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Using Raspberry Pi 3 And Face Detection Method To Take The Attendance of The Student In Classroom And Other Security Purposes

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ABSTRACT: Attendance for the students is an important task in class. When done manually it generally wastes a lot of productive time of the class. This proposed solution for the current problem is through automation of attendance system using face recognition. Face is the main identification for any human to know. This paper describes the method of detecting and recognizing the face in real-time using Raspberry Pi. This project describes an efficient algorithm using open source image processing framework known as OpenCV. Our approach has modules – Face Detection, Face Training, Face Recognition and Attendance Database. The face database is collected to recognize the faces of the students. The system is initially trained with the student`s faces which is collectively known as student database. The system uses user friendly User interface to maximize the user experience while both training and testing which are collecting student images and taking attendance with the system. Raspberry Pi 3 usage helps in minimizing the cost of the product and the usability as it can be connected to any device to take the attendance. This project uses modified algorithm of Cascades proposed by Viola-Jones for face detection and uses LBP histograms for face recognition and uses SQLite along with MYSQL to update the database. 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. This method will help in

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I. INTRODUCTION

The present day attendance system is manual i.e- it is taken by the human beings. It wastes a considerable amount of time both for teachers and students [1]. The waiting time of the students is increased if attendance is taken manually. This also effects the study time of the students. There are still chances for proxies in the class when attendance is taken manually. Manual attendance always a have a cost of human error. Face is the essential recognizable proof for any human. To make it available for every platform we have chosen the Raspberry pi 3 for face recognition. A Webcam is associated with the Raspberry Pi 3 module. Face identification separates faces from non-faces and those countenances that can be perceived. This module can be utilized for different applications where face acknowledgment can be utilized for validation. In this system we take the attendance using face recognition which recognizes the face of each student during the classhours [2]. This system will also help the guardians of the students to know if the student has attended the class or not. This system will be a precise model and will give automatic results.

II. BLOCK DIAGRAM OF THE PROPOSED MODEL

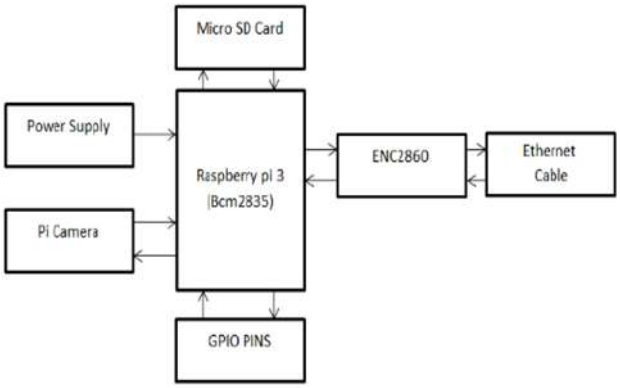


Fig 1: Proposed Model

III. INTRODUCTION TO COMPONENTS USED IN THE MODEL

1. Raspberry Pi 3:

Raspberry Pi 3 is the latest iteration of the world's most single board computer. It provides a quadcore 64bit ARM cortex A53 CPU running at 1.2GHz. It is a wireless networking with composite outputs. The headset that contains Raspberry Pi will at first trigger the sensor by pulling up the trigger pin for 10microsecondThe Raspberry Pi 3 is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. This Raspberry pi 3 equipped with ENC28J60 which is an Ethernet chip to get connected with internet.

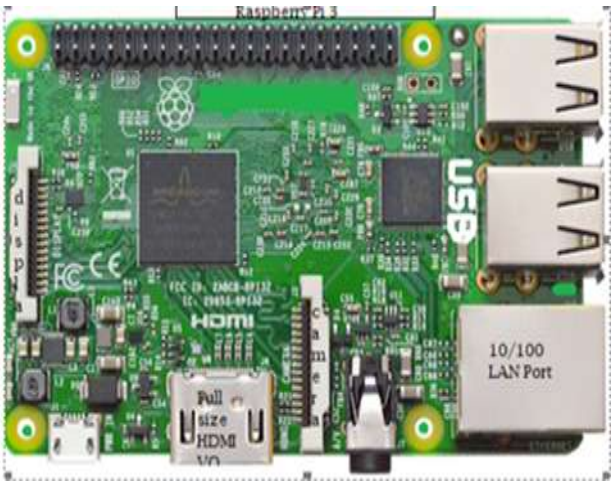


Fig 2: Raspberry Pi 3

2. Web Camera:

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks travelling through systems such as the internet, and e-mailed as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generallyconnected by a USB cable, or similar cable, or built into computer hardware, such as laptops. Webcams typically include a lens, an image sensor, support electronics, and may also include a microphone for sound. Various lenses are available, the most common in consumer-grade webcams being a plastic lens that can be screwed in and out to focus the camera. Fixed-focus lenses, which have no provision for adjustment, are also available. As a camera system's depth of field is greater for small image formats and is greater for lenses with a large f-number (small aperture), the systems used in webcams have a sufficiently large depth of field that the use of a fixed-focus lens does not impact image sharpness to a great extent.

3. Power Supply:

For this purpose center tapped secondary of 120V transformer is used. All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load. A DC power supply is one that supplies a constant DC voltage to its load. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains. The power supply is the main constituent from which the system will be activated.

4. GPIO Pins:

A powerful feature of the Raspberry Pi is the row of GPIO (general-purpose input/output) pins along the top edge of the board. A 40-pin GPIO header is found on all current Raspberry Pi boards (unpopulated on Pi Zero and Pi Zero W). Prior to the Pi 1 Model B+ (2014), boards comprised a shorter 26-pin header. Any of the GPIO pins can be designated (in software) as an input or output pin and used for a wide range of purposes.

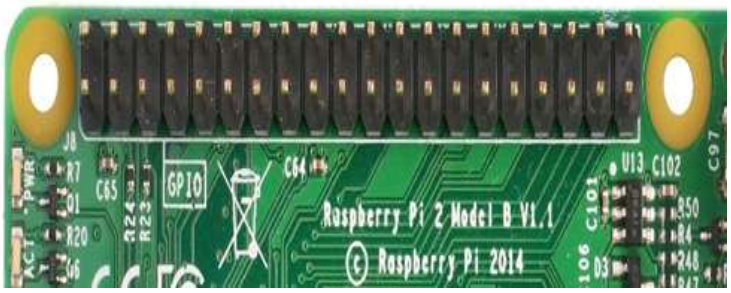


Fig 3: GPIO pins

5. SD Card:

The OS required for raspberry pi 3 is minimum of 8Gb. Secure Digital includes five card families available in three different sizes. The five families are the original Standard-Capacity (SDSC), the High-Capacity (SDHC), the extended-Capacity (SDXC), the Ultra-Capacity (SDUC) and the SDIO, which combines input/output functions with data storage.

IV. DESIGNED APPROACH FOR THE MODEL

The total system is divided into 3 modules-

- Data base creation
- Training the dataset
- Testing
- Sending alert messages as an extension

1. Database creation:

- Initialize the web camera and set an alert message to draw the attention of the students.
- Get user id as an input.
- Convert the image into gray scale, detect the face of the student.
- Store it in database by using given input as label up to 20 frames

2. Training:

- Initialize LBPH face recognizer.
- Get faces and Id's from database folder to train the LBPH face recognizer and to get the data obtained.
- Save the trained data as xml file.

3. Testing:

Load Haar classifier, LBPH face recognizer and trained data from xml file.

- Capture the image from camera
- Convert it into gray scale
- Detect the face of the person in it
- Predict the face using the above recognizer

This proposed system[3] uses Viola Jones algorithm for face detection which uses modified Haar Cascades for detection. Raspberry Pi 3 is the main component in 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 3. Firstly, the algorithm needs a lot of positive images and negative images to train the Haar cascades classifier. Positiveimages are images with clear faces where negative images are those without any faces.

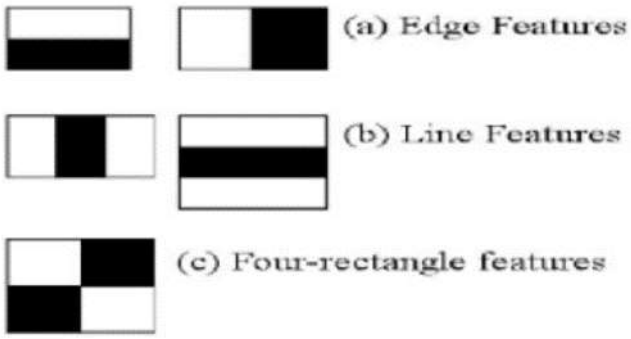
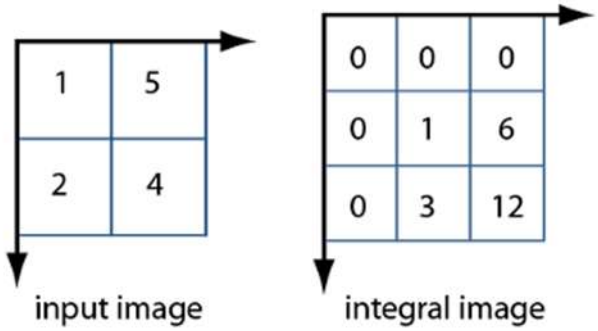


Fig 4: Haar Cascades

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 ofIntegral Image. An integral image helps to rapidly calculate summations over image subregions. Every pixel in an integral image is the summation of the pixels above and to the left of it. To calculate the summation of a subregion of an image, we can use the corresponding region of its integral image.



To solve the complexity of the number of classifiers applied for calculation we use Adaboost machine learning algorithm, which is inbuilt in OpenCV library that is cascade classifier, to eliminate the redundancy of the classifiers. Any classifier which has a probability of 50% of more in detection 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 strongclassifiers is treated as the detected face. Detected Faces are passed to the Face recognition phase. In this phase we use 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 vulnerable to the environment changes like brightness, facial expressions and position[4]. 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 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.

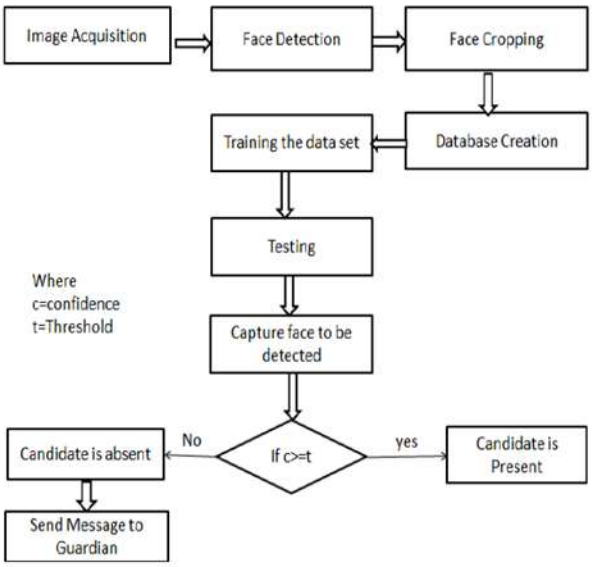


Fig 5: Flow chart of detection and sms sending mechanism

V. USED ALGORITHM IN THE MODEL

1. Python IDE: Python is an interpreted high-level programming language for general-purpose programming. 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[8]. The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or otherlanguages callable from C). Python is also suitable as an extension language for customizable applications. Python interpreters are available for many operating systems. C Python, the reference implementation of Python, is open source software and has a community-based development model, as do nearly all of Python's other implementations.

2. OpenCV: OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. Our model includes libraries such as Viola-Jones or Haar classifier, LBPH (Lower Binary Pattern histogram) face recognizer, Histogram of oriented gradients (HOG). It has C++, Python and Java interfaces and supports Windows, Linux, Mac OS, IOS and Android. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. Written in optimized C/C++, the library can take advantage of multi-core processing. Enabled with open CL, it takes advantage of the hardware acceleration of the underlying heterogeneous compute platform.

VI. PURPOSE OF IMAGE PROCESSING:

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

- Visualization- Observe the objects that are not visible in the areas.
- Image sharpening and restoration- To create a better image than that of the previous one.
- Image retrieval- Seek for the image of interest.
- Measurement of pattern– Measures various objects in an image, it can be 2D or 3D.
- Image Recognition– Distinguish the objects in an image.

A. Haar Classifier:

This object detection framework is to provide competitive object detection rates in real-time like detection of faces in an image. A human can do this easily, but a computer needs precise instructions and constraints. To make the task more manageable, Viola–Jones requires full view frontal upright faces[5]. Thus in order to be detected, the entire face must point towards the camera and should not be tilted to either side. While it seems these constraints could diminish the algorithm's utility somewhat, because the detection step is most often followed by a recognition step, in practice these limits on pose are quite acceptable.

The characteristics of Viola Jones algorithm are:

- Robust – very high detection rate (true-positive rate) & very low false-positive rate always.
- Real time – For practical applications at least 2 frames per second must be processed.
- Face detection only- The goal is to distinguish faces from non-faces (detection is the first step in the recognition process).

B. Histogram of oriented gradients (HOG):

Histogram of oriented gradients [6](HOG) is a feature descriptor used to detect objects in computer vision and image processing. The HOG descriptor technique counts occurrences of gradient orientation in localized portions of an image - detection window, or region of interest (ROI).

VII. IMPLEMENTATION OF HOG DESCRIPTOR ALGORITHM

- Divide the image into small connected regions called cells, and for each cell compute a histogram of gradient directions or edge orientations for the pixels within the cell.
- Discretize each cell into angular bins according to the gradient orientation.
- Each cell's pixel contributes weighted gradient to its corresponding angular bin.
- Groups of adjacent cells are considered as spatial regions called blocks. The grouping of cells into a block is the basis for grouping and normalization of histograms.
- Normalized group of histograms represents the block histogram. The set of these block histograms represents the descriptor.

In our project we need to convert images into multidimensional or 2D-array representation, and also conversions from gray scale to color images which can be done easily by Numpy.

Numpy: Numpy is the fundamental package for scientific computing with Python. Numpy is an acronym for" Numeric Python" or "Numerical Python". It is an open source extension module for Python, which provides fast precompiled functions for mathematical and numerical routines. Furthermore [7] Numpy enriches the programming language Python with powerful data structures for efficient computation of multi-dimensional arrays and matrices. The implementation is even aiming at huge matrices and arrays. Besides that the modulesupplies a large library of high-level mathematical functions to operate on these matrices and arrays.

VIII. 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 productive participation framework to actualize an image handling algorithm to identify faces in classroom and to check the attendance. This model will work precisely to check the faces for the attendance and to send the other information to the users.

IX. FUTURE USE OF THE MODEL

- This model can be used for the security purpose where authentication is needed for the system.
- It can be used to recognize more number of faces at a time in the criminology purpose.
- It can be used for the home security purpose.
- It can be used as the face recognition in the smartphone model.
- It can be used in the car also.

REFERENCES

[1]. Viola, P., & Jones, M. (2001). Rapid object detection using a boosted cascade of simple features. In Computer Vision and Pattern Recognition, 2001. CVPR 2001. Proceedings of the 2001 IEEE Computer Society Conference on (Vol. 1, pp.I-511). IEEE.
[2]. KAWAGUCHI, Y., SHOJI, T., Weijane, L. I. N., KAKUSHO, K., & MINOH, M. (2005). Face recognition-based lecture attendance system. In the 3rd AEARU Workshop on Network Education (pp. 70-75).
[3]. A. Hossein Sahoolizadeh, B. Zargham Heidari, and C. Hamid Dehghani,‖ A New Face Recognition Method using PCA, LDA and Neural Network‖, International Journal of Electrical and Electronics Engineering 2:8 2008.
[4]. Bruce A. Draper, Kyungim Baek, Marian Stewart Bartlett, ―Recognizing faces with PCA and ICA‖, Computer Vision and Image Understanding 91 (2003) 115-137.
[5]. Benfano Soewito, Ford Lumban Gaol," Attendance System on Android Smartphone", 2015 International Conference on Control, Electronics, Renewable Energy and Communications (ICCEREC).
[6]. Kanade, T. Computer recognition of human faces. Birkhauser, Basel, Switzerland, and Stuttgart, Germany 1973.
[7]. Y. Cheng, C.L. Wang, Z.Y. Li, Y.K. Hou and C.X. Zhao,‖Multiscale principal contour direction for varying lighting face recognition‖,Proceedings of IEEE 2010.
[8]. Lades M, Vorbruggen J, Buhmann J, Lange J, Cvd Malsburg, Wurtz R, Konen W Distortion invariant object recognition in the dynamic link architecture. IEEE Trans Comput 42(3):300–311,1993.

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