ISSN 2664-4150 (Print) & ISSN 2664-794X (Online)
South Asian Research Journal of Engineering and Technology
Abbreviated Key Title: South Asian Res J Eng Tech

| Volume-4 | Issue-6 | Nov-Dec- 2022 | **DOI: 10.36346/sarjet.2022.v04i06.005**

Original Research Article

Finding Correlation between Fingerprints and Footprints of a Person as an Identity

Dr. Ajay Goyal[1*], Dr. Sanju Kumari[2], Er. Yadwinder Singh[2], Er. Abhinash Singla[2]

[1]Professor IT, Bhai Gurdas Institute of Engineering & Technology, Sangrur, Punjab
[2]Assistant Professors IT, Bhai Gurdas Institute of Engineering & Technology, Sangrur, Punjab

***Corresponding Author:** Dr. Ajay Goyal
Professor IT, Bhai Gurdas Institute of Engineering & Technology, Sangrur, Punjab

Article History
Received: 13.11.2022
Accepted: 07.12.2022
Published: 31.12.2022

Abstract: Technological advancements from the dawn of the age of the computer to the beginning of the age of the internet, have all created easier and more efficient ways of criminal investigation. Police departments throughout the United States and in other countries now have ways to easily store and share information and eliminate problems that traditional paper records posed. In the case of difficulty in extracting orientation images reliably, a general-purpose approach improving local image contrast is favored. Today time with the increase in population crime increases day by day, and Police Department have over loaded work. To decrease the crime and to identify the theft and criminal, we try to make a new age safety system in which detect the theft by matching his /her Foot finger prints with Hand finger prints. Because due to plastic surgery sometimes criminal change their identity, and protect them self from punishment. In this work fingerprint and foot finger prints are recognized with the help of minutia because the minutia is the one element of the footprint and fingerprint that helps to find the matching with same and different persons.

Keywords: Footprint, Fıngerprint, accuracy, criminals, identity etc.

I. INTRODUCTION

Biometrics is the process of recognizing an individual on physiological or behavioral traits in real-time. Biometrics of an individual are unique and consistent. Biometrics offer an alternative to conventional authentication approaches that cannot be forgotten or lost. A broad range of biometrics like fingerprint, palmprint, iris, signature and voice (Fig 1.1) are used in real-time applications. The increase in the volume of transactions on handheld devices and the number of clients to be identified, are the motivation for designing efficient real-time fingerprint and palmprint recognition algorithm using less memory. Similarly, automatic latent fingerprint recognition is still a challenging problem due to its partial image and noisy nature.

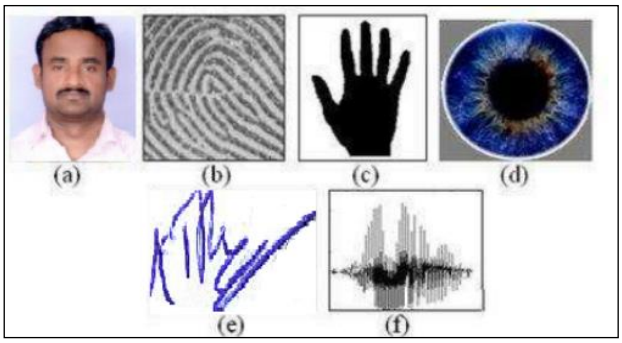

Figure 1: Types of biometrics: Physiological (a) face (b) fingerprint (c) palm (d) iris. Behavioral (e) signature (f) voice

Among these biometrics, fingerprint and palmprint based identification are the most widely used techniques. The typical block diagram of biometric recognition system is shown in figure 1.2. The block diagram shows the various phases involved in a biometric recognition system. Here, the sensors used to capture the biometric trait use different sensing technologies such as optical, and capacitive. The captured biometrics is passed to the pre-processing to enhance the image quality and then passed to extract the feature using template generator. The template received from template generator is matched against the stored templates in the matching stage to produce the matching result.

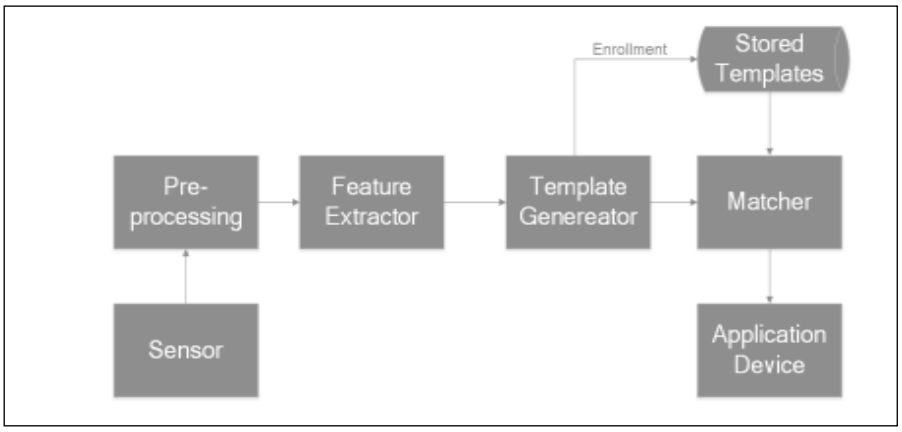

Figure 2: Typical block diagram of biometric recognition system.

The field of forensic science has improved criminal investigation in ways that could not have been imagined fifty years ago. With advancements in science and technology, newer and more effective techniques for the identification of criminals are available to police and criminal investigators. Since the earliest methods for the identification of individuals became available, there have been attempts to improve and redefine these techniques to keep up with modern advancements. Over the past hundred years, there have been some of the most important and significant advancements to the field [1]. Technological advancements from the dawn of the age of the computer to the beginning of the age of the internet, have all created easier and more efficient ways of criminal investigation. Police departments throughout the United States and in other countries now have ways to easily store and share information and eliminate problems that traditional paper records posed. The advent of the internet, allows instant communication and sharing of information that is often vital in the fast-paced world of criminal investigation [3].

II. METHODS OF FINGERPRINT IDENTIFICATION

Now that the history of fingerprint identification has been explored, it is necessary to understand what is meant when two prints are a match and what a technician looks for on each print to begin comparison. There are many different identifying markers that are used to help classify and identify fingerprints. The current system that is used consists of three major types of patterns that can be broken up into several more specific subdivisions. The three main categories include arches, loops and whorls [8]. Arches can be of two types, plain and tented, as seen below in Figure 1.1. Loops also consist of two subdivisions; ulnar and radial (Figure 1.1). The final category is known as whorls and is divided into four subdivisions; plain, central pocket, double look and accidental (Figure 1.1) [28]. These classifications are the first level of sorting used to differentiate one print from another, both manually and within AFIS databases.

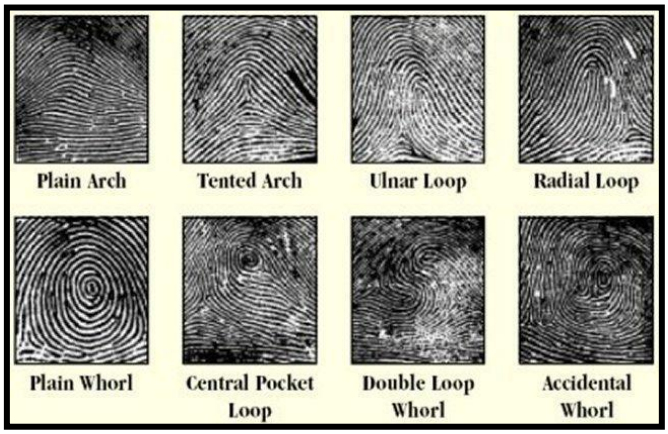

Figure3: First Level Fingerprint Classification

Arches are a classification of fingerprints that are characteristically identified by their overall mountainous appearance [9]. Ridges found in this type of print are generally continuous from one side to another, with a peak being found in the middle of the print. Ridges found near the bottom of the print peak very slightly and may even seem to be straight lines across the print [8]. Tented arches have ridges that do not flow as smoothly from one side to another and have a more defined center peak. Tented arches can display a nearly vertical ridge at the core of the print emphasizing the tent-like nature of this pattern [8]. Loops are overall characterized by ridges flowing from one side of the print upwards towards the center before looping around the core and sloping back towards the point of origin before reaching the other side of the print. The ridges that make up the core of a loop print begin and end on the same side of the print creating the telltale loop that this pattern is known for [9]. The differentiation between radial and ulnar loops is dependent on which side of the print the loops point towards. Radial loops flow towards the radius bone of the arm or the thumb of the hand and ulnar loops flow towards ulna bone or the pinky finger [9]. Plain whorl patters are characterized by the presence of two deltas on opposite sides of the print between which a complete circuit exists [8]. Central pocket loops can look similar to loop patterns but have a distinct center circuit that makes it characteristic of a whorl pattern [8]. Double loop whorls consist of two loops that point in opposite directions which form around one another in the core of the print [8]. Accidental whorl patterns are formed by a combination of the different patters described above in a random fashion that does not seem to fit succinctly into any other category [9].

Once a general classification of a fingerprint is made, more specific and unique characteristics are used to find the individuality of each person's fingerprints and make positive comparisons. All of these unique markings are a result of the shape, direction, and intersection of the ridges that make up each fingerprint. There are eight main identifying features that become the so called "points of comparison" spoken of when two prints are identified as the same. These are known as crossovers, cores, bifurcations or forks, ridge endings, islands or independent ridges, deltas, lakes, and pores4. Visual representations of these features are shown in figures 1.3 and 1.4 below. The first identifying feature that can help a technician determine if the print found is a complete or partial fingerprint is the core. This is the center portion of the fingerprint and is typically used as a reference point off of which the locations of other print markers are described. Pores create small holes in the ridge lines of a print and thus often look like voids [2][8]. These voids can look like single circular spots in a ridge line or create broken ridges. Differences in appearance of pores on a fingerprint are due to the size and location of a pore along the ridgeline or between ridges in areas known as valleys. Pores are created by the presence of sweat pores on the pads of fingers that help to secrete oils and sweat that are necessary for a print to develop on a surface [8]. Ridge endings are the starting point for the identification and location of the rest of the identifying markers that will be discussed. Ridge endings are found at each end of a ridge and must be located in order to differentiate how one ridge interacts with another [8]. They are particularly helpful in determining the presence of islands or independent ridges. Islands look just as one would expect an island to appear, a small ridge surrounded by much larger ridges [7]. It is important to understand that an island is an independent ridge which does not seem to fit into the flow of a longer ridge. Islands are the product of a short ridge, whereas lakes are the product of the valleys of a fingerprint [7]. These resulting ridges do not converge to create a lake, but rather continue as separate ridges until their respective endings [5]. Deltas create what looks like triangular shaped points within a fingerprint. Created by three ridge endings which come together in a way that resembles the delta of a river, the point where a river opens up to a larger body of water. Crossovers occur when two ridges meet one another, cross and continue on their separate ways. These points look like X's in the ridge pattern of a particular fingerprint [8].

III. LITERATURE SURVEY

I studied so many papers and some of them are given below:

Andreea-Monica Dincă Lăzărescu *et al.*, (2022) [1] have studied presents an algorithm for fingerprint classification using a CNN (convolutional neural network) model and making use of full images belonging to four digital databases. The main challenge that we face in fingerprint classification is dealing with the low quality of fingerprints, which can impede the identification process. To overcome these restrictions, the proposed model consists of the following steps: a preprocessing stage which deals with edge enhancement operations, data resizing, data augmentation, and finally a post-processing stage devoted to classification tasks. Primarily, the fingerprint images are enhanced using Prewitt and Laplacian of Gaussian filters.

Krishna K. Shinde *et al.*, (2022) [2] have studied pre-train VGG16, VGG19, and ResNet50 with ImageNet wights and our best CNN model to identify human fingerprint patterns. The system including pre-processing phase where the input fingerprint images first technique apply cropping and normalize for unwanted part remove of fingerprint images and normalize its dimension, second Image Enhancement for removing noise in to ridgelines, and last Canny Edge Detection technique for adjustment to smooth image with Gaussian to remove noise. Then apply one by one model on KVKR fingerprint dataset. Our best CNN model has automatically extracted features and RMSprop optimizer use for classification this features. This study performing experimental work of each pre-processed dataset and testing these three models with different dataset size of input train, test, and validation data. The VGG16 model got a better recognition accuracy than VGG19 and ResNet50 models.

Uttam U. Deshpande1*et al.*, (2022) [3] have studied developed a local minutia-based convolution neural network (CNN) matching model called "Combination of Nearest Neighbor Arrangement Indexing (CNNAI)." This model makes use of a set of "n" local nearest minutiae neighbor features and generates rotation-scale invariant feature vectors. The proposed system doesn't depend upon any fingerprint alignment information. In large fingerprint databases, it becomes very difficult to query every fingerprint against every other fingerprint in the database. To address this issue, They make use of hash indexing to reduce the number of retrievals. We have used a residual learning-based CNN model to enhance and extract the minutiae features. Matching was done on FVC2004 and NIST SD27 latent fingerprint databases against 640 and 3,758 gallery fingerprint images, respectively.

Nur-A-Alam *et al.*, (2021) [4] have introduces an intelligent computational approach to automatically authenticate fingerprint for personal identification and verification. The feature vector is formed using combined features obtained from Gabor filtering technique and deep learning technique such as Convolutional Neural Network (CNN). Principle Component Analysis (PCA) has been performed on the feature vectors to reduce the overfitting problems in order to make the classification results more accurate and reliable. A multiclass classifier has been trained using the extracted features. Experiments performed using standard public databases demonstrated that the proposed approach showed better performance with regard to accuracy (99.87%) compared to the more recent classification techniques such as Support Vector Machine (97.86%) or Random Forest (95.47%). However, the proposed method also showed higher accuracy compared to other validation approaches such as K-fold (98.89%) and generalization (97.75%). Furthermore, these results were supported by confusion matrix results where only 10 failures were found when tested with 5000 images.

Behnam Bakhshi *et al.*, (2019) [5] have studied Fingerprint recognition has become one of the most reliable ways for human identification due to its uniqueness and consistency. The fingerprint matching problem is formulated as a classification system in which a model is learned to classify every two fingerprints as a genuine or impostor pair. Traditional approaches perform a feature extraction step before matching a fingerprint pair. On the other hand, recently convolutional neural networks (CNNs) have presented exceptional success for many image processing tasks such as face recognition. However, there have been only a few attempts to develop fully CNN methods to deal with challenges in fingerprint recognition problem. In this paper, a CNN-based fingerprint matching method has been developed. A key contribution of the proposed method is to directly learn fingerprint patterns from raw pixels of images. In order to achieve robustness and characterize the similarities comprehensively, incomplete and partial fingerprint pairs were taken into account to extract complementary features. Also, we proposed an end to end CNN approach that contains the feature extraction part of the trained AlexNet network. The network reached an EER of 17.5% on the FVC2002 dataset, that shows better results in comparison to the MinutiaSC and A-KAZE methods.

Marasco *et al.*, (2013) [18]: has presented the Biometric systems are widely deployed in governmental, military and commercial/civilian applications. There are a multitude of sensors and matching algorithms available from different vendors. This creates a competitive market for these products, which is good for the consumers but emphasizes the importance of interoperability. Interoperability is the ability of a biometric system to handle variations introduced in the biometric data due to the deployment of different capture devices. The use of different biometric devices may increase error rates. In this -scale empirical study of the status of interoperability between fingerprint sensors and assess the performance consequence when interoperability is lacking.

Soni *et al.*, (2013) [26]: in this world of mobile and cameras, new methods differ from the traditional methods. Traditional methods used contact-based fingerprint matching while the new technique uses contact-less fingerprint matching. Fingerprint matching using sensors uses grayscale images which are very much defining comparative to the images which are taken by cameras and mobiles. And in case of mobile and cameras images can be blurred including noise and distortion. In this paper, we are defining techniques to overcome the issues of blurred images and have to find out better minutiae to match with the database set. To extract the features from blurred images, images which are taken by low cost sensors are filtered and then further processed for minutiae matching.

Drahansky *et al.*, (2012) [2]: has studied that many people who suffer from some of the skin diseases. These diseases have a strong influence on the process of fingerprint recognition. People with fingerprint diseases are unable to use fingerprint scanners, which is discriminating for them, since they are not allowed to use their fingerprints for the authentication purposes. First in this the various diseases, which might influence functionality of the fingerprint-based systems, are introduced, mainly from the medical point of view. This overview is followed by some examples of diseased finger fingerprints, acquired both from dactyloscopic card and electronic sensors. At the end fingerprint image enhancement algorithm is described.

Kumar *et al.*, (2012) [13]: the purpose of this work is to increase the security that customer use the ATM machine. Once user's bank card is lost and the password is stolen, the criminal will draw all cash in the shortest time, which will

bring enormous financial losses to customer, so to rectify this problem we are implementing this project. The chip of LPC2148 is used for the core of microprocessor in ARM7, furthermore, an improved enhancement algorithm of fingerprint image increase the security that customer use the ATM machine.

Kulshrestha *et al.*, (2012) [12]: have studied the Fingerprints are the most popular and studied biometrics features. Their stability and uniqueness make the fingerprint identification system extremely reliable and useful for security applications. Fingerprints are the oldest and most widely used form of biometric identification. Everyone is known to have unique, immutable fingerprints. Two approaches have been discussed in this that is based on minutiae located in a fingerprint and based on gabor filter which is used to matching the fingerprint.

Lopez *et al.*, (2012) [14]: studied the fingerprint authentication method is proposed, based on the core and minutiae detection of the fingerprint. The relationship between authentication reliability and region size is studied experimentally. A bank of Gabor filters, orientated to different angles are applied to the image to clean it from noises that can result on false alarms or authentication mistakes. Our approach will be the extraction of the core using the flow field and determining the angle that each vector of the flow field has with respect to the horizontal. A function that reduce the image to an specific size and increments one by one will be perform to investigate which type of orientation (e.g., arch, right loop, left loop, and whorl) the fingerprint has, to help us determine the core. From the core, vectors will be trace to the minutiae for the purpose of image alignment and fingerprint matching.

IV. RESEARCH GAPS

The above study of this research topic overcome the different research points of different researchers on the topic of finger prints matching based on their minutiae and the correlation of different points of the fingers. In this the different authors works on different techniques to find the correlation of finger print matching and their percentage of matching with same person and the different persons. There is the research gap between the correlation of footprints and the fingerprints matching based on their minutiae of different persons and the same person to identify the criminals. The previous work is representing the specification of the person for security, but some time the minutiae is matched with more then one persons that creates the problem to identify the correct person. In this work I have removed the identification problem on the based on foot print and finger prints matching with correlation of same and different persons minutiae.

V. PROBLEM FORMULATION

Over the past hundred years, there have been some of the most important and significant advancements to the field. Technological advancements from the dawn of the age of the computer to the beginning of the age of the internet, have all created easier and more efficient ways of criminal investigation. Police departments throughout the United States and in other countries now have ways to easily store and share information and eliminate problems that traditional paper records posed. Low power of discrimination is another problem that is common to all PCR analysis techniques. Skeptics of fingerprinting job applicants also raise the concern of these prints being added to the databases and being used in criminal investigation. Both of these are concerns in today's society.

The problem with this is when there is not a full print and a list of possible suspects is generated. If the police have a suspect in mind who happens to be on the list of possible matches, police can become blind to the fact that there could be other suspects and could potentially arrest and prosecute the wrong person.

Another problem even most of the people come up with losing the passwords, forgetting them or even worth, when the passports are stolen. People who agitate for using biometrics point out that those problems with password will not be urgent with the use of biometrics. Biometric templates are matched against each other in order to solve authentication problems.

The problem of ulnar or radial abducted phalanges causing large variations when matching the footprint using moments is not present in this application domain. Furthermore, problems regarding anatomical differences between hand and foot will be pointed out. Using feet instead of hands, new problems arise, such as the difficulty of distinguishing between creases caused by different rotations of feet and permanent line patterns. Typical principal lines, such as life line, head line and heart line, can not be identified in footprints.

The major problem for flatbed optical fingerprints is low contrast between ridges and valleys. In the case of difficulty in extracting orientation images reliably, a general-purpose approach improving local image contrast is favored. Today time with the increase in population crime increases day by day, and Police Department have over loaded work. To decrease the crime and to identify the theft and criminal, we try to make a new age safety system in which detect the theft by matching his /her Foot finger prints with Hand finger prints. Because due to plastic surgery sometimes criminal change their identity, and protect them self from punishment.

VI. CONCLUSİON

Biometrics system has a long history that starts from the very old time and is widely used in these days. This is very important because most of the people think that biometrics as a science appeared not long ago and just used in criminalistics. Although many people even do not realize that biometrics have many different methods. Each method is based on the uniqueness of the measured part of the body. Fingerprinting and Footprint is one of the oldest and most popular method of biometrics is widely used in criminalistics. The main idea of the method is that the picture of papillary pattern is unique for each person. The sample of papillary pattern can be easily taken from any surface that the person touches. It is also considered that fingerprints and footprints are the most popular evidences in the places of crime.

In the future work the footprints and fingerprints is matched with the help of different filters because i have implement with enhancement .The maximum accuracy of the matching is improved with the help of different techniques and different algorithms.

REFERENCES

1. Dincă Lăzărescu, A. M., Moldovanu, S., & Moraru, L. (2022). A Fingerprint Matching Algorithm Using the Combination of Edge Features and Convolution Neural Networks. Inventions, 7(2), 39.
2. Shinde, K. K., & Kayte, C. N. (2022). Fingerprint Recognition Based on Deep Learning Pre-Train with Our Best CNN Model for Person Identification. *ECS Transactions*, 107(1), 2209.
3. Deshpande, U. U., Malemath, V. S., Patil, S. M., & Chaugule, S. V. (2020). CNNAI: a convolution neural network-based latent fingerprint matching using the combination of nearest neighbor arrangement indexing. Frontiers in Robotics and AI, 7, 113.
4. Ahsan, M., Based, M. A., Haider, J., & Kowalski, M. (2021). An intelligent system for automatic fingerprint identification using feature fusion by Gabor filter and deep learning. *Computers and Electrical Engineering*, 95, 107387.
5. Bakhshi, B., & Veisi, H. (2019, April). End to end fingerprint verification based on convolutional neural network. In 2019 27th Iranian conference on electrical engineering (ICEE) (pp. 1994-1998). IEEE.
6. Barua K., Bhattacharya S., "Fingerprint Identification", Global Journal of Computer Science & Technology, Vol. 11 (Issue 1), (Apr 2011).
7. Drahansky M., Dolezel M., "Influence of Skin Diseases on Fingerprint Recognition", Hindawi Publishing Corporation *Journal of Biomedicine and Biotechnology*, Vol. 26, (Feb 2012).
8. Eugene B.B., "Science vs. Crime: The Evolution of the Police Lab", Craigmont Publications: New York, (1979).
9. Habib H.A., Mufti M., "Real Time Mono Vision Gesture Based Virtual Keyboard System", IEEE Transactions on Consumer Electronics, Vol. 52 (Issue 4), (Nov 2006).
10. Jain A.K., Bolle R., Pankanti S., "Biometrics: Personal Identification in a Networked Society", Kluwer cademic Publishers, (1999).
11. James E.S., "A Critical Analysis of Selected Features of Fingerprinting", In Forensic Science and Law: Investigative Applications in Criminal, Civil, and Family Justice, Wecht, Cyril H., Rago, John T. Eds., Taylor and Francis Group: New York, P.P. 299-322.
12. James M., "Catching the Killers: A History of Crime Detection", Ebury Press: London, (2001).
13. Katherine R., "The Forensic Science of C.S.I.", Berkley Boulevard Books: New York, (2001).
14. Kelly M.P., "The U.S. Forensic Laboratory System under Siege Forensic Science under Siege: The Challenges of Forensic Laboratories and the Medico-Legal Death Investigation System", Elssevier: New York, P.P. 51-107.
15. Kelly M.P., "DNA: Convicting the Guilty, Exonerating the Innocent. Forensic Science Under Siege: The Challenges of Forensic Laboratories and the Medico-Legal Death Investigation System", Elssevier: New York, P.P. 291-340.
16. Kulshrestha M., "Finger Print Recognition: Survey of Minutiae and Gabor Filtering Approach" International Journal of Computer Applications (0975 – 8887), Vol. 50 (Issue 4), (Jul 2012).
17. Susmita, K. S. V., & Kailas, D. P. (2021). Portable firewall for data security toward secured communication. *gateways*, *4*, 5.