Automated Student Attendance Management System
Using Multiple Facial Images

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Abstract. Nowadays, many applications such as video monitoring/surveillance system, human-computer interaction, door access control system and network security use biometric authentication. One of the biometric identification is using fingerprint. It is considered to be the best and fastest method because every person has unique fingerprint and does not change in one's lifetime. Fingerprint recognition is a mature field today, but using face recognition technique is still better to be applied in capturing the present of the student in the class. Other advantages using face recognition are knowing the attitude of students in class such as students readiness or interestedness in lecture. This paper discusses a method for managing student attendance system in classroom using multiple facial images for classifying the facial objects. From the experiments conducted by involving 19 students situated in classroom setting, it results in 174 out of 205 successful faces recognition. Recognition rate is about 85%.

Introduction

Keeping the valid and correct student attendance record in traditional face-to-face (F2F) class setting, the faculty staffs should have a proper mechanism. They have to verify and maintain or manage that attendance record on regular basis. They have difficulties, especially in classes attended by a large number of students. The manual system also need time longer for reporting the average attendance of each enrolled student. On the other hand, applying the automated attendance system may reduce the administrative burden of its staff. Therefore, this paper describes on how we can manage student’s attendance in class using face recognition technique automatically from the digital images captured in classroom setting.

Automated system using feature-based approach detects key point features of the face, such as eyes, mouth. It means the calculation covers some parts of the given image. The other way uses brightness-based approach or holistic-based or image-based approach. It calculates all parts of the given image. It takes longer time and more complicated to process the image. But it is more robust.

To make it more acceptable, the image has to be transformed into a certain model such as introduced by Turk and Pentland in 1991, based on the Principle Component Analysis (PCA) method [1][2][3]. Other proposed models Discrete Wavelet Transform (DWT) [4] and Discrete Cosine Transform [5][6][7][8]. This paper covers the combination usage of DWT and DCT and also refers to the key results obtained from the preliminary research of the same project as published in [9] [10].

Related Work

Cheng et al. [11] proposed the system to manage the present of the students at classroom lecture by using note PCs for all the students. Because this system uses the note PC of each student, the attendance and the position of the students are obtained. However, it is difficult to know the detailed situation of the lecture. In recent decade, a number of algorithms for face recognition have been proposed [12], but most of these works deal with only single image of a face at a time. By
continuously observing of face information, our approach deals with multiple face images in classroom situation.

**System Design**

**Camera Configuration**

Hardware configuration in a classroom consists of two cameras. They can rotate in both direction, horizontally and vertically. The two cameras are placed so that they can capture the image of students in class at all seat available in class, Fig. 1. The cameras are also connected to the server via certain switch outside the class, Fig. 2.

![Figure 1. Classroom scenario.](image1)

![Figure 2. Hardware configuration.](image2)

**Information System**

The server is equipped with data of each class schedule and student’s enrollment. Cameras are set to be on automatically according to the schedule of the class. System basically has two main modules for proper functioning. First module is admin which has right for creating space for new batch. Any entry of new faculty, updating subject if necessary, and sending notice. Second module is handled by the user which can be a faulty or an operator. User has a right of making daily attendance, generating report. Attendance report can be taken in the basis of subject and month or in the basis of Class. The Table Relationship Diagram (TRD) of the system is shown in Fig. 3.

![Figure 3. TRD of the Proposed System.](image3)

The system can also produce reports to the teacher and to the student about the student attendance through their email automatically. Report formats to the lecturer and to the student are shown in Fig. 4 and 5.

![Figure 4. Report format for lecturer.](image4)

![Figure 5. Report format for student.](image5)

From Fig. 4 can be seen that subjectID is followed by subject name whereas enrollID by class code with 6 characters, name of the day with 10 characters and start and end time of the class. TeacherId is also followed by Teacher name. Since, one semester consists of 16 weeks of lecturing...
then there exist 16 columns. Each column will be filled by 1 if student presents the class and 0 otherwise. The total of each column represents the percentage of students who attend the class.

One student enrolls less than 8 subjects within one semester. Therefore, report to the student has maximum 8 enrollIDs. Row Total represents the percentage of student attending the class respectively within one semester.

**Block Diagram System**

The block diagram of the face recognition system is presented in Fig. 6. Training image is a set of student facial images. It is constructed from a number of students. The number of student facial images of each student can vary among others. Fig. 7 shows some of the training images.

![Figure 6. Block diagram of the system.](image)

![Figure 7. Some of the training images.](image)

The purpose of feature extraction is to extract features from any student’s facial image. Each image should be in size 64 x 64 pixels. The feature extraction process is completed by performing grayscale normalization, histogram equalization, Discrete Wavelet Transform (DWT), and Discrete Cosine Transform (DCT). For each histogram equalization of a facial image is represented by p-DCT coefficients then for n images in training set can be represented as a n × p matrix denoted as matrix X = \{x_{ij}|i = 1,2, ..., n ; j = 1,2, ..., p\}

Input data set consists of k classes which are labeled as c_i, i = 1,2, ..., k, then outputs of the trained RBFNN are the average and the variance of each hidden layer nodes, \(\mu_i\), \(\sigma_i^2\) and also the weights of RBFNN from hidden layer nodes to the output layer nodes. \(\mu_i\) and \(\sigma_i^2\) are parameters of i-th node in the hidden layer. They are called as the vector centres and variances of the training data of i-th class from k classes respectively. The weights of RBFNN is denoted as a square matrix \(W\) of size k × k, [10].

Face detection process is designed to get student’s facial image from the input image. It is an image of students captured in the classroom, Fig. 8 and Fig. 9. It can be seen that from one input image, the system can capture some student’s facial images. In one section class, there are many input images are taken from many different directions. We can expect that all student’s facial image can be captured at least one image.

In recognition process, a single facial image is extracted by p DCT coefficients stated as a vector \(x = (x_1 x_2 ... x_p)\). While the output of hidden layer is presented as vector \(h = (h_1 h_2 ... h_k)\), and the RBFNN output as \(O = (o_1 o_2 ... o_p)\). The index j of the highest value of component \(o_j\) indicates that it is the index of the expected class of the given facial image. Each index is associated to a unique student ID.
Experiment Result and Discussion

Experiment is conducted in one section class. Some input images are taken from cameras in a period of time. It is about about 15 minutes. By representing a facial student image with 16 DCT coefficients. The experiment is run with two level of DWT. From the results presented in Table 1, it can be seen that out of 205 facial images, 174 facial images are recognized succesfully. This figure is perceived as the best recognition rate that is about 85%. However, all of present students are identified present in class. Further analysis of the unrecognized facial images indicates that a same student may be recognized more than one students. Fig. 10 indicates that Jason’s facial images are accidentally recognized as Leo and Kim; while three of Veri’s images are recognized as Kim, Ivan and Johan. However, it is also a possibility in which case two facial images of Evan are recognized falsely as Leo, Harry as Alvin, and Leon as Ivan, Fig. 11.

Table 1. Level of DWT and Level of Recognition.

<table>
<thead>
<tr>
<th>Student name</th>
<th># Images</th>
<th>Recognize</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>alvin</td>
<td>8</td>
<td>7</td>
<td>87.50</td>
</tr>
<tr>
<td>evan</td>
<td>5</td>
<td>4</td>
<td>80.00</td>
</tr>
<tr>
<td>felix</td>
<td>16</td>
<td>9</td>
<td>90.00</td>
</tr>
<tr>
<td>gerry</td>
<td>10</td>
<td>9</td>
<td>90.00</td>
</tr>
<tr>
<td>harry</td>
<td>6</td>
<td>3</td>
<td>50.00</td>
</tr>
<tr>
<td>ivan</td>
<td>10</td>
<td>8</td>
<td>80.00</td>
</tr>
<tr>
<td>ivans</td>
<td>39</td>
<td>34</td>
<td>87.18</td>
</tr>
<tr>
<td>jason</td>
<td>18</td>
<td>15</td>
<td>83.33</td>
</tr>
<tr>
<td>johan</td>
<td>7</td>
<td>6</td>
<td>85.71</td>
</tr>
<tr>
<td>keren</td>
<td>12</td>
<td>11</td>
<td>91.67</td>
</tr>
<tr>
<td>kim</td>
<td>6</td>
<td>5</td>
<td>83.33</td>
</tr>
<tr>
<td>leo</td>
<td>6</td>
<td>5</td>
<td>83.33</td>
</tr>
<tr>
<td>leon</td>
<td>9</td>
<td>8</td>
<td>88.89</td>
</tr>
<tr>
<td>livia</td>
<td>8</td>
<td>5</td>
<td>83.33</td>
</tr>
<tr>
<td>marcel</td>
<td>24</td>
<td>20</td>
<td>83.33</td>
</tr>
<tr>
<td>samuel</td>
<td>9</td>
<td>8</td>
<td>88.89</td>
</tr>
<tr>
<td>steven</td>
<td>3</td>
<td>2</td>
<td>66.67</td>
</tr>
<tr>
<td>veri</td>
<td>12</td>
<td>11</td>
<td>91.67</td>
</tr>
<tr>
<td>wong</td>
<td>5</td>
<td>4</td>
<td>80.00</td>
</tr>
<tr>
<td>Total</td>
<td>205</td>
<td>174</td>
<td>84.88</td>
</tr>
</tbody>
</table>

Figure 10. Multiple recognitions of one student.
The overall level of recognition from the experiment does not meet high expectation, therefore further research could be done. It is dealing with the techniques used in this research. More precisely, the special attention should be paid to the improvement of the feature extraction or recognition process technique.

**Conclusion**

It can be concluded that automated managing students attendance system using face recognition works quite well. The success rate of the proposed system in recognizing facial images of the students who are seated in classroom is about 85%. However, it is opened to be improved by paying attention either in feature extraction or recognition process. This improvement may help the recognition process become more robust.

**Acknowledgment**


**References**


