The Student Attendance Controlling Based on Face Recognition by using Learning Vectorization Quantization (LVQ) Algorithm

Poltak Sihombing¹, Rudy Candra², Amer Syarif³, Dahlan Sitompul⁴, Irham Taufik⁵
¹,²,³,⁴,⁵ Faculty of Computer Science and Information Technology, University of North Sumatra, Jl. Dr. Mansur No.9, Medan.

Email: poltakhombing@yahoo.com¹

Abstract. The verification system of Attendance has an important role in everyday life, especially in the scope of work such as offices, factories, hospitals, schools, universities, and other places that require absenteeism. One of the most important to verification is the human face recognition. There are many applications based on the human face recognition such as video monitor system, human-computer interaction, door control system and network security. In this paper, we proposed a method for Student’s Attendance controlling system based on face recognition technology by using Learning Vector Quantization (LVQ) algorithm. This method will record the attendance of the students in the class room environment automatically. Our system will provide the facilities of the faculty to access the information of the students easily by maintaining a log for clock-in and clock-out time. We have developed the prototype, we then tested in the classroom of Computer Science Department, Faculty of Computer Science and Information Technology, University of North Sumatra. The result shows that the average total time taken to record the attendance of a class with 50 students are around 40 seconds.

1. Introduction
Nowadays, the human face recognition technology has developed and is widely used for identification purposes. This identification problem becomes very necessary to guarantee the accuracy of one's data for various purposes, for example for verification of control systems, offices and various other fields.

Actually, there are several methods of identification that also develop like fingerprints, or scanning irises, etc. It can be also accurate, but human face recognition technology has always been the main focus of researcher because of its non-invasive nature and to be the main technology of identifying people.

Finally, human face recognition technology has gradually evolved into one of the universal biometric solutions because of it is considered more accurate if we compared to other biometric identification options [1].

This biometric face recognition technology is basically used in three main domains, namely: (1). for time attendance and employee management systems; (2). visitor management system; and (3). for authorization systems and access control systems in certain places [2].
2. Related Work
The use of this human face recognition technology for identification has begun in 1960 with a semi-automatic system. This technique is made by making signs on photos of human faces. The mark on the face photo is to look for the main features on the face, such as features like eyes, ears, nose, mouth, certain marks on the face and face shape. Then the distance and the ratio of the signs on the face are calculated and stored as a reference. This reference will be compared to the certain face data at the time of identification, where the reference points are stored compared to the data test.

Subsequent developments, in the early 1970s, Goldstein, Harmon, and Lesk created systems with 21 subjective markers such as hair color, lip thickness, eyebrow thickness, and so on. This turned out to be more difficult to automate because the subjective nature of many measurements is still made entirely by hand. Then the Elschlagerb Fisherman approached by measuring different parts of the face and mapping them all into a global template, and he found that this feature does not contain enough unique data to represent an adult's face [3].

Next is an approach with Connectionist approach technology, which seeks to classify human faces using a combination of various movements and a set of identification markers. This is usually implemented using 2-dimensional pattern recognition and the principles of artificial neural networks. Most of the time this approach requires a large amount of training to achieve decent accuracy. This technique has not been implemented on a large scale [4].

Then the first automatic system developed using pattern recognition is very common. This technique compares faces with the general facial feature model that is expected and creates a series of matters for images relative to this model. This approach is very statistical and depends on the histogram and gray scale values [5]. This paper proposes the use of LVQ algorithm (Learning Vectorization Quantization) to create a more effective method for tracking student attendance in class.

3. System Overview
Based on figure 1, this paper proposed consists of three parts as follows: (A). Face Detection and Extract, (B). Learn and Train Face Images, and (C). Recognize and Identification.

![Diagram Block of System Overview](image)

**A. Face Detection and Extract.**
In this study, students' faces will be photographed by using real-time computer cameras. The results of the photograph are then extracted into binary process to produce images in binary form 1 and 0 and stored as references of face information in an excel file format for the purposes of future testing. The extract binary process is carried out as follows: after the face is photographed, then the next process is grayscale and proceed with the binary process. The input used is a photo with *.bmp format with a size of 100 x 100 pixels. The binary process as shown in Figure 2.
In this implementation, each student's face has been captured through webcam cameras, each with 5 sample faces on different face form and stored in the database. This stored face will be used later as a reference when the student's face recognition is carried out as proof of attendance in the classroom.

![Figure 2. Face captured by the camera](image)

Grayscale values in figure 2.a, b can be obtained by using the formula below:

\[
I = \frac{R + G + B}{3}
\]

with information:

- \(I\) = pixel values in grayscale image;
- \(R\) = bit red value on RGB image;
- \(G\) = the bit value of green in the RGB image;
- \(B\) = the bit value of blue in the RGB image.

**B. Learn and Train Face Images**

Referring to figure 1, The face image captured by the camera and continue to the RGB process. After processing of the RGB (Red, Green, Blue) value, we then continue to calculate the grayscale value process. The grayscale value will be converted to binary form by using a threshold of 50 and resulted a threshold image as is shown figure 2.b and binary patterns are generated as shown in Figure 3.
C. Recognize and Identification

In Figure 4, we can see the training flowchart in the Learning Vector Quantization (LVQ) Algorithm to recognize the student attendance based on faces recognition.

---

Figure 3. The Example of Binary Pattern

Figure 4. Flowchart of The Student Attendance based on face recognition
4. The System Test and Result

Face suitability testing has been done on a number of students of computer science, where each student face is photographed 5 times and saved in the database. Furthermore, the results of this photo will be compared to the original face when the attendance controlling is done. The student will bring his face to the camera to take a picture and system will compare the face to the stored database. If the face is suitable, it will be counted as a student who is present, and if it is not known, it will be counted as a student who is not present in the classroom room. Examples of these facial testing results is shown in table 1.

Table 1. The Result Detection Platform

| Test Data | Face Detection | Threshold Image | Test of Taget | Information |
|-----------|----------------|-----------------|---------------|-------------|
| 1         | Rudy           | Rudy            | Rudy          | Suitable    |
|           | Rudy           | Rudy            | Rudy          | Suitable    |
|           | Rudy           | Rudy            | Rudy          | Suitable    |
|           | Rudy           | Rudy            | Rudy          | Suitable    |
|           | Rudy           | Mangasa         | Not Suitable  |             |
| 2         | Hafiz          | Hafiz           | Hafiz         | Suitable    |
|           | Hafiz          | Hafiz           | Dhiwa         | Not Suitable|
|           | Hafiz          | Hafiz           | Hafiz         | Suitable    |
|           | Hafiz          | Hafiz           | Hafiz         | Suitable    |
| 3         | Cut Amalia Saffiera | Cut Amalia Saffiera | Cut Amalia Saffiera | Suitable |
|           | Cut Amalia Saffiera | Cut Amalia Saffiera | Lyli          | Not Suitable|
|           | Cut Amalia Saffiera | Cut Amalia Saffiera | Cut Amalia Saffiera | Suitable |
|           | Cut Amalia Saffiera | Cut Amalia Saffiera | Nita          | Not Suitable|
|           | Cut Amalia Saffiera | Cut Amalia Saffiera | Cut Amalia Saffiera | Suitable |
| 4         | Chyntia        | Chyntia         | Chyntia       | Suitable    |
|           | Chyntia        | Chyntia         | Kevin         | Not Suitable|
|           | Chyntia        | Chyntia         | Chyntia       | Suitable    |
|           | Chyntia        | Chyntia         | Chyntia       | Suitable    |

We have tested the existing faces and are not existing face in the database, results show that system can identify those faces that existing in the database, and vice versa. For example, the faces of students named Mangasa, Dhiwa, Lyli, Nita and Kevin was not recognized because his face was not yet extracted in the data base. But all of the students whose faces have been extracted in the database can be identified. The Example of Results Implementation of the student’s attendance system based on face recognition is shown in Figure 5.

![Figure 5. The example of student attendance](image)
5. Conclusions
From the results of this research that has been tested on the Computer Science department, Faculty of Computer Science and Information Technology, University of Sumatera Utara, can be concluded that the use of face recognition techniques with learning vector quantization algorithms (LVQ) has succeeded in accurately determining student attendance by comparing students present is photographed in real time to the data reference in database.

The system can accurately detect more than one face in a relatively fast time. To record the attendance of all students, it only takes 40 seconds time for a total of 50 students. This system has succeeded in recording students’ entry and exit time according to the time when their face was photographed. From the results of our experiments, we can also conclude that performance improvements in estimated time attendance are very significant if we compared to the traditional attendance systems.

References

[1] T. D. Russ, M.W. Koch, and C.Q. Little, 2004. “3D Facial Recognition: A Quantitative Analysis,” 38th Annual 2004 International Carnahan Conference on Security Technology.
[2] P.Sinha, B.Balas, Y.Ostrovsky, and R.Russell, “Face Recognition by Humans: Nineteen Results All Computer Vision Researchers Should Know About,”in Proceedings of the IEEE, vol. 94, Issue11, 2006.
[3] Y.-W.Kao, H.-Z.Gu, and S.-M.Yuan “Personal based authentication by face recognition,” in proc.Fourth International Conference on Networked Computing and Advanced Information Management, pp 81-85, 2008.
[4] Hagan, Martin T., Demuth,Howard B., Beale,Mark Hudson., Jesus, Orlando De 2014. Neural Network Design. Oklahoma State University.
[5] He, Ran dkk., 2017. Learning structured ordinal measures for video based face recognition. Elsevier Ltd : Amsterdam, Netherlands.
[6] Kohonen, Teuvo dkk., 2016. A program package for the correct application of Learning Vector Quantization algorithms. Helsinki University of Technology Laboratory of Computer and Information Science Rakentajanaukio 2 C, SF-02150 Espoo, Finland.
[7] Kumar, Gaurav dkk., 2016. Learning Vector Quantization Neural Network Based External Fault Diagnosis Model for Three Phase Induction Motor Using Current Signature Analysis. Cochin, India.
[8] Sato, Atsushi & Keiji Yamada., 2015. Generalized Learning Vector Quantization. Kawasaki, Japan. Information Technology Research Laboratories, NEC Corporation.
[9] Sharma, Abhilash and Gupta, Rajani., 2015. Iris Recognition Based Learning Vector Quantization and Local Binary Patterns on Iris Matching. Bhopal, Madhya Pradesh.