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Security Authentication for Student Cards' Biometric Recognition Using Viola-Jones Algorithm

S. Ibrahim, K.R. Jamaluddin and K.A.F.A. Samah
Faculty of Computer and Mathematical Sciences,
Universiti Teknologi MARA (Kampus Jasin),
77300 Merlimau, Melaka, Malaysia

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ABSTRACT

The unauthorized access to the university entrance could be gained by only flashinga student card. This unsecure situation shows the loophole of security authentication in a university. In order to overcomethis, a biometric recognition could be the most suitable candidate as itvaries uniquely from one person to another. A study on student cards' biometric recognition using Viola-Jones algorithm is presented as it is proven as a powerful algorithm in terms of superb detection rates and speed. It is done by comparing the facial structures and features between the student card's image and the card holder image, thus determining the similarity. The recognition performance is evaluated based on the percentage of similarity using 100 testing images of 50 students. The observation on results obtained the effectiveness of the Viola-Jones features in student cards' biometric recognition rate.

Corresponding Author:

S. Ibrahim,
Faculty of Computer and Mathematical Sciences,
Universiti Teknologi MARA (Kampus Jasin),
77300 Merlimau, Melaka, Malaysia.
Email: shafaf2429@melaka.uitm.edu.my

1. INTRODUCTION

The recognition of an individual by their attributes or traits refer to the biometrics, which offers automated procedures on the concept of measurable physiological or behavioral features [1]. The term 'bio' refers to biology where it involves the study of life and in this study, it refers to the human bodily features. As for 'metric', it is a term used for any kind of measurements. Biometric recognition systems utilize iris and retinal scan, an individual voice, facial feature similarities and facial thermograms and hand geometry even though the most favored are based on face recognition and fingerprint coordination [2].

Compared to the other species, human's faces are very diverse and unique [3]. Every human has a mouth, a nose, a pair of eyes and ears, and yet, everyone looks are entirely different. Some biometric modalities like fingerprints, iris, palmprints and some experiments include face and voice can be used whenever Deoxyribonucleic Acid (DNA) cannot discriminate between the twins [4]. One of them could have a bigger jaw, or have more wrinkles, or have a slightly bigger nose but none of them are totally the same. Since their genetic is indistinguishable, identical twins are more difficult to distinguish than unrelated persons [5].

Manipulation and deception are rather easy to execute upon the human components of the system [6]. People tend to be fooled even when they are focusing a lot. Differentiating an image on a student card with the acclaimed owner is sometimes confusing. Humans could trust their instinct in certain matters but not in the matters that involve security. A fitting system to overcome this is very much needed. As cited in [7], the base of a wide array of highly secure identification and personal validation is what to become of biometric recognition techniques.

A biometric recognition system could mathematically calculate the percentage of similarity between two or more subjects. Some of the facial features [8-9] that could be used to differentiate it would be the shape of the eyes [10], mouth, and nose, or the size of the jaw, or even the length of the forehead. Even though the structure of any individual's ridge patterns of the fingerprint exists consistently and will not have the absolutely same arrangement, facial structures and features would also be unique to distinguish different people for security purposes in general.

The unauthorized access to the university entrance could be gained by only flashing a student card.This does not only show how much of a loose security the university has but it shows how incompetent human judgments and perceptions could be. For a more secured access to the more secured environment, a better approach to security authentication is needed for a university. The biometrics recognition systems are proven to provide better user convenience for personal validation on restricted or protected access apart from ensuring a better level of protection for online and commercial applications [11].

Due to the non-intrusive, natural, and high throughput environment of face data fetching, automatic facial recognition (FR) has many advantages compared to other biometrics [12]. FR automatically distinguishes or identifies an individual from digital images or a video frame from a source as a computer application [13]. Without any unambiguous action or involvement from the user, FR can be done passively since their faces could be acquired from a distant camera [14]. It is also claimed that noise and slight variations in orientation, scale, and illumination can remunerate with a decent FR algorithm and an appropriate image pre-processing. FR records the spatial geometry of unique features of the face and it includes five stages such as (i) individual's face image extraction, (ii) locate face on image, (iii) facial image analysis, (iv) comparison and (v) matching results [13].

In another note, the Viola-Jones algorithm is proven as a powerful algorithm by the recent study due to its superb detection rates and speed [15]. The framework was done by [16] is mainly an object detection framework which was inspired and implied on the task of detecting faces. High frame rates were obtainable even by using information available in just a single greyscale image.

Thus, in this study, a biometric recognition of student cards' using Viola-Jones algorithm is proposed. The proposed study detects the facial structures and features between the student card's image and the card holder thus determining the similarity. The proposed study is expected to offer a new way to enhance the security system in universities.

The remainder of this paper is organized as follows. In Section 2, the research material and method used are discussed in detail. Section 3 presents the results and analysis of the testing results. Finally, Section 4 summarizes the conclusion and future work.

2. RESEARCH MATERIAL AND METHOD

In this study, the research method is divided into three parts which are the testing images, flow-chart and the face detection feature extraction using Viola-Jones Algorithm.

2.1. Testing Images

Hundred testing images of 50 students are tested in order to achieve the objectives of high accuracy recognition. Two types of input images of each student are acquired, which are the student image and the student card image as the sample in Table 1.

Table 1. Sample of Testing Images

No.	Student Image	Student Card Image
1.		
2.		
3.		
4.		

2.2. Flow-Chart

Figure 1 reveals the proposed overall process flow-chart. The overall process flow-chart begins with a face image input from the user upon the execution. The input image is obtainable through any kind of devices that produces image files with JPG or PNG format. The process continues by detecting the image input for any presence of face structures. Once a face structure is detected and confirmed, the facial features such as the position of the eyes and the size of mouth are extracted.

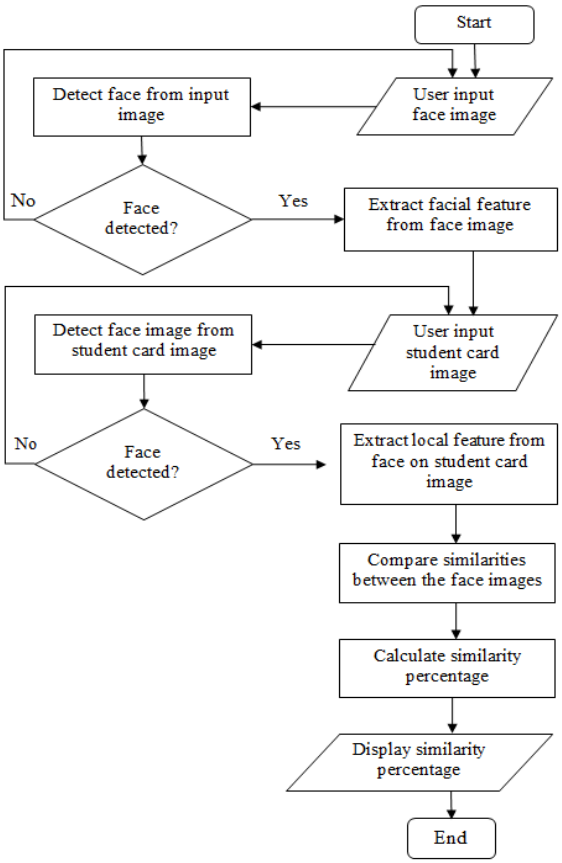


Figure 1. Overall Process Flow-Chart

Next, the process proceeds with an input of the student card image. Similarly, the face areas on the student card image are detected and the features are extracted. Finally, the facial features extracted from both images are then compared in order to calculate the similarity percentage.

2.3. Face Detection and Feature Extraction using Viola-Jones Algorithm

Viola-Jones algorithm is a local feature technique which categorized as a feature based technique. In this study, the Viola-Jones algorithm was implemented in both, face detection and feature extraction. After the user has uploaded both input images, the optimum threshold values are identified in which the Viola-Jones algorithm could detect the correct face area and hence, extract the features using the same algorithm.

Ordinarily, the human face was ciphered on the two-dimensional (2D) FR systems with the usage of either local or global texture attributes [17]. In this study, the usage of local texture attributes is implemented. Before ciphering the textural values of each element, local techniques, as in Figure 2, each value of the human face like eyes, nose, and mouth are firstly identified.

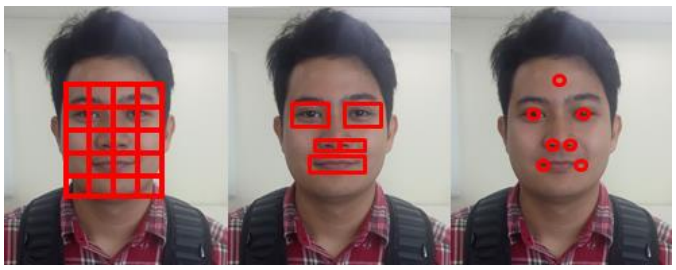


Figure 2. Example of Feature-Driven Local Technique

The Viola-Jones algorithm uses Haar-like rectangle features to construct the classifiers. It utilized a set of features resembling Haar Basis functions along with other filters that are more complicated than Haar filters itself [15]. An integral image was established to calculate said features swiftly and at variant scales. The integral image with any of these Harr-like features could be calculated with a small number of operations per pixel from an image and at any scale, accordingly. As the total number of Harr-like features is humongous, the learning process must ignore a big total of the available features thus concentrating on a little bunch of crucial features to assure fast classification.

Based on the value of uncomplicated features, the detected object images are categorized. There are various reasons which lead to utilizing these features instead of the pixels straightaway. There are five Haar features used in Voila-Jones algorithm. The features are depicted in Figure 3.

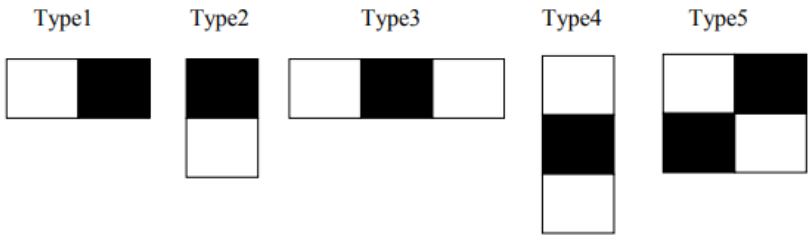


Figure 3. Haar Features Used in Viola and Jones

The Haar features could be of various height and width. It was applied to the input images and the total numbers of black and white pixels are identified. The difference values between the black and white pixels are then calculated. If the difference value is more likely in a specific region, then it represents a part of the face and is identified as face, eyes or mouth.

After the face is successfully detected, the features will then be extracted. These data are then overlapped and compared. It overlaps the detected and extracted features between the two input images and places a pinpoint at coordinates that it found to be similar. The specific coordinates of the first input image are represented in a cross-like point, while the coordinates of the second input image are represented in a circle point. If similar points between the two inputs are found but are far apart, it will display a line between the points that depicts the distortion distance between it, or vice versa.

3. RESULTS AND ANALYSIS

Hundred testing images of 50 students are tested in order to achieve the objectives of high accuracy recognition. The recognition performance is evaluated based on the percentage of similarity between the student cards' images and the image of the card holder. However, the performance of face and feature detection are observed beforehand.

The detection of the face and features were performed on all the testing images. The Viola-Jones algorithm was observed to successfully detected and extracted all the facial regions and features for both input types of the student cards' images and the image of the card holder. Table 2 demonstrates the sample of the Viola-Jones face and features detection.

Table 2. Sample of Testing Images

Image	Face Detection	Eyes Detection	Mouth Detection
			

Next, the percentage of similarity is calculated. The percentage of accuracy refers to the matching overlapped areas of the compared features. The percentage of similarity is calculated using Eq. (1) and Eq. (2), and Table 3 tabulates samples of testing images and percentage of similarity produced.

$$Overlapped = Image\ 1\ \cap Image\ 2 \quad (1)$$

$$\%\ of\ Similarity\ = \frac{Overlapped}{Image\ Total\ Pixels}\ x\ 100 \quad (2)$$

Finally, the results were observed and analyzed to magnify the performance of recognition. Table 4 shows the average of similarity percentage that recorded 75.48% of face similarity, 77.83% of the eyes regions and 87.02% of the mouth regions. The observation on results obtained in student cards' biometric recognition rate indicated the effectiveness of the proposed algorithm based on Viola-Jones features.

Table 3. Similarity Tabulation Sample of Testing Images

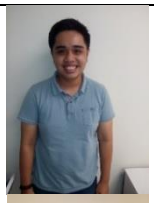
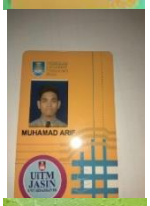
No	Student Image	Student Card	Percentage of Similarity (%)		
			Face	Eyes	Mouth
1			75.55	83.28	99.84
2			88.43	81.3	89.66
3			69.4	71.3	79.38
4			74.53	78.63	78.55
5			77.11	79.43	81.19
6			80.5	71.02	94.6

Table 4. Average of similarity percentage

Number of Images	Average Percentage of Similarity (%)		
	Face	Eyes	Mouth
100	75.48	77.83	87.02

4. CONCLUSION

This paper presents a study on student cards' biometric recognition using Viola-Jones algorithm. The Viola-Jones algorithm is proven as a powerful algorithm by the recent study due to its superb detection rates and speed. The proposed study detects the facial structures and features between the student card's image and the card holder thus determining the similarity. The percentage of similarity is measured to magnify the performance of recognition. From the testing performed, it is found that more than 70% averages of similarity are produced in face, eyes and mouth recognition respectively. Up to the present findings, further investigations may pursue on utilizing more facial features for comparison between inputs and a more thorough detection which utilizes a combination of algorithms.

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