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CLASS ATTENDANCE SYSTEM BASED-ON PALM VEIN AS BIOMETRIC INFORMATION

[1,2] SAHAR BAYOUMI, [1]AFNAN ALDAYEL, [1]MARIAM ALOTAIBI, [1]MUNEERA ALDRAIHEM, [1]SARA ALRASHED AND [1]SOROOR ALZAHRAHI

[1]Department of Information Technology, College of Computer Science and Technology, King Saud University, Saudi Arabia
[2]Asstt. Prof., Department of Information Technology, Institute of Graduate Studies & Research Alexandria University, Egypt

E-mail: [2]sahali@ksu.edu.sa

ABSTRACT

Information technology has been involved in many aspects of our lives. One of these aspects is involving technology in education that helps in improving the educational process. Attendance is an important factor that is used in different institutions and universities. So, it must be performed accurately. There are a lot of problems regarding traditional ways of taking attendance. Some of these problems are that it consumes a lot of time and effort. Therefore, we are working in developing a class attendance system based on palm vein as biometric information to solve the previous problems. Our project is based on using infrared camera that captures a student's palm vein image when placed in front of the camera. After that, process the image to extract biological palm vein data that is unique. The extracted biological feature is then compared with previously stored features in the database which allows us to mark student as attend.

Keywords: *palm vein, authentication, PCA, attendance, Euclidean distance.*

1. INTRODUCTION

As we know, Information Technology is playing a vital role in all aspects of our lives. It has increased dramatically in the past ten years or more. To keep up with that speed we have to involve it in every aspect of our lives in order to be ahead of other nations in this world. Attendance is considered an important and essential factor especially in critical institutions. It shows disciplined people, it forces people to attend. Also, it is very important in case critical situation has occurred. Biometric technology is the science of identifying people. The term "biometrics" is derived from the Greek words bio (life) and metric (to measure). For our use, biometrics refers to technologies for measuring and analyzing a person's physiological or behavioral characteristics. These characteristics are unique to individuals hence can be used to verify or identify a person [1].Some examples of different Biometrics are Face, Fingerprint, Voice, Palm print, Hand Geometry, Iris, Retina Scan, Voice, DNA, Signatures, Gait, and Keystroke [1].There are many applications that use biometric concept such as Mobile Biometrics; it is becoming a necessity to implement systems that can deliver the demands of our global economy. Governments and industry are turning towards mobile biometrics to meet this need and challenge. On the other hand Biometrics in Healthcare is becoming a necessity to solve the mistakes that are committed within our healthcare system these days [2]. We can expose this improvement of biometric technology to break daily routines such as taking attendance at work, universities, school, courts and companies. Most of these places capture attendance data manually where lots of time and efforts are wasted. Now, we will focus on our paper to solve these problems by involving technology and capturing attendance data automatically. Our system will mainly focus on designing and implementing class attendance based on Palm vein concept using PCA. We strongly believe that such a technology will be most efficient in capturing all students' attendance when they come to school or they attend any lab or any activity within their campus.

2. RELATED WORKS

In 2013, Al-Juboori et al. discussed in their paper personal authentication based on the extracted palm vein features. The authors had performed an experiment which passes through the following steps. First, the authors enhanced the palm vein

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images using histogram equalization. Then, they used Gabor filter to extract the feature vector and Fisher Discriminated Analysis (FDA) to get best features for verification. Finally, the authors used Nearest Neighbor classifier to classify the taken images in the database. According to the performed experiments, the false acceptance rate result was 0.2335%. [3]

In 2014, Bhosale et al. used three different algorithms -as steps- to process Palm Vein Pattern Image of an individual. These algorithms are Pattern Marker Algorithm that transforms the image into Gray scale Pattern, Pattern Extractor Algorithm that transforms the image into Threshold Pattern and Pattern Thinning Algorithm which transforms the image into Thinned Pattern. The Authors recommended these algorithms for authentication. [4]

In 2012, Damavandinejadmonfared et al. compared in their paper between three different methods PCA, KPCA and KECA. Experiments proved that KPCA as a feature extractor achieved the higher accuracy in all different experiments (100% accuracy). The authors conclude that KPCA is not only the most appropriate method in comparison to other methods, but also it is the efficient enough to be used in finger vein recognition. [5]

In 2011, Yang et.al discussed Gabor filters method elaborately in their paper .Gabor filters used for personal identification based on finger-vein recognition. The authors analyzed the underlying characteristics and combined both global and local finger-vein features together to construct a finger-vein code (FVCode) for feature matching. For reliability improvement, cosine similarity measure classifier and a fusion scheme in decision level is adopted. Experimental results showed that the Gabor filters method performed well in personal identification. [6]

In 2012, Yang et.al proposed in their paper a new finger vein recognition method based on $(2D)^2$ PCA as a feature extractor and metric learning. Experiments showed that the proposed method is effective by achieving a recognition rate of 99.17%. [7]

In 2001, MartõÂnez el al. illustrate in their paper different appearance-based methods which are used for object recognition systems. These methods are PCA and LDA which are used in many applications as face recognition. According to the performed experiments, PCA has been proven to outperform LDA in the case of using small number of samples per class or when the training data non-uniformly sample the underlying distribution. [8]

3. PROBLEM DEFINITION

Attendance is an important topic to achieve discipline in work environment but using the traditional manual ways has some problems. One of these problems is that it consumes effort and time. For example, in universities instructors take attendance by calling each student individually to check whether she/he attends or not. Also, attendance can be taken using cards that identify each person by scanning its bar code. Both of the ways can lead to impersonation and loosing of rights. For example, two friends hiding each other absence by claiming that they are the intended person using each other cards. Another way of taking attendance is using biometric based systems. Taking attendance using biometrics has many different techniques such as finger print, voice and face biometrics and Iris recognition system. Finger print technology has some unsolved problems such as stealing someone else finger print and faking it using Silicon fingers. Also, finger print can be affected by cuts, dirt and burn. Voice biometric systems can be affected by illness and it can be recorded. Face biometric systems are inaccurate when someone wears a mask or make cosmetic surgeries. Iris recognition systems are not preferable to people because of the direct application of light into their eyes [9].Palm vein pattern has a high level of accuracy due to the uniqueness and complexity, the pattern of blood veins is unique to every individual, even among identical twins. Palms have a broad and complicated vascular pattern and thus contain a wealth of differentiating features for personal identification. Furthermore, it is a very secure method of authentication because this blood vein pattern lies under the skin. This makes it almost impossible for others to frog or resembles someone's identity [9].

4. PROPOSED SOLUTION

Due to the previous problems we are proposing in this project to design and implement class attendance system based on palm vein as biometric information.

- The system work by identifying the subcutaneous (beneath the skin) vein patterns in an individual's hand. The process starts with a user placing his/her hand in front of an IR camera which capture images show maps of veins. Figure 2 shows a schematic of the imaging module.

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- The red blood cells – hemoglobin – going throw the veins will grip the rays and be presented on the map as black lines while the remaining hand structure will appear white.

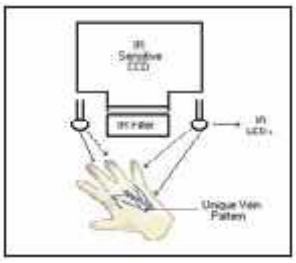

Figure1.Schematic Of A Hand Vein Pattern Imaging Module[9]

The process of authenticating a user via his/her palm consists of the following steps:

- Acquiring the image: where the user places his/her hand on a scanner or a camera where his/her vines pattern will be captured using a completely safe near-infrared light.
- Pre-processing tasks: contrast, brightness, edge information, noise removal, sharpens image, etc.
- Extraction of the pattern: This is unique for each user.
- Matching and recognition: comparing the captured image of the user's palm against the one that is stored in the database – one to many matching- as illustrated in Figure 3.

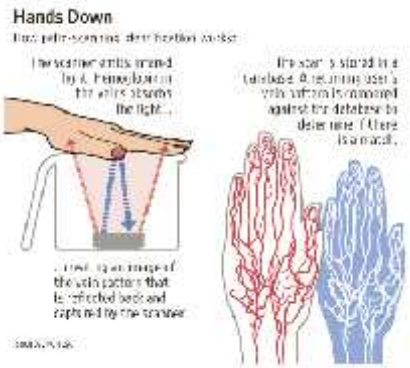

Figure 2. Authenticating A Person With His/Her Palm One To Many [9].

Using this system will prevent people from stealing others identity because it is based on the internal structure of the hand [10]. Also, it will save the time and effort .In addition to decreasing the risk of having errors of attendance process.

5. DEVELOPMENT ENVIRONMENT

Visual studio 2010: Microsoft's Visual Studio 2010 is an integrated solution for developing, debugging, and deploying all kinds of applications. We used it in our project to develop the system (The admin, student and instructor pages).
Matlab R2008a: is a multi-paradigm numerical computing environment and fourth-generation programming language. We used it in our project to process the image and extract its biometrics features based on PCA that are used for registering students and taking their attendance.
My SQL and PHP my admin: My SQL: is an open-source relational database management system (RDBMS) PHP my admin: is a server-side scripting language designed for development. We used them to develop the database to store the student, admin and instructor different information.
Palm secure (introduction tool): it's a palm vein scanner. We used it in our project to capture the student's palm vein for registration and taking their attendance.

6. IMPLEMENTATION:

6.1 Graphical User Interface:

System components: (Admin, Student and Instructor)

In the login page user has to choose user login type, whether she/he is admin, instructor or student.

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- ***Admin main components***

1. Control Panel

Admin is allowed to accept or reject instructor registration through its control panel

2. Assign instructor to a course

3. Student Registration

4. Add student to a course

- ***Instructor main components:***

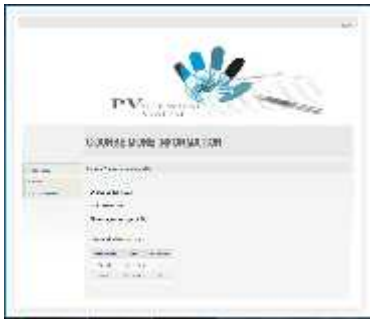
1. Home page

2. Student attendance

✓ ***Student main components:***

1. Add new course

2. Class attending



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3. Remove course

6.2 Feature Extraction:

The developed system used PCA for extracting biometric features from captured palm vein images. Figure 3 show steps followed in extracting features from palm vein images.

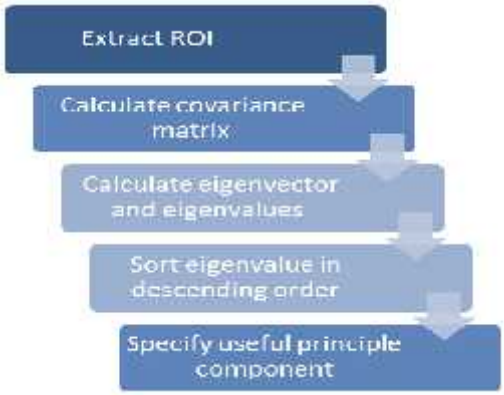

Figure 3: Feature extraction using PCA

- ✓ Extracting the region of interest "ROI": captured image (Figure 4) was dimensioned 480x640 which contains non-interesting data that can increase the complexity of PCA calculations. A region of Interest specified that contain the most important information with dimension 201x201.
- ✓ Calculating the covariance of the matrix.
- ✓ Calculating the Eigen values and eigenvectors for covariance matrix.
- ✓ Sorting eigenvalues in descending order.
- ✓ The output from the above steps is basically a huge vector (201*201) which shows how much Eigen vein a certain image has, however we can reduce this vector by choosing an appropriate number of useful eigenvectors (K) that can represent image features taking into consideration not to lose any unique features in the process.

Original Image *ROI*

Figure 4: Image captured by Infrared camera

In order to specify K, we run a test on five sample images to study the percentage of information represented in each eigenvector. Results showed that 95% of the image information is concentrated in the first two eigenvectors.

7. RESULTS:

For classification, Euclidean distance measure used to find the nearest similar pattern. Results showed that 76 % of students were classified successfully, 78.95 % of them were classified from the first attempt. Table 1 show Euclidean distance measures for sample of 5 images for different students.

- The students who were not attended from the first attempt but correctly in the second, they mainly were not adjusting their hands correctly.
- The students who were not attended in the two attempts, the infrared camera does not detect their veins clearly.

Table 1 Euclidean Distance Of 5 Samples

	1	2	3	4	5
1	0.8048	0.8551	1.9261	1.5718	0.6687
2	0.7064	0.7849	1.9268	1.4894	0.5589
3	0.9446	1.2248	1.8187	1.5069	1.1563
4	1.6182	1.5411	1.3224	1.9759	1.8447
5	0.9729	1.0560	1.8169	1.3411	0.3032

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8. SOFTWARE IMPACT

✓ Global Impact

As far as biometrics concerned and according to a report done by Professor Young-Bin Kwon in 2009, world market size of biometrics is around 3,422 M$(USD) and expected growth till 2014 is about 22.3%, these numbers derive us to believe the world is moving towards relaying on biometrics.

Talking specifically about veins recognition , it rather consider to be a new technology comparing with older methods such finger print , though it's modernity did not stop this technology of showing a promising future on the charts , IBG's Biometrics Market and Industry Report 2009-2014(it is the industry's most comprehensive, extensive and Authoritative analysis of biometrics technologies) shows Vein Recognition Systems with a percentage of 2.4% declaring an industrial interest rather than only being a subject of lab research [11], [12]. Similar projects to ours are used now in critical environment, such as keeping track of attendance in universities and companies , for example in Australia , some companies use Time Target to keep track of time and attendance by scanning their hands to start their work day .

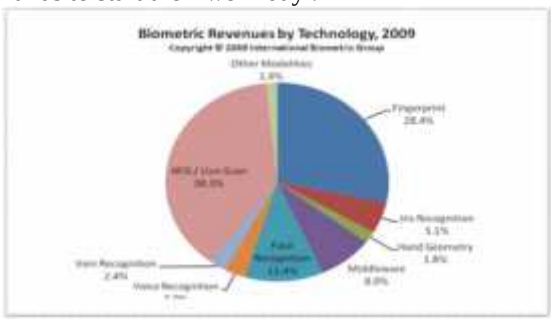

Figure 3 Biometrics revenues by Technology [13]

✓ Local Impact

Palm vein technologies are one of the upcoming technologies in the world, which are highly secure and having high accuracy. And it is the world's first contactless personal identification system that uses the vein patterns in human palms to confirm a person's identity. So If the Saudi Arabia's universities use Palm vein technologies to control attendance for facility member and student this will be easier, faster and more accurate and fairest[12].Most of the companies here in Saudi Arabia who uses the biometric technology use finger print for access controls or attendance. For example King Abdul-Aziz City for Science and Technology use finger print for attendance [14]. Also Al-Obeikan education Company uses finger print for access door.

9. CONCLUSION

We proposed a system for attendance using palm vein as a biomedical features based on Principal Component Analysis (PCA). In our system, we used PCA to discriminate the variances between the image features instead of between the whole training set. Our system was able to identify 70% of the unknown patterns in real-time which considered good results regarding to the local PCA features. As a future work, we are planning to improve the system accuracy by generating more features and enlarge the training set.

10. REFRENCES:

[1] Marios Savvides. *"Introduction to Biometric Technologies and Applications"* ECE & CyLab, Carnegie Mellon University

[2] *"Find Biometrics Global Identity Management"* Northstar Recruiting. URL: http://findbiometrics.com/applications/

[3] Al-Juboori , Bu, Wu and Zhao *"Palm Vein Verification Using Gabor Filter"* IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 1, No 1, January 2013.

[4] Bhosale1, Kale, Pawar, Patil, Patil and Madankar. *"Palm Vein Extraction and Matching For Personal Identification."* IOSR Journal of Computer Engineering (IOSR-JCE) Volume 16, Issue 2, Ver. IX (Mar-Apr. 2014), PP 64-68.

[5] Damavandinejadmonfared, Mobarakeh, Pashna, Rizi, Nazari, Khaniabadi and Bagheri. *"Finger Vein Recognition using PCA-based*

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Methods". World Academy of Science, Engineering and Technology Vol:6 2012-06-25.

[6] Yang,Shi and Yang. "*Personal identification based on finger-vein features"*. Computers in Human Behavior. Volume 27, Issue 5, September 2011, Pages 1565–1570.

[7] Yang ,Xi and Yin. *"Finger Vein Recognition Based on (2D)2 PCA and Metric Learning"*. Journal of Biomedicine and Biotechnology Volume 2012, Article ID 324249.

[8] MartõÂnez. "*PCA versus LDA*". IEEE transactions on Pattern Analysis and Machine Intelligence, Volume:23 (2), Feb 2001.

[9] IshaniSarkar, FarkhodAlisherov, Tai-hoon Kim, and Debnath Bhattacharyya.*" Palm Vein Authentication System: A Review"*, int. Journal of Control and Automation .Vol. 3, No. 1, March, 2012 .

[10] Masaki Watanabe, Toshio Endoh, MoritoShiohara, and Shigeru Sasaki . *"Palm vein authentication technology and its applications"* The Biometric Consortium Conference, Virginia , USA, 2005.

[11] Pierre-Olivier Ladoux, Christophe Rosenberger, Bernadette Dorizzi.*" Palm Vein Verification System based on SIFT matching"*, 3rd International Conference in Advances Biometrics ICB 2009, Alghero, Italy, June 2-5, 2009.

[12] Asmita Rajawat , M.Hanmandlu and Shuchismita Pani .*" Fuzzy Modeling Based Palm Print Recognition System "* International Conerence on Emerging Trends in Electronic and Photonic Devices & Systems (ELECTRO-2009), India , 2009.

[13] Sahar Bayoumi; Ghada Alsebayel; Sara Alzahrani; Sulaf Almagoshy; Afnan Sheikho and Sara Alsayigh. *" PCA-Based Palm Vein Authentication system"*. ICISA2013 The 4th International Conference on Information Science and Applications, June 24-26, 2013, Hilton Pattaya Hotel, Thailand.

[14] King-abdulaziz city for science and technology. "*Brocade Helps KACST Deliver High-Performance Connectivity to Global Network of Universities and Research Agencies*." http://newsroom.brocade.com/press-releases/brocade-helps-kacst-deliver-high-performance-conne-nasdaq-brcd-0937287.