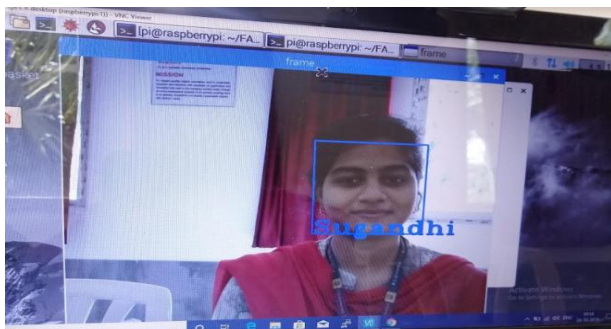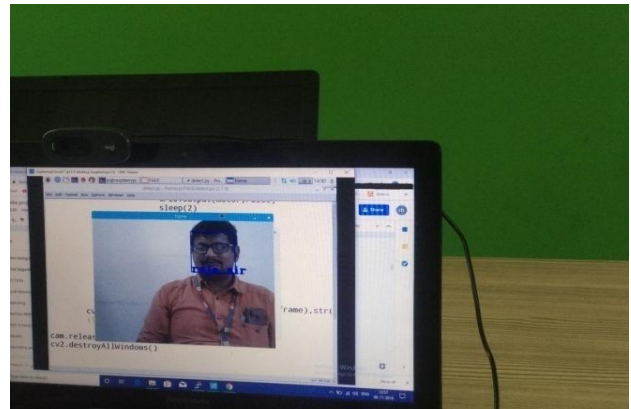
								Attendance				
#	Coursecode	Coursedesc	Ltps	Section	Year	Semester	Fr Date	Total Conducted	Total Attended	Total Absent	Tcbr	Percer
1	15EC4110	Digital Image Processing	L	S-7-MA	2019-2020	Odd Sem	N	29	28	1	0	97%
2	15EC4110	Digital Image Processing	T	S-7-B	2019-2020	Odd Sem	N	22	22	0	0	100%
3	15EC4110	Digital Image Processing	P	S-7-B	2019-2020	Odd Sem	N	28	24	4	0	86%
4	15EC3058	Video Surveillance	L	S-2-MA	2019-2020	Odd Sem	N	40	38	2	0	95%
5	15EC4064	Knowledge Based Systems	L	S-1-MA	2019-2020	Odd Sem	N	39	33	5	1	85%

Total 11 items.
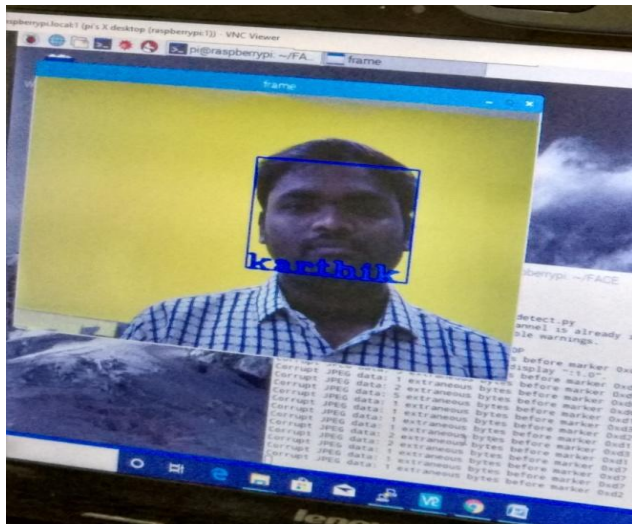
Future Scope

Today, security is one of the fields that most uses facial recognition. Facial recognition is a very effective tool that can help law enforcers recognize criminals, and software firms use the technology to help users access their technology. This technology can be developed further to be used in other ways such as ATMs, access to confidential files or other sensitive material.This can obsolete other security measures like passwords and keys. The current project can be modified using raspberry pi by an Infrared camera interface, which can be used in the Smart Surveillance Security Monitoring System Whichever sort of public security is just using Live body monitoring or spying, It could also be used with school attendance applications utilizing Raspberry Pi or Arduino UNO platform interfaces such as biometric scanner switching, finger tracking, drug warning systems, agricultural pressure detection, database server temperature prediction, environmental changes etc.Scientific studies are now being carried out to enable images to be processed on the Raspberry Pi's GPU, resulting in better results using specific libraries.

VIII.CONCLUSION

In this advanced system twenty faces were detected and being recognized,the student attendance was taken hour wise and semester wise percentage of each student were stored in university database and being informed to parents and respective department HOD. The goal of this research paper is to create a digital attendance system for use in educational institutions that can produce more accurate results than the manual attendance sheet. The system is based on Raspberry Pi as the hardware. The software is configured using both the face recognition system Python and the database of the attendance management system SQL. In addition, a model door is created using servo motor that would open the door for the recognized student to pass whenever the recognition succeeds. The attendance will be registered in MySQL Server and the data will be accessed from any computer web browser with internet connection. To access his / her attendance sheets, each lecturer / student had to log in to the SAS website. The compact hardware design is important because it is necessary to fix the entire product with the camera on an electrical door in the classroom.

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