Implementation of a Wireless Communication based Student Attendance System

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Abstract : Image processing-based attendance system is easy way to monitor and track the attendance of individuals in an organization (Educational, Security, Business, etc). We have many methods to identify a person such as fingerprint, face, retina etc among these methods face recognition is the most natural one as we humans identify a person by looking at their face . Other methods such as fingerprint and retina can be more accurate, but they are not suitable for natural smart interactions because of their intrude nature. Face recognition using python OpenCV processes the image and extracts all the faces in it. These extracted faces are predicted over a large data set of known faces (trained faces).

Our proposed system is posting student attendance in institutes using face recognition. Raspberry pi is an ATM card size computer. We can connect a camera to Raspberry Pi and install python, OpenCV to detect and recognize faces in an image/ video. Student database such a name, register number and images are collected. A high-definition camera is placed just above the black board/ digital board in such a way that everyone is visible in camera. We can trigger camera to click pictures at specified intervals from python code. Images are further processed to post attendance. This process helps us to post attendance conveniently at any point of time without human intervention.

Key Words: *Raspberry pi 4, Face Detection, Student Attendance, Image processing, LBPH algorithm, Face Recognition, Open CV, Python, Mi 360 Camera.*

I. INTRODUCTION

Now a days every period attendance is stored in either register or web application (Database). In a period of 50 min taking attendance kills 5 to 10 min and there may be a chance of proxy. If the attendance is stored in register, then faculty needs to enter recorded attendance into excel sheet or database everyday this takes another 5 min for each period . Face recognition-based attendance system helps to take attendance every period automatically without human intervention. Attendance recorded by this system is stored in excel sheet and helps to generate reports without any delay. Face recognition-based attendance system takes image of class room and extracts faces from the image. All the extracted faces are compared over the available dataset. If the face prediction confidence over the dataset is high attendance is marked for the person. At any point of time admin can access all the files with attendance and generate

Raspberry Pi is low-priced computer containing memory, microprocessor(s), microcontroller(s), input/output and features required for computer fuctioning on single chip. It is used to automate simple processes in educational institutions, security maintenance companies, industries etc.

In this project Raspberry pi is used as microcontroller which stores dataset of all the students and yields the results. Pi module accesses camera using Wi-Fi. Python with OpenCV program can capture images from camera and use it for processing. Local Binary Pattern Histogram (LBPH) algorithm is used to analyse the extracted face and compare it with the dataset.

1.1. Overview Of The Problem Statement

Many organisations use attendance systems to record the work duration of employees or to record the student presence in class. In organisations attendance systems are maintained to track employees who are late to work or students who failed to attend classes. It takes time to record attendance using RFID or fingerprint modules as person needs to interact with the module one after the other. This takes lot of time if there are a greater number of employees/ students.

1.1.1. Existing System

RFID: Radio Frequency Identification (RFID) is used in different areas such as transportation, agriculture, healthcare, hospitality etc. RFID technology uses radio waves to identify the smart card. RFID system has 3 parts:

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1) RFID reader.
2) RFID smart card.
3) Antenna.

Smart card consists of Integrated Circuit (IC) and the antenna to transfer the data . We have 2 types of smart cards active and passive. Passive cards need to be powered up to transmit the data. When a smart card is in range of RFID reader, data is transferred from IC in the card to the reader. On receiving, data is decoded by the reader.

Figure 1.1.1(a) Attendance using RFID Tag.

1.1.2. Fingerprint

Biometric is the most effective way of identifying the physical presence of person near the device. Thumb is placed on the touch sensor and impression is converted into data by sensor. Now the micro controller uses the extracted data from sensor to compare with available database. If the impression matches with data in database, the person is marked with presence. Identifying impression in database would take huge amount of time as there would be several thousands of employees working in an organisation.

Fig 1.1.2(a) Fingerprint based attendance system.

1.1.3 Limitations Of Existing System

1. Poor rate of reading occurs if the receiver and the reader are not aligned properly.
2. Cost rate increases when we use the fingerprint method.
3. Proxy may be increased, like a single student holding multiple tags.
4. Processing rate is very slow if we use only fingerprint method.
5. Users need to physically touch the sensor to mark their presence if fingerprint is used.

1.2 Proposed System

Proposed system has two steps first is to detect the face and second is to recognise the face.

1.2.1 Face Detection

To detect the face, we take help of Haar-cascade classifiers/ LBP classifiers. These classifiers are formed by training many positive images (with person face) and negative images (without person face).

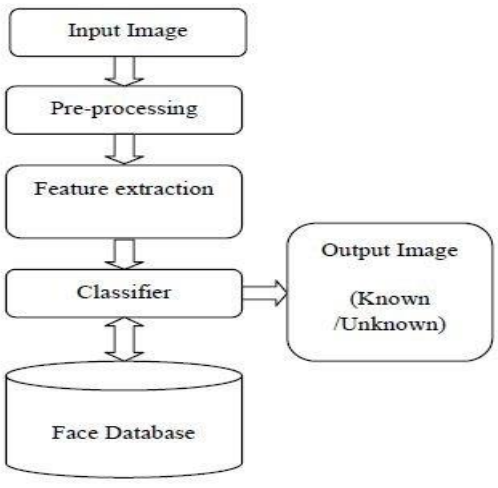
1.2.2 Face Recognition

To recognise the face, there are several algorithms available. These algorithms convert the image into digital data and then compare the digital data with the training set of data. We also get the confidence % with which the face matches with trained data.

1.2.3 Advantages Of The Proposed System

- Easiest method to keep track of attendance.
- Provides nearly accurate attendance of the students.
- Proxy attendance is completely eradicated by this system.
- There are no physical interactions with the system.

II. BLOCK DIAGRAM



Block Diagram of Face recognition

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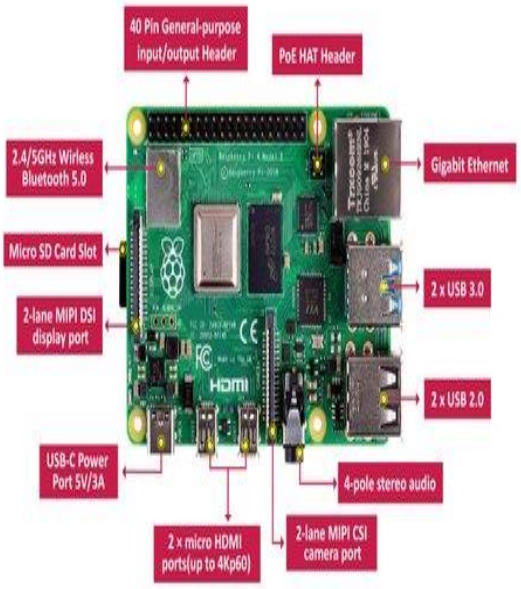
In “Input image” stage image is captured from video recorder. In “Pre-processing” stage image is processed using haar classifier and faces are extracted from image. In “Feature extraction” phase face features are extracted using algorithm. The extracted features are given as input to classifier along with pre trained data. The classifier compares the data and throws the id, confidence. Based on the confidence person is determined as Known/ Unknows.

III. HARDWARE REQUIREMENTS

3.1 Raspberry Pi 4:



Raspberry is System on Chip (SoC) circuit. It is called credit card size computer. We can connect external monitor, keyboard and mouse and use it as computer. Below are few of the versions of Pi modules.

- Raspberry Pi 1 Model B Was launched in 2012.
- Raspberry Pi 1 Model A Was launched in 2013.
- Raspberry Pi 1 Model B+ launched in 2014.
- Raspberry Pi 1 Model A+ launched in 2014.
- Raspberry Pi 2 Model B launched in 2015.
- Raspberry Pi Zero launched in 2015.
- Raspberry Pi 3 Model B launched in 2016.
- Raspberry Pi Zero W Was launched in 2017.
- Raspberry Pi 3 Model B+ launched in 2018.
- Raspberry Pi 3 Model A+ launched in 2019.
- Raspberry Pi 4 Model A launched in 2019.
- Raspberry Pi 4 Model B launched in 2020.
- Raspberry Pi 400 launched in 2021.

Over the versions processing speed of Pi has increased from 512MB to 8 GB. Pi module needs only 5V of input to power up and perform operations. These mostly used in schools to learn basics of programming. Pi cost is only 15% of actual desktop/ laptop cost. Pi can perform equally as computers do. It has memory card slot we have to insert the memory card with Raspbian OS installed on it. We have wide range of OS that works on Pi but Raspbian OS is recommended.

3.2 Mi Camera 360° 1080p

Mi camera is connected to Pi module through Wi-Fi. Mi camera module streams video over Wi-Fi and Raspberry Pi can access the video using IP address.

SOFTWARE REQUIREMENT

4.1 Raspbian OS:

4.1.1 Installation of OS:

4.2 Libraries

4.2.1 OpenCV

4.2.2 Pandas

SOURCE CODE

Folder Structure:

```
Project
├── Data_Set
│       User.abc.1
│       User.abc.2
│       …..
│       User.abc.n
│       User.xyz.1
│       User.xyz.2
│       ..…
│       User.xyz.n
│       …..
├── Trained_Data
│       LBPHFTrainer.yml
│   DataSetCreator.py
│   DataSetTrainer.py
│   DataSetRecogniser.py
```

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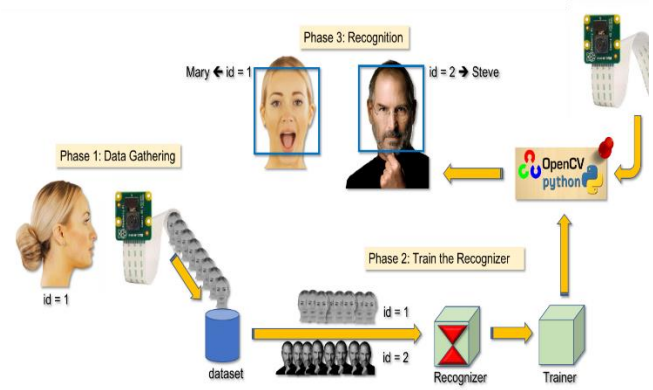
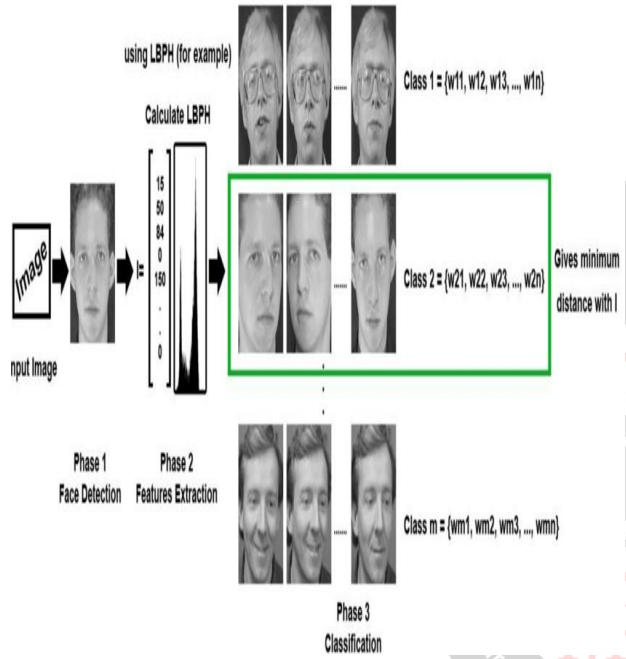
WORKING OF PROJECT



Phases of face recognition.



Working of LBPH algorithm.

Phase 1 – Data Gathering:

In this stage about 50 – 100 samples of individual user are collected. All these images are converted to gray scale images . These gray scale images are processed with haar classifiers to extract the phase. All the faces extracted are stored in dataSet folder.

Phase 2 – Train the Recogniser:

The images in the DataSet folder are taken by the trainer and are sent to LBPH ML algorithm to extract the features. The extracted features are then stored againest the user id in .yml files

Phase 3 – Face Recognition:

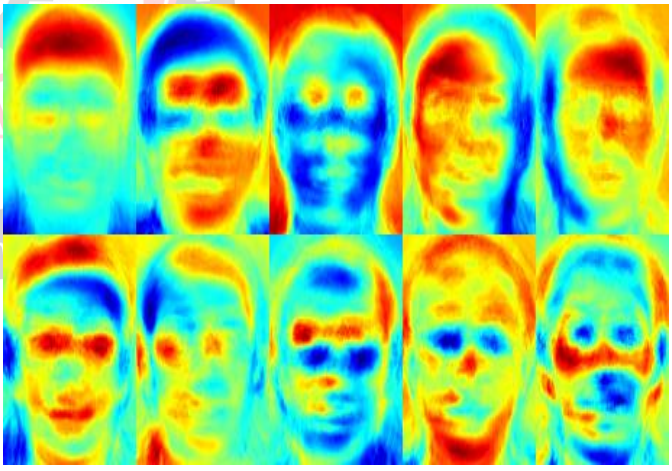
In this stage the .yml files are given to LBPH ML funtion. Now the images are taken using video instance and faces from the captured image are extracted by using haar claasifier. These faces are then predicted against the data in .yml files.

IV. ALGORITHM

7.1 Eigen Faces Face Recognizer

This algorithm takes into account the fact that not every part of a face is equally essential or useful. When you look at someone, you can tell who they are by their distinct features, such as their eyes, nose, cheeks, and forehead, and how they differ from one another. So you're concentrating on the areas of the face that have the most improvement (variation in mathematic terms). There is a noticeable difference between the eyes and the nose, as well as the nose and the mouth. When comparing different faces, these sections of the faces are the most useful and significant components of a face. They're crucial because they capture the most variation in facial expressions, which lets you distinguish one from the other.

The Eigen Faces face recognizer examines all of the training photos of all of the people as a whole and attempts to remove the most significant and useful components (the ones that capture the most variance/change) while discarding the rest. It not only removes the essential components from the training data in this manner, but it also saves memory by discarding the less important components. Principal components are the essential components it removes. The principal components derived from a list of faces are shown in the image below.



7.2 FisherFaces Face Recognizer

Instead of extracting useful features that represent all of the faces of all of the people, the Fisherfaces algorithm extracts the useful features that distinguish one person from the others. This way, one person's characteristics do not rule over the others, and you have characteristics that distinguish one person from the others. An picture of features extracted using the Fisherfaces algorithm is shown below.

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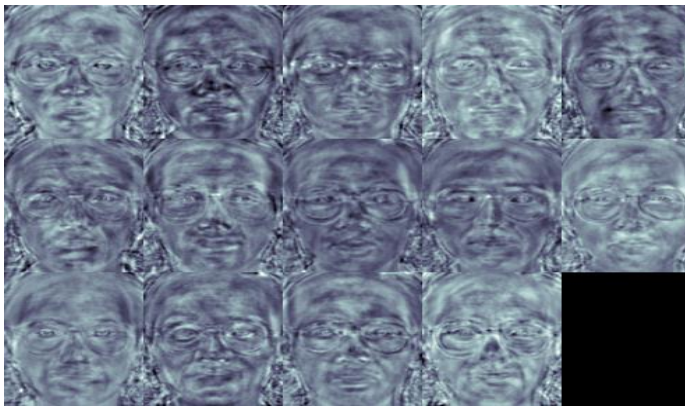
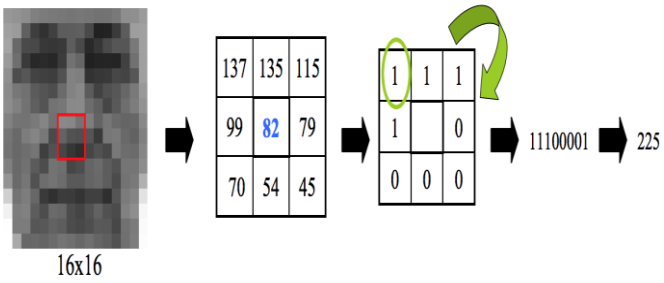


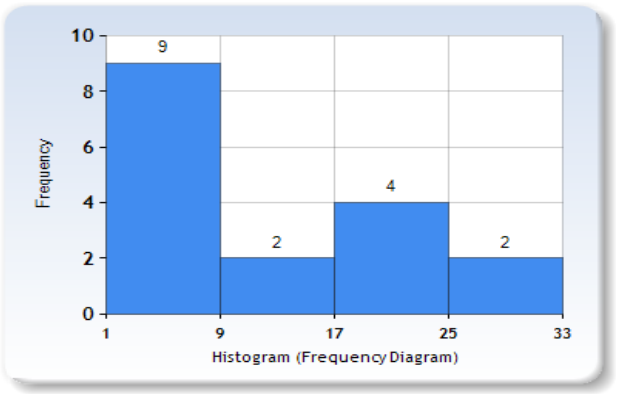
7.3 Local Binary Patterns Histograms (LBPH) Face Recognizer

The LBPH algorithm attempts to determine the image's local structure by comparing each pixel to its neighbours.

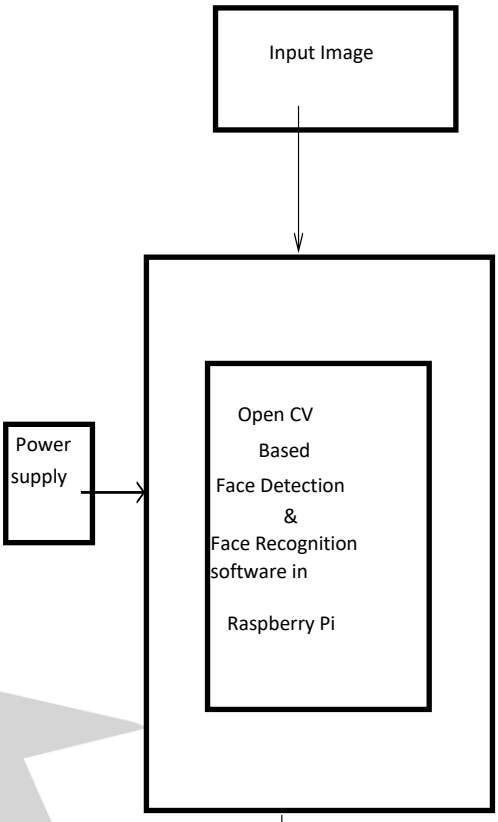
Take a 3x3 window and transfer it one image at a time, comparing the pixel in the centre with its neighbour pixels at each move (each local part of an image). Neighbors with an intensity value less than or equal to the centre pixel are denoted by 1 and those with a value greater than or equal to the centre pixel denoted by 0. Then you read these 0/1 values in a clockwise order under a 3x3 window, and you'll get a binary pattern like 11100011, which is local to a specific area of the image. You can do this on the entire picture and get a list of local binary patterns.

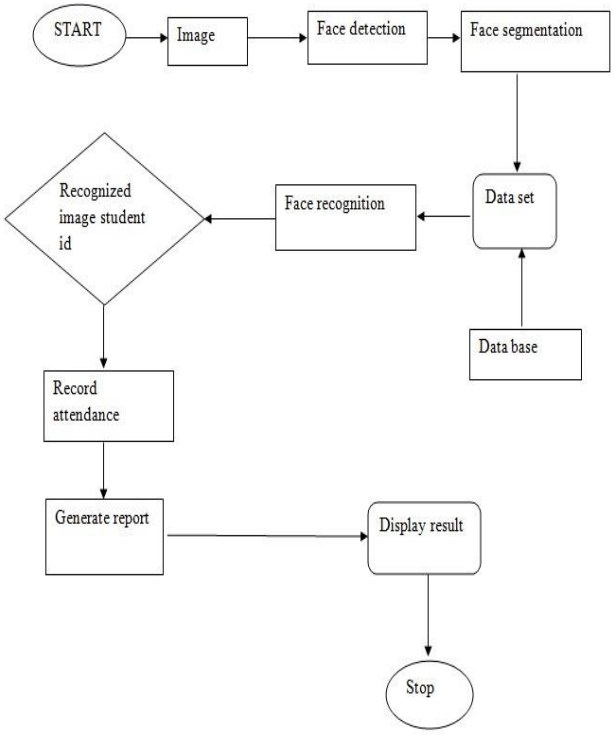


List of local binary patterns are obtained and each of the binary pattern is converted into a decimal number (as in above image) and histogram are formed out of all those decimal values obtained. An example of histogram formed looks as below image.



Flowchart





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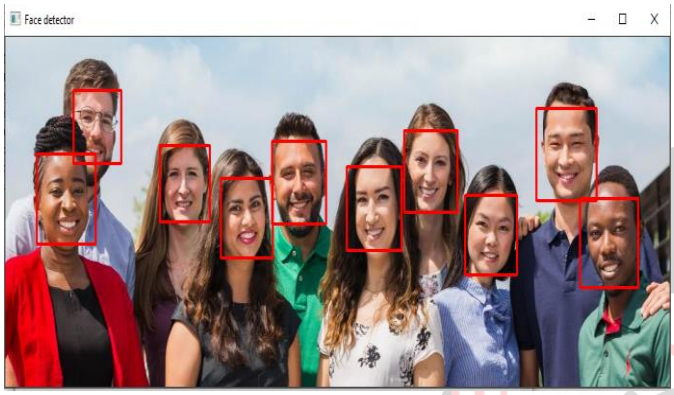
V. RESULT AND DISCUSSION

Test – Detect multiple faces in an image:

Input:

Output:



Result: Passed

VI. CONCLUSION

We conclude Image processing-based Student Attendance System using Raspberry pi using Open CV tool as software for image processing and attendance is provided to the students. We can track the attendance of the students by using the language python and Open CV software, which is very easy to install and is open-source software and can be used in real time application in a quick manner. In this project we have shown the tracking of the students in the class by using camera in the system. This proposed system reduces the possibilities of proxy attendance of the students, who were not present in the class and reduces the time. Raspberry pi is used as a microcontroller which provides live streaming of the students as an input to the program. The input image can be converted into a black and white image by applying grey scale filter. Then we have applied fisher faces feature extraction to subtract background. The extracted faces are saved and trained. Then according to the live streaming of video in class gives the attendance to the students.

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