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Class Attendance Using Face Detection System

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Abstract: *Attendance for the students is an important task in class. If we do manually it generally wastes a lot of productive time of the class. The solution for the current problem is through automation of attendance system using face recognition. Face is the primary identification for any human. This project describes the method of detecting and recognizing the face in real-time using Raspberry Pi. Project describes an efficient algorithm using open source image processing framework. Our approach has five modules – Face Detection, Face Pre-processing, Face Training, Face Recognition and Attendance Database. The software database is collected to recognize the faces of the students. The system will initially trained with the student`s faces which is collectively known as student collection database. The system uses easy interface to maximize the user experience while both training and testing which are collecting student images and taking attendance with the system. Raspberry Pi u helps in minimizing the cost of the product as it can be connected to any device to take the attendance. This project also used for other applications where face recognition can be used for authentication. This project uses modified algorithm of Haar's Cascades proposed by Viola-Jones for face detection. The system will automatically update the student's presence in the class to the student's database and sends message to guardians of absentees and also to Head of department.*

Keyword: *Raspberry Pi, Haar cascade, Edge Detection, Viola-Jones framework.*

I. Introduction

Technology has become a way of life. It is successfully utilized in resolving many of our problems. Technology benefitted us in every aspect of the quality of instruction .In ancient day student were taught in a gurukul where they were taught by the gurus. With the passage of time and progress in life, this system was replaced by modernized culture i.e classroom based teaching –learning came into existence .New method of teaching have been introduced and todays we witness one of the most versatile gift of science, known as Smart Classroom. Face is the essential recognizable proof for any human. So automating the attendance process will increase the productivity of the class.

1.1 Raspberry Pi 3

The Raspberry Pi is a device has low cost, credit-card sized computer that plugs into a computer monitor, and uses standard keyboard and mouse. It is a capable small device that enables user of all ages to explore computing, and to learn how to program in languages like Python. It is equipped with ENC28J60 which is a Ethernet chip to get connected with internet.

Fig -1: Raspberry Pi 30

1.2 Camera

A camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may be different still photographs or sequences of images constituting videos or movies. The camera is a remote sensing device it senses subjects without any contact.

1.3 GPIO Pins:-

General-purpose input/output (GPIO) is a generic pin on an integrated circuit or computer board whose behaviour— including whether it is an input or output pin—is controllable by the user at run time.

1.4 Power Supply:-

The Power Supply is a Primary requirement for the project work. The required DC power supply for the hardware kit unit as well as for the recharging unit is derived from the mains line. Here we are using 12 V transformer as source. This transformer we are getting 5V power supply.

1.5 SD Card:-

The OS required for raspberry pi is raspbian and the minimum recommended card size is 8 GB.

II. Proposed Approach

The total system is divided into 3 modules- Database creation, Training the dataset, Testing, sending alert messages as an extension.

1. **Database creation**

a) Initialize the camera and set an alert message to grab the attention of the students.
b) Get user id as input
c) convert the image into gray scale, detect the face and
d) Store it in database by using given input as label up to 20 frames.

2. **Training**

a) Initialize LBPH face recognizer.
b) Get faces and Id's from database folder to train the LBPH face recognizer.
c) Save the trained data yml file or as xml.

III. Testing

Load Haar classifier, LBPH face recognizer and trained data from xml or yml file
Capture the image from camera,
Convert it into gray scale,
Detect the face in it and
Predict the face using the above recognizer

This proposed system uses Viola Jones algorithm for face detection which uses modified Haar Cascades for detection. Raspberry Pi is the heart of the project. We will be using USB webcam to capture photos. We can access. Raspberry Pi's console either by using SSH in laptop or by using Keyboard and mouse with the display device like TV connected to Pi. Firstly, Haar algorithm needs a lot of positive images as well negative images to train the Haar cascades classifier. Positive images are those images with clear faces where negative images are those without any faces.

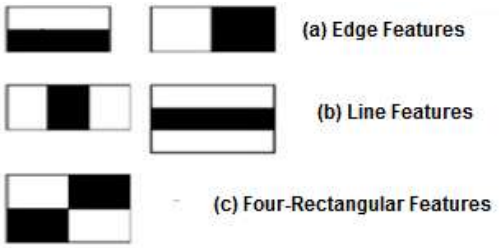

Fig -2: Haar Cascades

$$I_{\sum}(x,y) = \sum_{\substack{x' \le x \\ y' \le y}} i(x',y')$$

Each feature is represented as a single value obtained from the difference of the sums of pixels in white rectangle from the sum of all pixels in the black rectangle. All different possible sizes and locations of classifier is used for calculating of plenty of features. As the number of classifiers increase the arithmetic computations seems to take a long time. To avoid this, we use the concept of Integral Image. In Image Processing Integral image is that data structure which summed area table and algorithm is for quickly and efficiently generating sum of values in a rectangular grid subset. Integral image is derived by using the given formula.

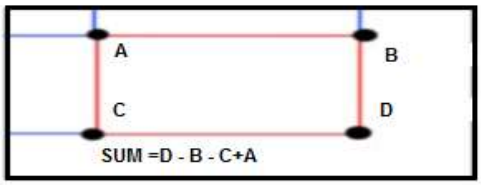

Fig -3: Integral image

To solve the complexity of the number of classifiers applied for calculation we use Ada boost machine learning algorithm, which is inbuilt in Open CV library that is cascade classifier, to eliminate the redundancy of the classifiers. Classifier which has a probability of 50% of more in detection face is treated as weak classifier. The Sum of all weak classifier gives a strong classifier which makes the decision about detection. Although it is very vague to classify with one strong classifier we use the cascade of classifiers. Classification takes place in stages, if the selected region fails in the first stage, we discard it. We don't use the classifiers on that region which is discarded. The region which passes all the stages i.e. all strong classifiers is treated as the detected face. Detected Faces are passed to the Face recognition phase. In this phase we uses Local Binary Patterns algorithm for face recognition. Local binary patterns are simple at the same time very efficient texture operator which assigns the pixels of the image by comparing with the adjacent pixels as threshold and which results in a binary result. The detected integral image is subjected to this Local binary pattern which results in decimals are represented as histogram for every integral image. Face recognition is extremely difficult to the environment changes like brightness, facial expressions and position. Face preprocessing is the module which reduces the problems that makes the picture unclear to recognize the face such as less brightness and contrast problems and noise in the image and make sure the facial features always be in a constant position. In this project we use histogram equalization for face preprocessing. For efficiency result we use separate preprocessing which is histogram equalization for left and right face. So histogram equalization is done three times, firstly for the whole face and the other two for side faces.

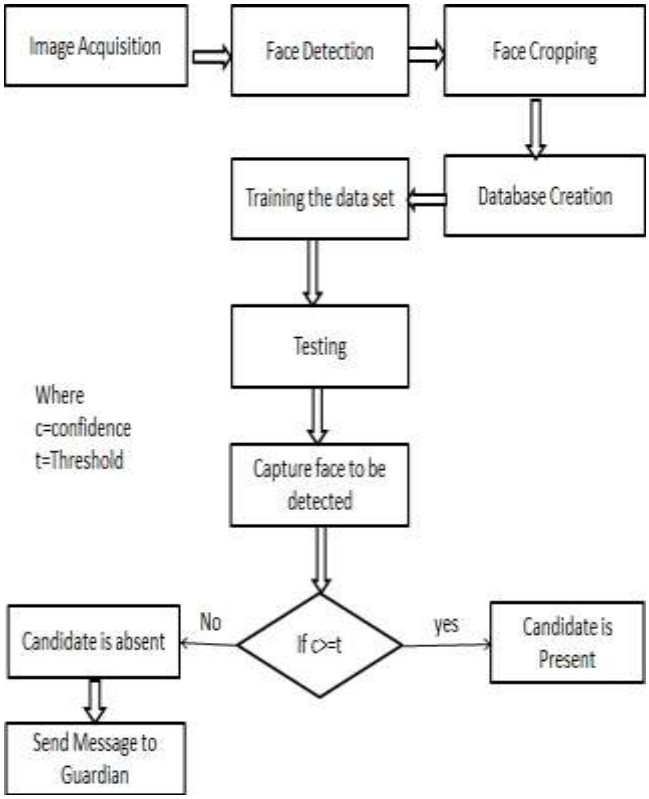

Fig-4: Flow Chart

IV. Algorithms

a) 4.1 Python IDE

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms. The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications.

4.2 Open CV

Open CV is a library of programming functions mainly aimed at real-time computer vision. It has a modular structure, which means that the package includes several shared or static libraries. We are using image processing module that includes linear and non-linear image filtering, geometrical image transformations (resize, affine and perspective warping, and generic table-based remapping), color space conversion, histograms, and so on. Our project includes libraries such as Viola-Jones or Haar classifier, LBPH (Lower Binary Pattern histogram) face recognizer, Histogram of oriented gradients (HOG).

b) **Purpose of Image processing**

The purpose of image processing is divided into 5 groups. They are:

1. Visualization- Observe the objects that are not visible.
2. Image sharpening and restoration- To create a better image.
3. Image retrieval- Seek for the image of interest.
4. Measurement of pattern– Measures various objects in an image.
5. Image Recognition–Distinguish the objects in an image.

V. Conclusion

We came to realize that there are extensive variety of methods, for example, biometric, RFID based and so on which are tedious and non-productive. So to defeat this above framework is the better and solid arrangement from each keen of time and security. Hence we have accomplished to build up a solid and to productive participation framework to actualize an perceive the confronts precisely to check the attendance.

VI. Scope And Future Work

The same project can be utilized for several security applications where authentication is needed to access the privileges of the respective system. It can be used in recognizing wrong parties involving in unauthorized business. Face recognition algorithm can be improved with respect to the utilization of resources so that our project can recognize more number of faces at a time which can make the system more efficient. Many other application of the project can be developed and utilized for home security and personal or organizational benefits. We can also trace a particular student in an organization quickly with the help of this system.

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