



SMART ATTENDANCE SYSTEM USING FACE RECOGNITION

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Abstract

Face is the crucial part of the human body that uniquely identifies a person. Using the face characteristics as biometric, the face recognition system can be implemented. The most demanding task in any organization is attendance marking. In traditional attendance system, the students are called out by the teachers and their presence or absence is marked accordingly. However, these traditional techniques are time consuming and tedious. In this project, the Open CV based face recognition approach has been proposed. This model integrates a camera that captures an input image, an algorithm for detecting face from an input image, encoding and identifying the face, marking the attendance in a spreadsheet and converting it into PDF file. The training database is created by training the system with the faces of the authorized students. The cropped images are then stored as a database with respective labels. The features are extracted using LBPH algorithm.

Keywords: LBPH, Open CV, camera, attendance, biometric, face recognition, spreadsheet

1. Introduction

Nowadays Educational institutions are concerned about regularity of student attendance. This is mainly due to students' overall academic performance is affected by his or her attendance in the institute. Mainly there are two conventional methods of marking attendance which are calling out the roll call or by taking student sign on paper. They both were more time consuming and difficult. Hence, there is a requirement of computer-based student attendance management system which will assist the faculty for maintaining attendance record automatically. In this project we have implemented the automated attendance system using PYTHON. We have projected our ideas to implement "Automated Attendance System Based on Facial Recognition", in which it imbibe large applications. The application includes face identification, which saves time and eliminates chances of proxy attendance because of the face authorization.

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Hence, this system can be implemented in a field where attendance plays an important role. The system is designed using PYTHON platform. The proposed system uses Principal Component Analysis (PCA) algorithm which is based on eigenface approach. This algorithm compares the test image and training image and determines students who are present and absent. The attendance record is maintained in an excel sheet which is updated automatically in the system.

Problem Statement Attendances of every student are being maintained by every school, college and university. Empirical evidences have shown that there is a significant correlation between students' attendances and their academic performances. There was also a claim stated that the students who have poor attendance records will generally link to poor retention. Therefore, faculty has to maintain proper record for the attendance. The manual attendance record system is not efficient and requires more time to arrange record and to calculate the average attendance of each student. Hence there is a requirement of a system that will solve the problem of student record arrangement and student average attendance calculation. One alternative to make student attendance system automatic is provided by facial recognition.

Face recognition can be applied for a wide variety of problems like image and film processing, human-computer interaction, criminal identification etc. This has motivated researchers to develop computational models to identify the faces, which are relatively simple and easy to implement. The existing

system represents some face space with higher dimensionality and it is not effective too. The important fact which is considered is that although these face images have high dimensionality, in reality they span very low dimensional space. So instead of considering whole face space with high dimensionality, it is better to consider only a subspace with lower dimensionality to represent this face space. The goal is to implement the system (model) for a particular face and distinguish it from a large number of stored faces with some real-time variations as well. The Eigenface approach uses Principal Component Analysis (PCA) algorithm for the recognition of the images. It gives us efficient way to find the lower dimensional space.

“Eigenfaces for recognition” (Mathew Turk and Alex Pentland) [1], here they have developed a near-real time computersystem that can locate and track a subject's head, and then recognize the person by comparing characteristics of the face to those of known individuals. The computational approach taken in this system is motivated by both physiology and information theory, as well as by the practical requirements of near-real time performance and accuracy. This approach treats the face recognition problem as an intrinsically two-dimensional recognition problem rather than requiring recovery of three-dimensional geometry, taking advantage of the fact that these faces are normally upright and thus may be described by a small set of two-dimensional characteristic views. Their experiments show that the eigenface technique can be made to perform at very high accuracy, although with a substantial

“unknown “rejection rate and thus potentially well suited to these applications. The future scope of this project was-in addition to recognizing face, to use eigenface analysis to determine the gender of the subject and to interpret facial expressions. “Fast face recognition using eigenfaces” (Arun Vyas and Rajbala Tokas) [2], their approach signifies face recognition as a two-dimensional problem. In this approach, face reorganization is done by Principal Component Analysis (PCA). Face images are faced onto a space that encodes best difference among known face images.

The face space is created by eigenface methods which are eigenvectors of the set of faces, which may not link to general facial features such as eyes, nose, and lips. The eigenface method uses the PCA for recognition of the images. The system performs by facing pre-extracted face image onto a set of face space that shows significant difference among known face images. Face will be categorized as known or unknown face after imitating it with the present database. From the obtained results, it was concluded that, for recognition, it is sufficient to take about 10% eigenfaces with the highest eigenvalues. It is also clear that the recognition rate increases with the number of training images.

2. System Analysis

2.1 Proposed System

The present system of attendance marking i.e., manually calling out the roll call by the faculty have quite satisfactorily served the purpose. With the change in the educational system

with the introduction of new technologies in classroom such as virtual classroom, the traditional way of taking attendance may not be viable anymore. Even with rising number of course of study offered by universities, processing of attendance manually could be time consuming. Hence, in our project we aim at creating a system to take attendance using facial recognition technology in classrooms and creating an efficient database to record them.

Block diagram

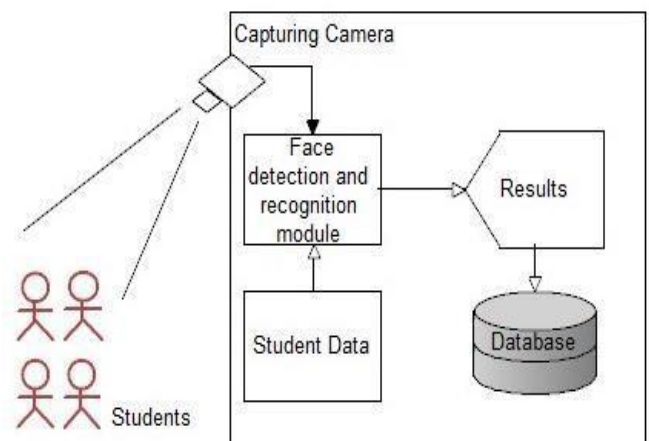


Figure 1 Proposed system

The block diagram in figure 1 describes the proposed system for Face Recognition based Classroom attendance system. The system requires a camera installed in the classroom at a position where it could capture all the students in the classroom and thus capture their images effectively.

3. Requirements & Specifications

3.1 Scope of the System

We are setting up to design a system comprising of two modules. The first module (face detector) is a mobile component, which

is basically, a camera application that captures student faces and stores them in a file using computer vision face detection algorithms and face extraction techniques. The second module is a desktop application that does face recognition of the captured images (faces) in the file, marks the students register and then stores the results in a database for future analysis.

3.2 Objective of the System

The main objective of this project is to offer system that simplify and automate the process of recording and tracking students' attendance through face recognition technology. It is biometric technology to identify or verify a person from a digital image or surveillance video.

3.3 SYSTEM REQUIREMENTS

3.3.1 Software Requirements

- ❖ Operating system - Windows 7 Ultimate.
- ❖ Coding Language - Python.
- ❖ Front-End - Python.

3.3.2 Hardware Requirements

- Processor - Pentium –IV
- RAM - 8 GB (min)
- Hard Disk - 200 GB
- Key Board - Standard Windows Keyboard
- Mouse - Two or Three Button Mouse
- Monitor - SVGA

3.4 SYSTEM DESIGN

3.4.1 INPUT DESIGN The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those

steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3. When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

3.4.2 OUTPUT DESIGN A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making. 1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

4. DESIGN REQUIREMENTS

We used some tools to build the HFR system. Without the help of these tools it would not be possible to make it done. Here we will discuss about the most important one.

4.1 Software Implementation

OpenCV: We used OpenCV 3 dependency for python OpenCV is library where there are lots

of image processing functions are available. This is very useful library for image processing. Even one can get expected outcome without writing a single code. The library is cross-platform and free for use under the open-source BSD license.

Example of some supported functions are given bellow:

- Derivation: Gradient / Laplacian computing, contours delimitation
- Hough transforms: lines, segments, circles, and geometrical shapes detection
- Histograms: computing, equalization, and object localization with back projection algorithm
- Segmentation: Thresholding, distance transform, foreground/background detection, watershed segmentation
- Filtering: linear and nonlinear filters, morphological operations
- Cascade detectors: detection of face, eye, car plates
- Interest points: detection and matching
- Video processing: optical flow, background subtraction, camshaft (object tracking)
- Photography: panoramas realization, high-definition imaging (HDR), image inpainting.

Image Processing Toolbox

The Image Processing Toolbox is a collection of functions that extend the capability of the PYTHON® numeric computing environment. The toolbox supports a wide range of image processing operations, including:

- Spatial image transformations
- Morphological operations
- Neighborhood and block operations
- Linear filtering and filter design



- Transforms
- Image analysis and enhancement
- Image registration
- De blurring
- Region of interest operations

Many of the toolbox functions are PYTHON M-files, a series of PYTHON statements that implement specialized image processing algorithms. You can extend the capabilities of the Image Processing Toolbox by writing your own M-files, or by using the toolbox in combination with other toolboxes, such as the Signal Processing Toolbox and the Wavelet Toolbox. The toolbox also includes a Simulink interface called the Image Acquisition Block set. This block set extends Simulink with a block that lets you bring live video data into a model.

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub assemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

5. TEST OBJECTIVES

- All field entries must work properly.
- Pages must be activated from the identified link.
- The entry screen, messages and responses must not be delayed.

5.1 TEST APPORACHES

Field testing will be performed manually and functional tests will be written in detail.

TYPES OF TESTING

5.2 Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application. It is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

5.3 Integration testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfactory, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

5.4 Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items: Valid Input-identified classes of valid input must be accepted. Invalid Input-identified classes of invalid input must be rejected. Functions-identified functions must be exercised. Output-identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked. Organization and preparation of functional tests is focused on requirements, key functions,

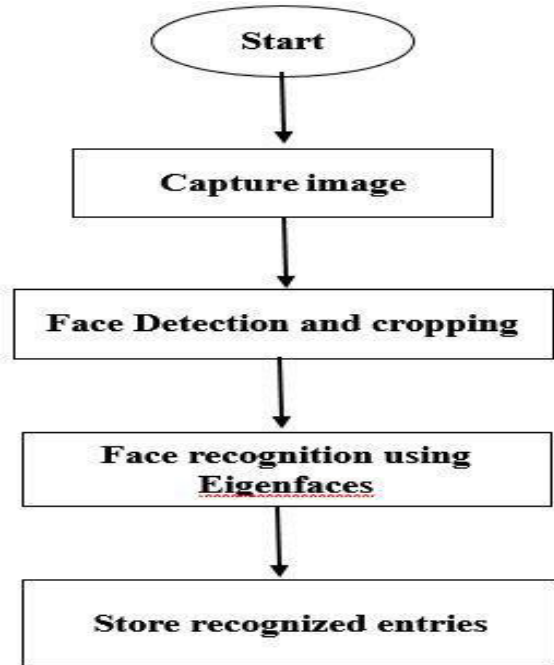


Figure 3 Image processing procedure

6. System Implementation

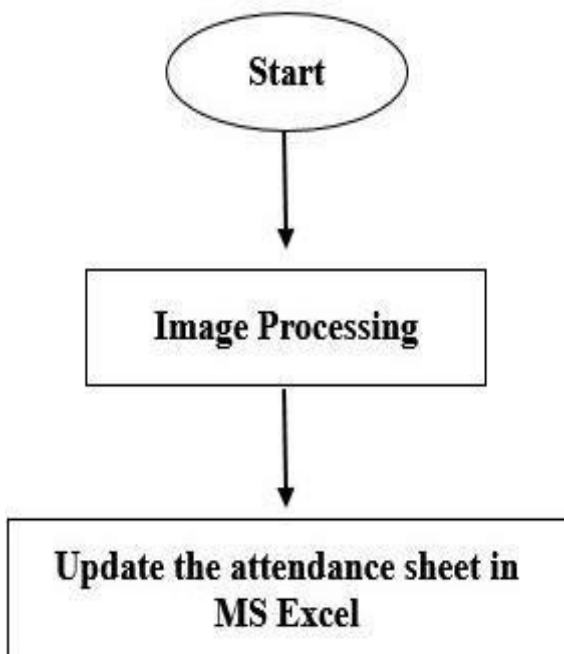
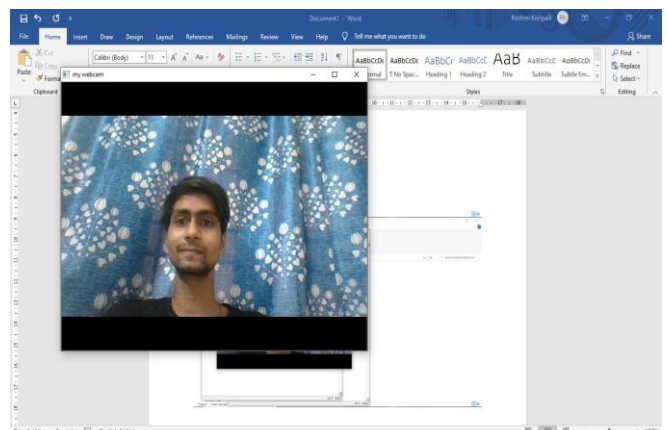


Figure 2 System Flowchart

7. Result and Analysis

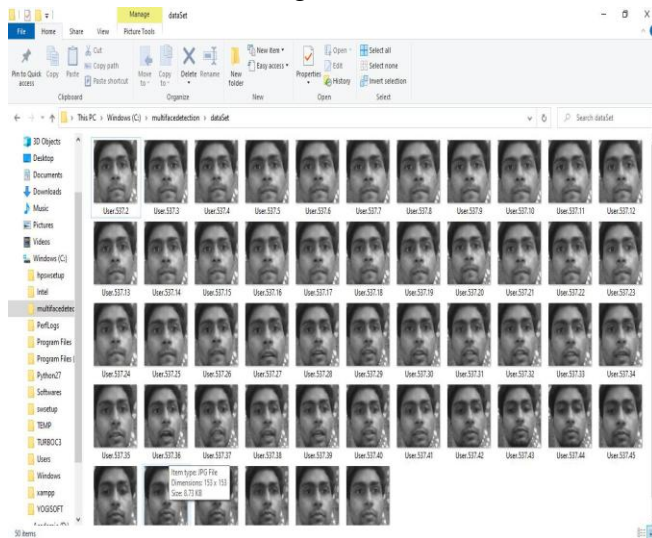
Using the all the functions we have created; we have tested for output in using existing test images as well as in real-time. Following section, the screenshots of the output of different functions are given. We have tested the system with the help of four volunteers. Taking images from cam to create the test database



Images are saved with enrollment number and a dataset is created

Collect Training Dataset

Using the function TrainDatabase we create a database of the enrolled students which is stored in the folder. Figure



With the help of four volunteers, three images of each candidate is stored on the database as shown in the figure. For more accuracy we can increase the number of training images but with a compromise in the speed of calculation. However, for our application calculation speed variation won't be problem since a class timing is typically at least one hour and this period is just a lot more than the computation time takes by the algorithm.

One thing we have keep in mind during this phase is to take the picture in ambient lighting and the frontal face must be clearly visible. Also there must be slight variation on the position or expression of the student in each captured image for better results. In normal lighting conditions and based on the proper sitting posture of the students the faces are efficiently captured. The classroom

lighting has to be efficiently maintained. Also in case of blackouts appropriate alternatives have to be arranged.

All the detected faces which can be seen in figure, are cropped and saved in the Test Database folder. From this location the next algorithm read the image and further processing are carried out. The path of the folder must be exactly specified. Also the name each of the faces are given as numbers automatically. This helps in easier reading of the images from the folder.

Face Recognition

Cropped facial images are fed into the face recognition algorithm and we get the results. The Eigen faces algorithm is applied to the image and compared with the database. We get the output as in figure after this process.

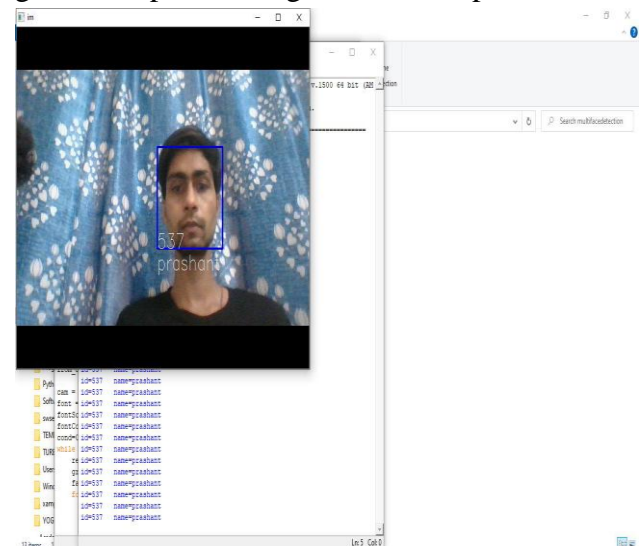


Figure A student is recognized and appropriate message is displayed

If a person whose database is not present in the database, his image is simply ignored.

However proper lighting has to be maintained in order to prevent in any false detection.

Output in MS Excel

We get the output as given below. After that we can derive the results in appropriate format using different function in the spreadsheet as in figure 7-4. We can get the following parameters by using this format as output as shown in the figure. This function is performed using the Spreadsheet Link Ex toolbox of the PYTHON.

- If a person is present, a '1' is passed on to the particular field of the student
- The date and time are also passed on to the sheet.

We can include any number of students' data using this system and provided we use a better quality of an image capturing device.

In the next section we describe how we integrate all these function y using the Graphical User Interface (GUI). This gives an easy-to-use interface to the users.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
153	S23	roshini	10-07-2021																	
154	S23	roshini	10-07-2021																	
155	S23	roshini	10-07-2021																	
156	S23	roshini	10-07-2021																	
157	S23	roshini	10-07-2021																	
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163	S23	roshini	10-07-2021																	
164	S23	roshini	10-07-2021																	
165	S23	roshini	10-07-2021																	
166	S17	prashant	10-07-2021																	
167	S17	prashant	10-07-2021																	
168	S17	prashant	10-07-2021																	
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179	S17	prashant	10-07-2021																	
180	S17	prashant	10-07-2021																	
181	S17	prashant	10-07-2021																	

Figure Output obtained in the excel format

CONCLUSION

In this system we have implemented an attendance system for a lecture, section or laboratory by which lecturer or teaching assistant can record students' attendance. It saves time and effort, especially if it is a lecture with huge number of students. Automated Attendance System has been envisioned for the purpose of reducing the drawbacks in the traditional (manual) system. This attendance system demonstrates the use of image processing techniques in classroom. This system can not only merely help in the attendance system, but also improve the goodwill of an institution

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