



Fingerprint Recognition System: A Systematic Literature Review

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<i>Abstract</i>	
	<p>The biometrics system is mainly focuses on fingerprint recognition and how this system would be implemented. If it is implemented in research area, this system would authenticate or contradict the uniqueness of each individual endeavouring to gain access to the research region with a given sum of precision. The method of authenticating a person's identity through a comparison of their fingerprints with previously captured samples is known as fingerprint recognition. Human finger impressions in the form of ridges and grooves are called fingerprints. The minutiae points, or the places where scars start or end, are used to locate fingerprints stored in the system. To create a minutiae template, these are further mapped with lines connecting them. An additional key challenge of this will understand the methods used to analysed the information from the scan. There are several different methods has been implemented by different researchers for the fingerprint recognition system. In this paper the literature of the different approaches are discussed.</p>
CC License CC-BY-NC-SA 4.0	Keywords: <i>Fingerprint, biometric system, Fingerprint recognition, Fingerprint Identification System.</i>

I. INTRODUCTION

Modern security techniques involve passwords that are not precise and necessary to safeguard personal property; so, a biometric recognition system was employed. A fingerprint is a combination of numerous ridges and valleys on the surface of fingerprints. Ridges are indicated by black lines, while valleys are indicated by white lines. Human biometrics are divided into two groups. The first biometric behavior and second is biometrics related to physiology.

Each and every person has unique biometric traits that can be used to identify them. The four basic processes or internships in the fingerprint biometrics system are: collection, extraction, comparison, decision-making, validation, and identification. The fingerprint recognition system (FRS) compares an individual's fingerprints to those in the database in order to identify the people whose records are stored in the database. For the first time, in 1899, Galton investigated whether it would be feasible to identify newborns using a fingerprint recognition system. Children as young as 2.5 years old may also be identified using fingerprints [6].

Automated fingerprint identification systems, or AFSs, are a common and accurate method for identification and duplication of fingerprints (1:N search) and authentication (1:1 match) that are now used worldwide. The capacity of fingerprint recognition technology to accurately identify people is a modern convenience. A crucial application such as forensics, international border crossing, financial transactions, and computer security. This paper deals with review of literature on various features of fingerprint like minutia extraction, fingerprint enhancement, feature extraction.

The paper is organized as Section I is introduction section where as Section II is the Review of Literature, section III is conclusion and future work of study and section IV addresses the different references of the study.

II. REVIEW OF LITERATURE

In "A Study of Age and Ageing in Fingerprint Biometrics," Javier Galbally, Rudolf Haraksim, and Laurent Beslay (2012) [1] address the challenging 9 problem in the field of fingerprint recognition and offer some fresh perspectives on how the passage of time impacts fingerprint-based technology.

In the operational condition, a dataset for the examination of age and the ageing effect on fingerprint was collected by collecting fingerprints from people between the ages of 0-25 and 65-98 throughout varying time intervals, i.e., 0-7 years. Therefore, the proposal sheds some new light on issues like fingerprint quality and permanence.

Shimon K. Modi, Prof. Stephen J. Elliott, Jeff Whetson, Prof. Hakil Kim (2007) [2] in "Effect of Age Groups on Fingerprint Recognition" examines the effect of fingerprints of different age groups such as 18-25, 26-39, 40-62, and 62 and older on quality level, detail, and detail-based matching efficiency. Experimentally, the result shows the difference in image quality between different age groups, which is most evident in those aged 62 and older. And also know that fingerprint image quality is not the same between age groups.

Shunshan li, Min Wei, Haiying Tang, Tiange Zhuang and Michael H. Buonocore, (2005)[3] "Image Enhancement Method for Fingerprint Recognition System". Proceedings of the 2005 IEEE, Engineering in Medicine and Biology 27th Annual Conference, Shanghai, China, 1-4. September, page no. 3386-3389, proposed an image enhancement method for a fingerprint recognition system. This paper introduces a fingerprint image enhancement method, a complex Gabor filter. This enhancement method can be used to connect brush fractals, provide maximum gray values located in the center of the brush and be able to compensate non-linear deformations. It includes brush orientation estimation, Gabor filter processing, and refined Gabor filter processing. The first Gabor filter reduces noise, gives a more accurate distance between two brushes to the next filter, and obtains a rough brush direction map, while the advanced Gabor filter with its adjustment parameters significantly improves the brushes, merges the brush break and ensures a maximum. gray the values in the image are in the center of the brush. In addition, the algorithm has the ability to compensate for non-linear deformations. In addition, this method does not lead to a false structure, which avoids unwanted side effects in the post-processing and ensures reliable fingerprint image processing for the fingerprint recognition system. In other words, an advanced Gabor filter is used to process the fingerprint image, resulting in a good quality fingerprint image and improved performance of the fingerprint recognition system.

Wang Yuan, Yao Lixiu, Zhou Fuqiang, (2007) [4] "Real-time fingerprint recognition system based on a new fingerprint matching strategy." In the 8th International Conference on Electronic Measurement and Instrumentation, ICEMI proposed a real-time fingerprint recognition system based on a new fingerprint matching strategy. In this paper, they present a real-time fingerprint recognition system based on a novel fingerprint detailed matching algorithm. The system is designed to be compatible with today's embedded fingerprint recognition systems that use small area sensors. The proposed system includes fingerprint quality control, enhancement, feature extraction, matching with a new type of fingerprint matching algorithm, and integration with other identification systems. Here, they describe their approach to developing a more reliable and faster fingerprint recognition system based on modern and reliable embedded systems using small-area fingerprint sensors. An experiment on the FVC database shows that our system performs better than the
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benchmark. And because of these effective image correction and matching techniques, it can also provide real-time and high-reliability detection result.

Madhuri and Richa Mishr (2012) [5] proposed a paper "Fingerprint Identification Using Robust Local Features", according to them there are many fingerprint based human identification techniques. Most of these techniques use details to represent and match fingerprints. These techniques are not rotation invariant and fail to match human recorded images to a rotated test image, and such techniques do not match partial fingerprint images. This paper proposes a fingerprint recognition technique that uses local robust features to represent and match fingerprints.

Sangram Bana and Dr. Davinder Kaur [6] proposed a paper, "Fingerprint Identification Using Image Segmentation", which defines the research and implementation of a fingerprint identification system based on Minutiae-based matching methods. This approach mainly involves extracting distinctive features from sample fingerprints and then matching the fingerprints based on matching the details of the two fingerprints in question.

R.Kala*, Dr. A. Thilaka [7] wrote a paper "A Review on Biometrics Human Fingerprint Identification" This paper About the current research in the field of fingerprint recognition. We will discuss about a review of security correct quality and recognition of fingerprints. Fingerprint recognition systems are generally used in the identification instruments and biometric applications. Fingerprints are also influenced by a number of key factors, such as age and orientation. For identification, such as retina, face, signature, DNA, iris, etc., certain human body parts are used.

Jang, Han-UI, Kim, Dongkyu, Seung-Min Mun, Choi, Sunghee, and Lee, Heung-Kyu [8] proposed a pore extraction technique that thickens the pore intensity and makes use of a powerful convolutional neural network. Large regions of fingerprint images are employed to discover holes in deep tissues. a challenging issue as the pore information varies depending on the individual, area, and pore. Using CNN and deep pore intensity precision, the researchers demonstrated a pore extraction technique. On benchmark databases, researchers have demonstrated that DeepPore performs significantly better than a complex technique.

Kumar, Ajay, and Zhou, Yingbo [9] proposes a renewed strategy to enhance the literature-presented fiberglass-vein identification system's functionality. The suggested method combines several high-level distribution algorithms with the simultaneous acquisition of low-resolution and fingerprint pictures. Provide a fully functional and automated emissive framework that complicates both the bonding layer and the binder's surface at the same time, including the bonding radius and the finger texture.

Kauba, Christof, and Uhl, Andreas [10] proposes that it is impossible to use original image data to estimate the effect of defective pixels alone, regardless of subject aging and other external effects. The researchers investigated the effect of aging image sensors on pixel errors in the aging phenomenon of biometric patterns in fingerprint recognition systems using three different scenarios, including aged survey images only, age and sensor age, and reserved patterns when patterns are not combined. Since the effect of image sensor aging cannot be easily studied using a real fingerprint image captured by a real fingerprint sensor, ignoring all other pattern aging effects and external effects, we used an image sensor aging simulation algorithm to generate the fingerprint imageages.

Aman Attrish, Nagasai Bharat, Vijay Anand, Vivek Kanhangad [11] "A Contactless Fingerprint Recognition System" The study suggests a contactless fingerprint identification system that uses an image sensor to take distant pictures of fingers and then analyzes those images to extract both local and global information. The system computes matching scores between minutiae-based and CNN-based characteristics after extracting global features using a Siamese convolutional neural network (CNN). The two scores are fused to provide the final matching score. The Nvidia Jetson Nano development kit was used in the system's development, enabling real-time contactless fingerprint identification with minimal latency and respectable matching accuracy.

"FINGERPRINT RECOGNITION SYSTEM" Sankalp Bhalerao*1, Lakshya Vyas*2, Rishal Gedam*3, Rajat Soni*4 [12] The goal of this work is to create a fingerprint recognition system for security purposes and to make recommendations for enhancing current fingerprint systems. Image enhancement, skeletonization, Available Online At: <https://jazindia.com>

orientation, ROI extraction, and minutia extraction techniques are used by the system to compare an input fingerprint with a specified template. The paper concludes that A fingerprint recognition system is a safe substitute for conventional security measures like access cards or pin codes since each person's fingerprint is distinct and challenging to copy or hack.

“Touch-less Fingerprint Recognition System” Bee Yan Hiew¹, Andrew Beng Jin Teoh¹, Ying Han Pang^[13], Contactless fingerprint recognition is a viable alternative to contact-based fingerprint recognition because it solves hygiene, maintenance, and hidden fingerprint problems. • The proposed system uses a digital camera for fingerprint collection, preprocessing, and Gabor filter feature extraction. , and matching steps, achieving promising results in segmentation, enhancement and kernel detection. The test results of the contactless fingerprint identification system show its effectiveness in achieving accurate identification. The system overcomes challenges such as low contrast, focus and motion inaccuracies in digital camera fingerprint images • Generally non-contact The presented paper-based fingerprint recognition system offers a practical and efficient alternative to contact-based fingerprint recognition technology.

M. Yang, "Fingerprint Recognition System based on Big Data and Multi-feature Fusion," [14] The paper proposes a fingerprint recognition algorithm that addresses the limitations of traditional fingerprint recognition systems by incorporating deep learning and multitasking. It specifically focuses on improving the recognition accuracy of partially incomplete or sparse fingerprints. The algorithm sends the raw fingerprint data to the cloud-based deep learning engine anonymously and encrypted. This enables the collection of large amounts of targeted fingerprint data, which is then used to incrementally adjust the parameters of the deep learning model to achieve optimal accuracy. In addition, the system provides SaaS services for other applications to acquire fingerprints data recognition.

“Design and implementation of a fingerprint-based biometric access control system”, E. Esekhaigbe a , E. O. Okoduwa, [15], the proposed contactless unique mark acknowledgment framework accomplished an equivalent mistake pace of 2.19% on the IITI contactless finger impression dataset, which is viewed as a decent matching exactness . The concentrate on the ease of use of Histogram of Slope in Unique finger impression Acknowledgment showed a precision of 75% without improvement calculations, proposing that Hoard can be utilized for finger impression acknowledgment in the future with ideal settings.

Javier Galbally, Rudolf Haraksim and Laurent Beslay (2012), in “A Study of Age and Ageing in Fingerprint Biometrics” [16], present in this article which has addressed the difficult 9 issue in the field of fingerprint recognition, presenting some new insights into the way time affects fingerprint-based technology. In the operational condition, fingerprints from subjects aged 0-25 and 65-98 were collected with respect to different time ranges which is between 0-7 years and accordingly collects the dataset for analysis of age and ageing effect on fingerprint. As a result, the proposed gives some new sight into issue like fingerprint permanence and fingerprint quality.

III. CONCLUSION AND FUTURE WORK

An overview of the fingerprint recognition system is provided in this paper. Fingerprints are a very trustworthy and accurate method. A common biometrics and identification tool is the fingerprint recognition system. Because biometrics provide great security, they have been utilized for many years.

In conclusion, the aforementioned analysis and findings demonstrate that the Fingerprint Recognition System (FRS) is an extremely accurate, efficient, and user-friendly technology. While there may be occasional issues, these may be resolved with time.

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