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Human Face Detection and Recognition for Smart Attendance System

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Abstract — Being one of the most successful applications of the image processing, face detection and recognition has a vital role in technical field especially in the field of security purpose. Human face detection and recognition is an important field for verification purpose especially in the case of attendance system.
Maintaining the attendance is very important in all the institutes for checking the presence of students. Every institute has its own method in this regard. Some are taking attendance manually using the traditional pen and paper or file based approach. This system is developed for deploying an easy and a secure way of taking down attendance. The system first captures an image of all the students and stores the information into database. The system then stores the image by mapping it into a face coordinate structure. Next time whenever the registered student enters the premises the system recognizes the student and marks his attendance along with the time. In this project, we come up with a new hardware system for human face detection which makes use of Raspberry Pi. It is a credit-card sized computer with the components mounted on a credit card sized motherboard, running a dedicated version of Linux. It plugs into TV and a keyboard. It is a capable little computer which can be used in electronic devices and for much functionality that a desktop computer can perform. It comes at a very low price.

Keywords- Raspberry pi, Face Detection, Face Recognition, Attendance System, Linux (Python)

I. INTRODUCTION

As technology develops, face detection is becoming common place in many applications, such as face recognition, face tracking, facial feature detection, video surveillance, human computer interfaces, and robotics. The problem of face detection is challenging owing to textual differences among the faces, pose, facial expressions, orientation, facial size, lighting conditions, gender, different skin tones and changes in background. Scene changes can also be detrimental to face detection since a background can be simple as well as complex. Faces are not uniform in size and vary with the subject's distance from the camera. Owing to these challenge, researchers are striving to improve face detection by proposing new and more robust algorithms. Many a times, an effective face detection system should be coupled with noise filtering techniques. There are four different types of noise that could be generated in the images: Gaussian noise, Poisson noise, Salt and pepper noise and Speckle noise
Face detection is concerned with finding whether or not there are any faces in a given image and, if present, returns the image location and content of each face. Most face detection algorithms are designed in the software domain and have a high detection rate, but they often require several seconds to detect faces in a single image, a processing speed that is insufficient for real-time applications. This project describes a simple and easy hardware implementation off ace detection system using Raspberry Pi, which itself is a minicomputer of a credit card size and is of a very low price. The system is programmed using Python programming language. Both real time face detection and face detection from specific images, i.e. Object Recognition, is carried.
Image face detection methods generally include four categories. The knowledge-based methods use human knowledge to derive the rules for identifying a face; these rules are usually based on the relationships between facial features. Face detection applications also use color information, and this has been proved very successful. Template-matching methods use a predefined pattern, which is usually a frontal face. This type of algorithm computes the correlation values of facial characteristics, such as eyes and nose, by assessing patterns to determine the appearance of faces Appearance-based methods use statistical analysis and machine learning to collect information from a training set.
Traditionally student's attendance is taken manually by using attendance sheet, given by the faculty member in class. The Current attendance marking methods are monotonous & time consuming. Manually recorded attendance can be easily manipulated. Moreover, it is very difficult to verify one by one student in a large classroom environment with distributed branches whether the authenticated students are actually responding or not.

II. LITERATURE REVIEW

Two researchers Visar Shehu and Agni Dika proposed in [1] a system which introduces an attendance marking system, which integrates computer vision and face recognition algorithms into the process of attendance management. The system is implemented using a non-intrusive digital camera installed on a classroom, which scans the room, detects and extracts all faces from the acquired images. After faces have been extracted, they are compared with an existing database of student images and upon successful recognition a student attendance list is generated and saved on a database. This paper addresses problems such as real time face detection on environments with multiple objects, face recognition algorithms as well as social and pedagogical issues with the applied techniques.

In [2] PAN Xiang described work process of a system: When a person wants to enter the access control system, he used the RFID card to swiping card by non-touch way. The system reads the information in the card and meanwhile the video camera is started to take photos of the person. Then the face can be detected in a short time. The identity information in the card is compared to the information from the database and the corresponding face data will be obtained. If the identity information and the face data are all matched to the information from the database, the person will be passed. Else he can't enter. The manager can do the manage work such as query the records.

In [3] Mr. Jawale described a technique based on ear is also introduced that is a photo of the subject's ear is taken and fed into the computer. Edge detection is carried out on this picture. From this detected edge, is separated a reference line with respect to which other features are identified. These extracted features are stored in a database in the form of a vector, each vector corresponding to a particular image in the database. The feature vector of the test image obtained is compared with those in the vector database, For creating and maintaining database for records of individuals and feature vectors, which are used for the purpose of comparison and decision making, linking of MATLAB and some data base using ODBC Drivers is carried out according to which a match is calculated. This match is compared with a predecided threshold value, which decides the identity of the person.

The [4] Jian Xiao, Gugang Gao, Chen Hu, Haidong Feng proposed a framework for fast embedded face detection system based on three modules. One fast face detection method based on optimized AdaBoost algorithm with high speed and high detection rate, one SOC hardware framework to speed up detection operations and one software distribution strategy to optimize the memory sub-system.

The [6] describes a Real Time System developed for Multi-face detection. As most of the system are based on software algorithms. This proposed system is based on hardware design to enhance the processing time. The different stages of this hardware design includes skin color detection, morphology, Fast connected-component labeling algorithm, Implementation of the Fast connected-component labeling algorithm, Lip feature extraction, Horizontal edge detection

The [8] Yohei Ishii proposed a method of face and head detection simultaneously for real time surveillance system which employs four directional features (FDF) and linear discriminant analysis. FDF is one of the robust features to distinguish patterns. The FDF represents four directional (vertical, horizontal, and both diagonals) edge features of the input image. The proposed method achieved the performance of approximately over 10 fps for detection for implementation and so required a lot of improvements

The [10] Phuong-Trinh Pham-Ngoc, for a sequence of images usually in videos, face detection problem has been solved in two main approaches. The first way is to detect faces for every frame without using temporal information. The other is to detect a face in the first frame and then track the face through the sequence. This paper presents an improved face detection system in video sequence based on the first way. To reduce the effect of illumination changing caused by automatic focus of camera, we propose an adaptive selection of skin color models to receive more reasonable skin detection. Unreasonable skin regions are discarded by facial geometric conditions of human faces. Reasonable ones are prevented by replacing them with elliptic skin regions. Then we get the most potential ones considered as face candidates. We propose a modified LBP considering not only local spatial textures but also principal local shapes. A histogram of modified LBP coefficients is considered as facial representation. A combination of template matching and appearance-based methods is used for classification step. LBP histogram matching and eHMMs are combined into a hierarchical classifier to identify if face candidates are human faces.

III. PROPOSED WORK

A general block diagram of the system is as shown below

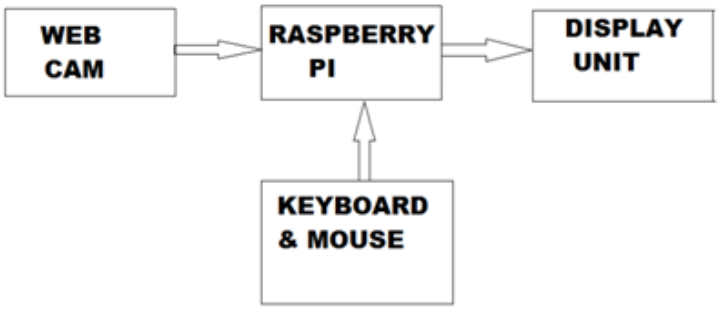

Fig 1. Block Diagram of the Proposed System

The proposed system consists of both hardware units and software. The Raspberry Pi is the heart of the system. The Raspberry Pi is a credit card sized single board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi is manufactured in two board configurations. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZFS 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built in hard disk or solid state drive, but it uses an SD card for booting and persistent storage.

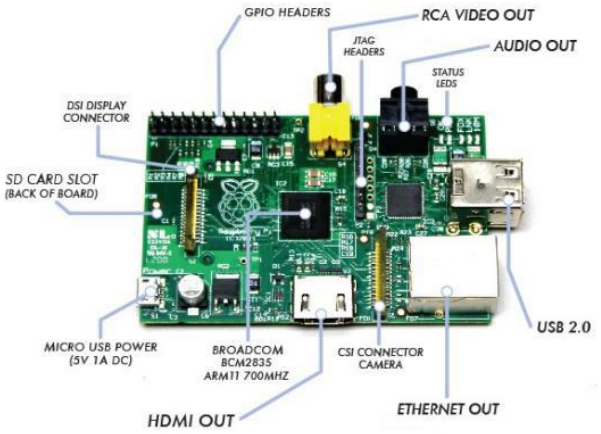

Fig 2: Raspberry Pi model-B board

The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language. There are different types of raspberry pi model available in the market, Such as Model A, Model B, Model B+ etc.
So here we make use of a Model B Raspberry Pi which has a size specification as 85.60 mm × 53.98 mm (3.370 in ×2.125 in), and around 15 mm deep. It has a 512 MB built in RAM and operates at 700MHz. It has 2 USB ports and an Ethernet port. 26 GPIO pins for peripheral connections supported by raspberry pi, external storage supported upto 32 GB, DSI display connector, CSI camera connector, HDMI connector for display, RCA video and audio jackies. The system is programmed using Python programming language.
For Real time face detection, webcam was connected to the Raspberry Pi to capture the real time video of people infront of it. Output video window was set to defined size and the video was displayed in it. The system is efficient to capture video of multiple faces and a red box was drawn across each of the detected face. The camera used here is a web camera that captures the images of students for both database creation and test images.
We have developed three algorithms, for face detection from a given image, from a folder of images and for real time face detection.

A. Face detection from a given image: Histogram equalization is done on the input image. Haar classifier is used for image calculation process and once face is detected, a red bounding box is drawn on the detected face. Detected face and sub faces are saved and time taken for detection is printed.

B. Face detection from a folder of images: After Histogram equalization of the given image, Haar classifier is again used for image calculation process. The difference from the first algorithm is that in addition to saving the detected face to a specified folder, the algorithm also checks if each image belongs to the source directory. If yes, the current file is named as a valid image with the file name. Otherwise, the file is named as an invalid image.

C. Real time face detection : Video is captured real time using the webcam. As long as a face is detected, a red bounding box is drawn and the video is displayed in the output window. The algorithm is efficient enough to detect multiple faces also.

IV. CONCLUSION

In this highly technological environment, by it‘s over clocking and future expansion capabilities, Raspberry Pi proved to be easy, economic and efficient platform for implementing the smart attendance system. This project has many applications, such as face recognition, face tracking, facial feature detection, video surveillance, human computer interfaces, and robotics. This system can also be enhanced to recognize a large group of students or used in campus surveillance and this Raspberry-Pi processor makes the system compact and efficient and thus replaces the personal computer. Similarly we can design an automated system for human face recognition in a real time background for a company to mark the attendance of their employees. So Smart Attendance using Real Time Face Recognition is a real world solution which comes with day to day activities of handling employees.

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