Online Attendance System

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Abstract **- Real-time face detection is one part of the automatic face recognition system and also used in developing an independent research subject. So, there are many approaches to overcome problems in face detection. This paper introduces a new approach in automatic attendance management systems, extended with computer vision algorithms .In our proposed system real time face detection algorithms are used in integration with an existing Learning Management System (LMS), which automatically detects and registers students attending on a lecture. The system represents a supplemental tool for instructors, algorithms used in machine learning are combined with adaptive methods used to track facial changes during a longer period of time. Time consumption is lesser than traditional methods, at the same time being nonintrusive and does not interfere with the regular teaching process. The tool promises to offer accurate results and a more detailed reporting system which shows student activity and attendance in a classroom.**

Keywords– Computer Vision, Object Tracking, FaceRecognition, Machine Learning and Teaching

I. INTRODUCTION

In traditional system students are stimulated to attend classes using attendance points which at the end of a semester constitute to be a part of a student's final grade. However, this presents additional effort from the teacher, who must make sure to correctly mark attendance, which at the same time wastes a considerable amount of time .Furthermore it can get much more complicated if onehas to deal with large groups of students. This paper introduces a new automatic attendance management marking system, without any interference with the regular teaching process. The system can be used in exam sessions or other teaching activities where attendance is mandatory. This system eliminates classical student identification such as calling student names, or checking respective identity cards, which can not only interfere with the teaching process, but also can be stressful for students during exam sessions.

II. RELATED WORK

System which introduces an attendance marking system, integrates computer vision and face recognition algorithms into the process of attendance management. The system is implemented using a non-intrusive digital camera kept fixed 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 on 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 as well as social and pedagogical issues with the applied techniques.

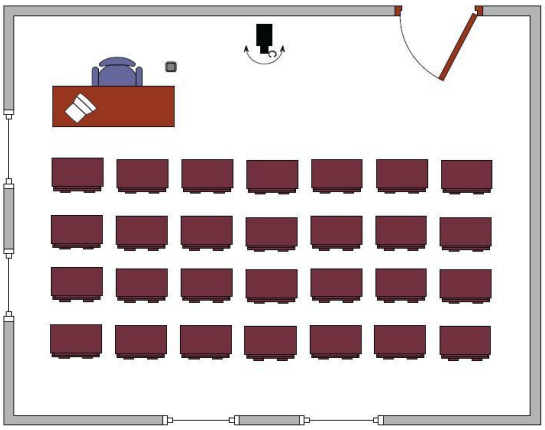


Fig. 1. Class Room Setup [1]

In [2] PAN Xiang described work process of a system as given below:

When a person wants to enter the access control system, he used the RFID for swiping by non-touch way. The system reads the information in the card and meanwhile the video camera take photos of the person. Then the face is detected within a short time. The identity information in the card is compared to the information from the database . If the identity information and the face data are matched with the information from the database,and then the person will be allowed to enter the class.

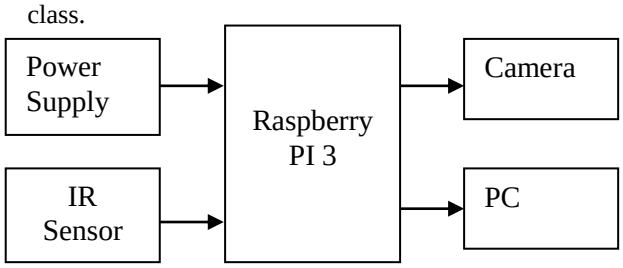


Fig. 2. Framework of access control system [2]

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

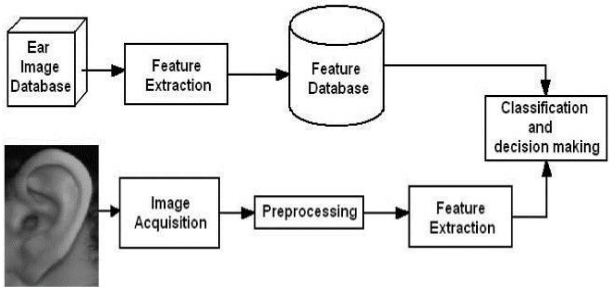


Fig. 3. Ear based attendance system framework [3]

The [4] proposed a framework for face detection system based on three modules. One fast face detection based on optimized Ada Boost algorithm with high speed and high detection rate, second the SOC hardware framework to speed up detection operations and third software distribution strategy to optimize the memory sub-system.
The [6] describes a Real Time System which is developed for Multi-face detection method. 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 in the design includes skin color detection, morphology,Fast connected-component labeling algorithm, Implementation of the Fast connected-component labeling algorithm, Horizontal edge detection.

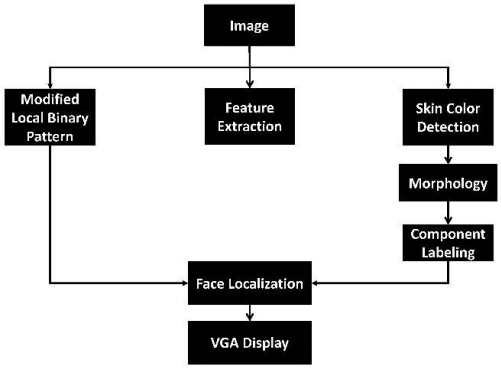


Fig. 5. Algorithm Flow

The [8] proposed method of face and head detection for real time surveillance system which employs four directional features (FDF) and linear discriminant analysis. FDF is one of the robust feature to distinguish patterns. The FDF includes four directional(vertical, horizontal, and both diagonals) features of the input image. The proposed method achieved the performance of approximately over 10 fps for detection,implementation and so requires a lot of improvement.
The [10] for sequence of images usued in videos, face detection problem has been solved in two main approaches. The first way is to detect faces for every frame without temporal information. The other is to detect a face in the first frame and then to track the face through a sequence. This paper presents an improved face detection system in video illumination caused by automatic focus of camera, we propose an adaptive selection of skin color models to receive reasonable skin detection. Unreasonable skin regions are discarded by facial geometric conditions. Reasonable ones are prevented by replacing them with elliptic skin regions. Then we get the most potential candidate faces. 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 oftemplate matching and appearance-based methods is used for classification step. LBP histogram matching and eHMMs are combined in a hierarchical classifier to identify as if the face candidates are human faces.

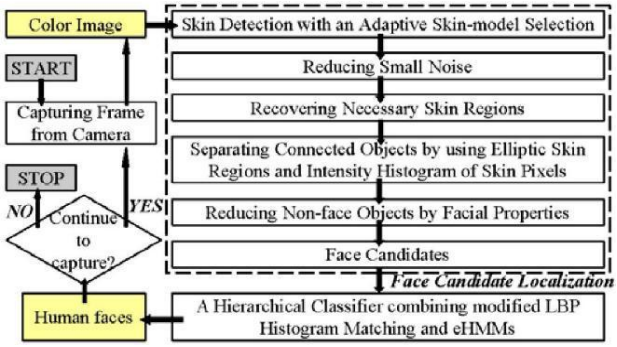


Fig. 6. Face Detection System

III. PROPOSED SYSTEM'S ARCHITECTURE

The system designed is part of an in-house built learning management suite [11]. It is constructed in many modules:
- Image capturing,
- Face Detector and
- Face recognizer.

The entire process is described in the pseudo code shown

```
scan room with digital camera

for each detected object
    transfer the object in server
next object

for each face in server
    if face in students database
        record student as enrolled
        save face in students database
    else
        mark face as unrecognized
next face
```

Fig. 7. System Basic Algorithm

The required infrastructure is a rotating camera positioned centrally in the front of the classroom. Using this setup, the camera is capable of capturing frontal images from students A different approach is to use a camera at the entrance of the classroom, which would individually detect faces wh are entering the classroom. This way, the face detector would have less work to do, but there would be only one chance to capture a good frame. A front camera in the middle of the classroom can take as many pictures. Physically the system is integrated on the existing South East European Universities infrastructure. For functioning, the system requires each classroom must have one internet connected computer. This computer communicates with the LMS server, where captured images are transferred. Fig. 8 depicts the physical architecture of this system.

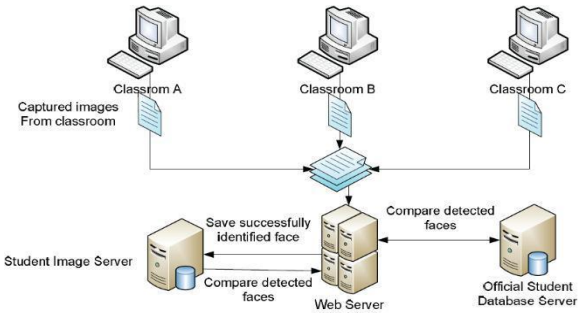


Fig. 8. Physical Architecture of the System

A) Image Capturing

Images are captured using a digital camera whose link is integrated to the application that is developed using the proposed idea. After an image is captured ,web services transfers the image on server for processing. Along with the image, the web service accepts the course code. Using this course code, the LMS is aware of those students who belong to that class and do face matching only for those students. The camera continuously take pictures on a given interval (by default each five minutes), until all faces detected are successfully identified or until the system stop its work. This means that in some cases, e.g., when a face cannot be successfully identified, the camera keeps taking pictures until the class finishes.

B) Face Detection

Because of intensive job of the face detection algorithm, this tool is server based. Detecting a face is in essence an object detection task, where the object of interest in this case is the face. However, many factors can interfere with the face detection algorithms such as face pose, scale, position, rotation, light, image colors etc. The same problems arise when one wants to identify (recognize) a face, with addition to some other obstacles.

The process of detecting faces from still pictures containing multiple faces can be separated in few steps. There are many face detection algorithms which can effectively detect a face (or any other specific object) in a picture. In the system presented here, most students face the camera in front hence we chose to use the HAAR classifier for face detection. This classifier is implemented on Intel's Open CV library.

The classifier works by training a model using positive face images and negative face images. A positive image is animage that contains the desired object to be detected, in our case this object is a face. A negative image is an image that does not contain the desired object. After the training of model is completed, it is able to identify face features, which is later, stored on a XML file.

A problem faced during this process was the large number of negative:objects mistakenly detected as faces. This was not such a big issue for us, since a negative does not result in a positive identification during the recognition phase. Because of this, we lower the detection threshold, so all faces could be detected.

After a face has been detected, the rectangle enclosing this face is cropped and processed later by the face recognition module. This rectangle represents a single face, and after that cropped image is transferred on server. Each file transferred is renamed to have a unique ID.

C) Face Recognition

Face Recognition means to identify a particular face from a list of faces on a database. Our university, upon enrollment takes pictures from every student, and those images are stored in a database. There are many existing algorithms used for face identification. Our system implements a server based module, programmed in Python (Pyfaces - http://pyfaces.blogspot.com/) which takes benefit of eigenfaces to identify a face. This algorithm has many drawbacks: it depends on scale, pose and the color of the compared images. However the algorithm is very fast, and can compare only two images, thus we do not need to have multiple images of a person to train our system.Since our system is setup to capture only frontal images the pose of the face in not an issue. The captured face is converted into gray scale. The same conversion is applied to faces on our student image database. Background subtraction is done on our images so that other objects do not interfere during the process.

Another issue is that faces are subjected during time (facial hair, eyeglasses etc). Whenever a face is successfully identified, a copy of that face is stored in the database. Together with the image we store the time and date. This way even if a student gradually changes his appearance (e.g., grows a beard) the system is capable to identify him, since it has multiple images of the same person.On each consequent scan of a student, the recognition module starts comparing images from the database, sorted by date in descending order. This approach was chosen since the latest image on the database is most likely to be more similar to the current captured image. Of course, a drastic change on a student's look causes the system to identify that particular student.To solve this issue, we have included a module, which lists all unidentified faces and the teacher is able to manually connect a captured face with a student from the list. This image is also stored on the database, as an updated picture of a particular student. This manual recognition process is performed only once. In a subsequent scan, the student is identified automatically by our system.To speed up the face recognition process we only compare images captured in a classroom, with the database of students enrolled before.

This ensures that we process only a small subset of images available on our central data base.

III. PRIVACY CONCERNS

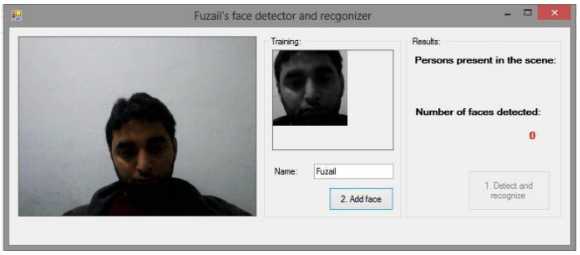
As mentioned previously, we store image data on server. This approach can always raise privacy concerns, regarding the safety of those images and access level to that server. Whenever one has to deal with this type of sensitive data, he must always offer means to protect data from unauthorized access. In some countries, especially in EU [4], these privacy concerns are considered very seriously with regulations in place in their corresponding legislatures.

Since this is system is mainly done to explore the advantages and the feasibility of using face recognition in attendance management, it still does not offer any privacy protection.

However, if the system proves to be usable one has to implement some type of secure means to ensure privacy. In password security one of the most popular approaches in this case is to encrypt data using a one way function. For us this means to encrypt images gotten from the camera and compare those images with existing (also encrypted) images on server. However, since biometric data is noisy, this approach is not feasible. Another approach can be to use one way encryption using a private/public key approach. This way only the person in possession of the correct key is able to decrypt the data.

IV. SOFTWARE APPLICATION

This section gives a description of a software application in which the proposed idea is implemented. In the training the image is captured and saved in the data base. And then the system is able to understand the face that is shown in the second image (Fig. 9) that is detection and recognition.



Training

Detection and Recognition

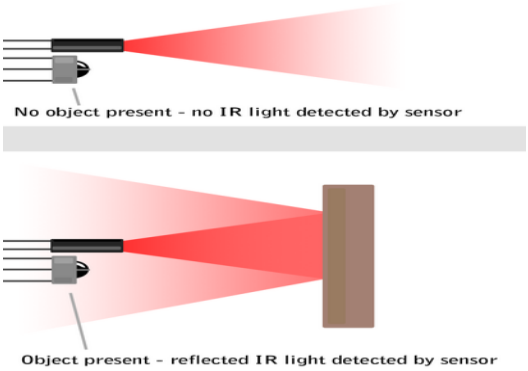
Fig 8. Description of software application

IR SENSOR

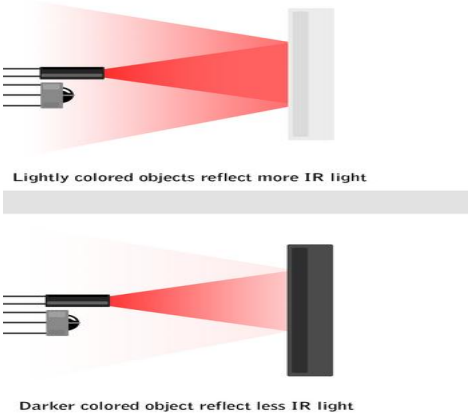
Principles of Operation

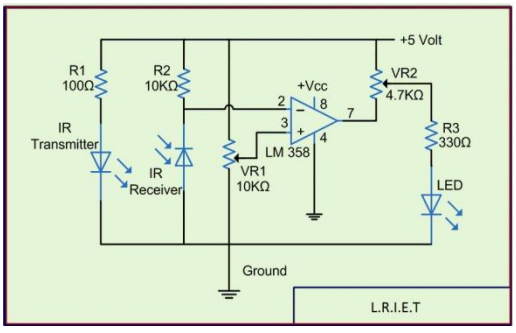
IR Sensors work by using a specific light sensor to detect a selected wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, we look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object into the light sensor. This results in a large variation in the intensity, which we already know can be detected using a threshold.

Detecting Brightness



Since the sensor works by looking the reflected light, it is possible to have a sensor that can return the value of the reflected light. This type of sensor can then be used to measure how "bright" the object is. This is useful for tasks like line tracking.





Raspberry Pi 3

The Raspberry Pi is a single computer board — developed to encourage the teaching of programming and computing. It is a starting point for the development of Internet of Things (IoT) projects. The low cost 'plug and play' nature of Pi makes for a board that is accessible to all and has numerous connectivity options. Pi is the perfect experimental tool that is use as a desktop computer, media centre, server or monitoring/security device within your home.Linux-based operating systems run on the Pi with plenty of access to free software and downloads.

V. CONCLUSION

An automatic attendance management system is a necessarytool for any LMS. Most of the existing systems are timeconsuming and require for a semi manual work from theteacher or students. This approach aims to solve the issues byintegrating face recognition in the process. Even though thissystem still lacks the ability to identify each student presenton class, there is still much more room for improvement.Since we implement a modular approach we can improvedifferent modules until we reach an acceptable detection andidentification rate. Another issue that has to be taken inconsideration in the future is a method to ensureusersprivacy. Whenever an image is stored on our servers, it mustbe impossible for a person to use that image.

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