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Contactless Palmprint Recognition using Deep Learning Technology

Salam Jabbar Abdu-al Kadhm , Taha Mohammad Hasan

Department of Computer Science – College of Science – Diyala University

salamalami54@gmail.com

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Abstract

The interest of researchers in the subject of biometrics has increased, which has opened new horizons in people identification systems, and one of these measurements is the contactless palm print. Identification of people through a contactless palm print is very important in the process of identifying terrorists and criminals whose faces are often covered. Therefore, a contactless palm print recognition system has been proposed through two pre-processing methods using a neural network. A Contrast Limited Adaptive Histogram Equalization (CLAHE) filter was used in the first processing of the data stage as well as the normalization method. The system was applied to several databases, including the standard Indian Institute of Technology Delhi (IITD) ones, and those collected from the Computer Department, College of Science, University of Diyala, After the process of data division, training and testing, the proposed system reached satisfactory results compared to previous work, and the accuracy was 99.95.

Keywords: Contactless Palmprint, Image, Biometrics Techniques, Deep Learning, Recognition.

التعرف على بصمة الكف بدون تلامس باستخدام تقنية التعلم العميق

سلام جبار عبد الكاظم و طه محمد حسن

قسم علوم الحاسوب – كلية العلوم - جامعة ديالى

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الخلاصة

زاد اهتمام الباحثين بموضوع القياسات الحيوية، مما فتح آفاقًا جديدة في أنظمة تحديد الأشخاص، ومن هذه القياسات بصمة الكف بدون تلامس. يعد التعرف على الأشخاص من خلال بصمة الكف بدون تلامس أمرًا مهمًا للغاية في عملية التعرف على الإرهابيين والمجرمين الذين غالبًا ما تكون وجوههم مغطاة. لذلك، تم اقتراح نظام التعرف على بصمة الكف بدون تلامس من خلال طريقتين للمعالجة المسبقة باستخدام شبكة عصبية. تم استخدام مرشح CLAHE معادلة الرسم البياني التكيفي المحدود على التباين في المعالجة الأولى لمرحلة البيانات بالإضافة إلى طريقة التطبيع. تم تطبيق النظام على عدة قواعد بيانات منها المعهد الهندي للتكنولوجيا المعياري دلهي (IITD) ، وتلك التي تم جمعها من قسم الحاسوب ، كلية العلوم ، جامعة ديالى ، بعد عملية تقسيم البيانات والتدريب والاختبار ، تم اقتراح حقق النظام نتائج مرضية مقارنة بالأعمال السابقة ، وكانت الدقة 99.95.

الكلمات المفتاحية: بصمة الكف، الصورة، تقنيات القياسات الحيوية، التعلم العميق، التعرف

Introduction

The contactless palm print has gained confidence on a wide level to identify people in many widespread systems, so the researchers' interest in it increased. The palm print identification technology has been developed and tested on a range of image resolutions (high and low). Biometric solutions for palmprint recognition and security systems have recently gained popularity [1]. Sir William Herschel used handprint recognition for the first time in 1858, when he registered the prints of Indian government personnel under his supervision and compared them to new samples collected on paydays to confirm identity [2]. The process of distinguishing the palm print is of high accuracy because it contains many features. Previous researchers indicated important results through deep learning and distinguishing inherent features by inserting filters on the data [3]. The process of palm print recognition based on the convolutional neural network (CNN). Algorithm is accomplished in the proposed system. It is possible to increase the security of personal information due to the results it has achieved and its high accuracy, and it can be used instead of other biometric techniques and in many applications that depend on identifying people through biometric technology. The proposed system can classify and distinguish the contactless palm print using the CNN algorithm and detect people who cover their faces and identify them by the palm print. Through the database people can be

identified by the search and matching process for identification through palm print. The aim of this project is to identify criminals and terrorists through the contactless palm print, and among the contributions is to create a contactless palm print database and include it in the system, extract the results and compare them with the results of the standard database.

Related Works

In this part, some of the previous work of researchers on contactless palm print has been reviewed.

Table1: Related Works

RE	AUTHOR	YEAR	CONTRIBUTION	DATABASE	RESULT
[4]	Raouia Mokni, Monji Kherallah	2016	The three descriptors Presented a method for identifying people for use in forensic medicine. The method of was used to extract the palm print by three descriptor: radius of mass methods of intersection counting box System using KNN, SVM	IITD CASIA	Accuracy= 95.58
	S. Kaushik &R. Singh	2016	A hybrid solution was presented by integrating 2D-LPF, PCA, and Gabor filter methods. The suggested technique improves accuracy while reducing complexity in palm print identification. but also demonstrates a technique for decreasing the complexity associated with palm print recognition systems based on PCA.	Not define the name	Accuracy= 99.0
[6]	Bilal Attallah, Amina Serir, Youssef Chahir	2017	Generating Ultra-informative Features to Increase Accuracy DiscreteWavelet Transforms Extraction of the Feature Code	IITD PolyU	Accuracy= 98.17

			Matching Features Map Using PCA		
[7]	A. Younesi &M. Amirani	2017	A new approach to personal identification based on palmprints was shown. This was accomplished by first extracting the ROI of the acquired palmprint and then sending it to the Gabor filter bank, which consists of four filters. We extracted textural information from phases using the BSIF technique. The final BSIF code is created by linearly concatenating the four BSIF codes with equal weights. After obtaining the normalized histogram of the BSIF code, six characteristics were extracted from it. Finally, people were identified using the KNN classifier.	Polytechnic University (PolyU) palmprint database	Accuracy= 99.27in dataset 1 And Accuracy= 99.81 in dataset 2
[8]	L. Zhang. Et al	2018	PalmRCNN, a DCNN-based system, has been proposed as the first DCNN research in the field of contactless palmprint/palm vein recognition. At the feature extraction step, we utilized a modified Inception ResNet v1 to extract deeper valuable traits that can subsequently be used for identification or verification. We train an SVM classifier for identification using feature vectors obtained by a modified Inception ResNet v1 network. For verification, we employ the Euclidean distance between the feature vectors of the two palms under study.	benchmark datasets	Accuracy= 100 Erro= 2.74
[9]	Zhou, Kaijun;	2019	Double Transform Network	IITD PolyU	Accuracy= 94.79

	Zhou, Xiancheng		Extract the image edge Builds two convolution layers by CNN	CASIA COEP	
[10]	H. Shao. Et al	2019	A suggested transfer autoencoder is proposed for cross-domain palmprint recognition. The transfer autoencoder is composed of two convolutional autoencoders and one discriminator. Convolutional autoencoders build on the basis of linear autoencoders by including convolutional layers and pooling layers. By optimizing the reconstruction loss, discriminative low-dimensional features are retrieved and information loss is minimized. The discriminator acts as a link between the source and target domains, allowing for the extraction of the same feature distribution in both.	Multispectral palmprint database	Accuracy= 99.90
[11]	A. Verma&P. Tiwari	2020	By utilizing KNN, scientists created a simple and effective method for improving the precision of the palmprint's orientation attribute.	collected data	Accuracy= Not definition
[12]	Zhao, Shuping; Zhang, Bob	2020	Deep Discriminative Representation (DDR) to Palmprint Identification This method is based on the extraction of multiple deep features using DCNN	IITD CASIA	Accuracy= 98.70
[13]	M. Manoj& S. Arulselv	2021	Proposed Because biometric properties of people fluctuate depending on the person and are difficult to guess, the biometric security system has improved the security	collected data	Accuracy= Not definition

			of systems or applications. Print identification is one of the most common biometric system approaches. Matching is also done with machine learning classifiers. Palm prints are matched using a KNN classifier in this proposed method.		

Problem Domain

The system addresses a problem, which is the inability of the surveillance cameras, the security services, and the security authorities to identify the criminals who cover their faces, so the system was proposed to identify the criminals through the palm print.

The Aim

Establishment of a system to identify people through a contactless palm print

Contribution

Create a database that is collected from students at the university and is trained and tested through the proposed system. Adopting a new method to identify the contactless palm print, the first of its kind in Iraq.

Palmprint Datasets

In the following table, the most important standard palm print databases available on the Internet will be summarized.

Table 2: Dataset in Palmprint

NO	Refers	Name	year	Details
1	[14]	CASIA Multi-Spectral Palmprint Image Database	2008	It has an 8-bit gray level and contains 7,200 palms from 100 participants, each with 72 samples and a 768x576 pixel image.
2	[15]	CASIA Palmprint Image Database	2005	It's an 8-bit grayscale image with 5505 palms taken from 312 participants with a 640x480 pixel resolution.

3	[16]	PolyU Multispectral Palmprint database	2001	It is a collection of color photographs of 6,000 palms obtained from 250 people, each with 24 samples.
4	[17]	PolyU palmprint database v1.0	2011	It's a grayscale one channel image with 600 palms obtained from 100 participants, each with 6 samples, and a 384x284 pixel image size.
5	[18]	PolyU palmprint database v2.0	2014	It's a grayscale image with 7752 palms obtained from 386 participants, each with 20 samples, and a 384x284 pixel image size.
6	[19]	KVKR-Palmprint Database	2015	It is a color photograph of 900 palms obtained from 150 participants, each with 6 samples, and has a 640x480 pixel image size.
7	[20]	IIT Delhi Touchless Palmprint Database	2008	It have JPG 2601 palm print 1200x1600 pixels and a bitmap image with 3290 palms obtained from 235 participants. Each subject has 14 samples with image sizes ranging from 150x150 to 800x600 pixels.
8	[21]	National Palm Print System	2019	The NPPS repository has about 15 million distinct palm print identities and over 29 million individual palm prints associated with those identities, all of which can be used as investigative leads.
9	[22]	COEP Palm Print Database	2021	It consists of eight distinct photos of a single individual's palm. The collection contains 1344 photos of 168 individuals. The database was compiled over the course of a year. The photos are labeled with the IMG person number suffix (image number). For example, jpg IMG 001(1). The photos have a resolution of 1600 x 1200 pixels. The "Rajiv Gandhi Science and Technology Commission" is funding the initiative.
10	[23]	The Tsinghua Palmprint Database	2016	This collection comprises 1,280 palmprint photos of 80 people (two palms per subject and eight impressions per palm), which were collected using a Hisign commercial palmprint scanner. All palmprint photos are 2040x2040 pixels at a resolution of 500 pixels per inch.

Proposed System

This proposed palm print discriminating system was created using a deep learning network. A method has been added to detect and recognize the palm print, which consists of three basic stages: First: Pre-processing, which includes resizing the image and normalizing it to the matrix. It also has a Contrast Limited Adaptive Histogram Equalization (CLAHE) filter added at this

point. Second: Recognizing the palm print using the CNN algorithm. Third: The results of the system testing phase. The main components of the system are shown in Figure (1)

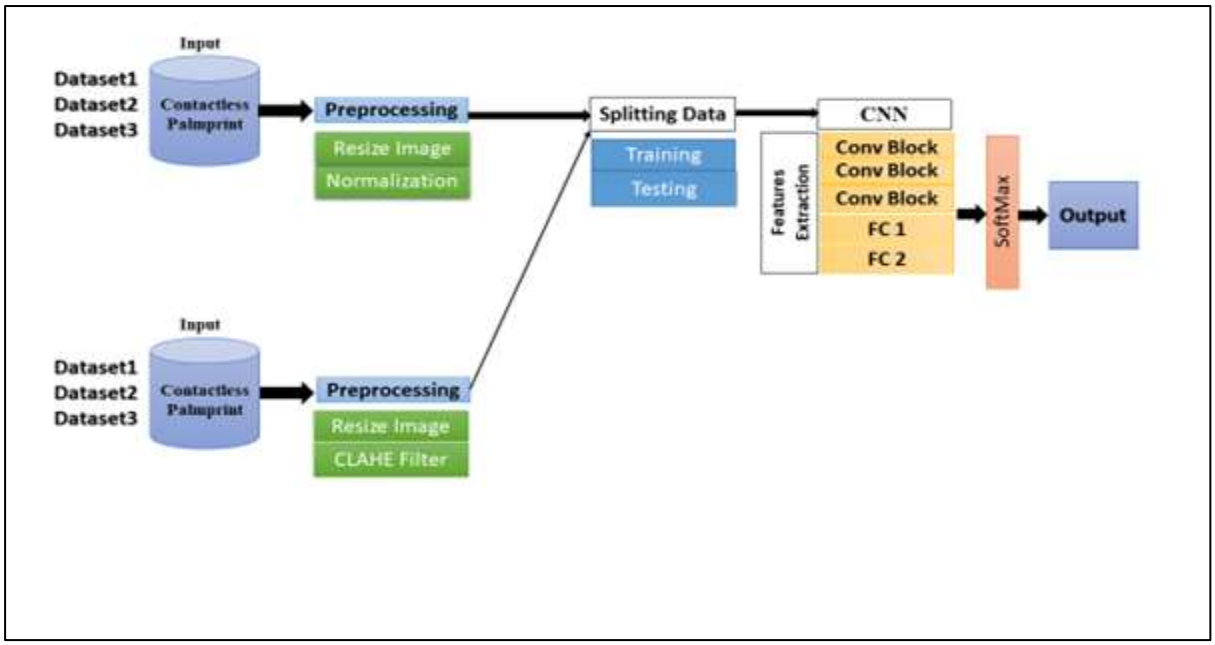

Figure 1: The Proposed System

Through the figure above, the system works by entering the data set and going through the processing in two stages, then the stage of dividing the data for training and testing and entering the convolutional neural network.

Result

After the data was randomly divided through the CNN algorithm 80% to training and 20% testing and the data was entered into the proposed system, the following results were obtained.

Table 3: The Evaluation Criteria of the CNN Algorithm.

Dataset Name	Epoch NO	Loss	Accuracy	Precision	Recall	F1_Score
IITD	15	0.0043	0.9995	0.9995	0.9995	0.9995
Collected	15	0.0055	1.0000	1.0000	1.0000	1.0000
Merge	15	0.0053	0.9993	0.9993	0.9993	0.9993

The previous table shows the accuracy obtained through the testing process, where the accuracy reached 99.95 for IITD dataset, collected dataset the accuracy reached 100 and merge dataset accuracy 99.93.

Conclusion

Through the proposed system, satisfactory and good results were reached compared to the previous researchers, as it was done through the algorithm that the high results are not achieved by increasing the number of layers. As the pretreatment played an important role in accuracy through the normalization process and the addition of the CLAHE filter led to acceptable results. The system can be modified in future works by adding a type of protection, and it can also be developed to be an application on smart phones.

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