Journal of Interdisciplinary Qur'anic Studies

Journal of Interdisciplinary Qur'anic Studies Vol.2, Issue 2, December 2023, 33-52

The Fingerprint: A Convergence of Qur'anic Revelation and Biometric Science

Mohammad Ebrahim Shenassa [1]

Assistant professor, Computer Engineering Department, Faculty of Electrical & Computer Engineering, Islamic Azad University, North Tehran Branch, Tehran, Iran

Houra Houshmand Viki [2]

Master of Public Administration, Faculty of Management and Economics, Islamic Azad University, Science and Research Branch, Tehran, Iran

Article History: Received 8 September 2023; Accepted 17 November 2023

ABSTRACT:

Original Paper

Since ancient times, human identification has been of paramount importance, and various methods have been employed to achieve this goal. Over time, advancements in science have mathematically and scientifically proven the uniqueness of fingerprints, making them the most common criterion used by identification systems today. The Qur'an, in many verses, addresses the concepts of the afterlife, the resurrection of the dead, and the accounting of human actions. A fundamental requirement for this accounting, whether for reward or punishment, is the accurate identification of individuals. In verses 3 and 4 of Surah al-Qīyāmah, God emphasizes the precision of human recreation, even down to the restoration of *banān* (often interpreted to mean fingertips). The primary objective of this research is to answer the question of whether the restoration of *banān* in the afterlife can be interpreted as the restoration of each individual's unique fingerprint. Employing a descriptive-analytical approach and an interdisciplinary perspective, this study examines the correlation between Qur'anic concepts regarding the restoration of *banān* and scientific findings in the field of biometrics, particularly fingerprints. Historical records indicate that fingerprints have long been of interest to humanity; however, the mathematical and empirical proof of their uniqueness was not established until the 17th century. The findings of this research suggest that by referring to the restoration of fingertips, the Qur'an has drawn attention to a feature

1. Corresponding Author. Email Address: me.shenasa@iau-tnb.ac.ir
2. Email Address: hr_houshmand@yahoo.com

http://dx.doi.org/10.37264/JIQS.V2I2December2023.2

that, while its intricacies were apparent to people at the time of its revelation, was not fully understood in its unique nature. In other words, God has alluded to a unique feature whose complexity and difficulty of restoration were comprehensible to the people of that era but have, with scientific advancements, become the most common and accessible biometric method in the world today.

KEYWORDS: The Qur'an and science, fingerprints, authentication, miracles of the Qur'an, biometrics, individual identity, *banān*

1. Introduction

Since the dawn of human civilization, the identification of individuals has always been of paramount importance. Throughout history, humans have relied on both overt physical differences and manual methods such as fingerprint and facial recognition to identify and verify individuals. Over time, with advancements in various scientific fields, significant progress has been made in this area. Interestingly, the lines on the palms, fingers, and fingerprints have captured the greatest attention of experts and researchers. By focusing on this specific body part and its details, the highly advanced methods used today have been developed. The intricate patterns formed on the fingertips of each individual are so unique that they have long been recognized as a biological signature.

In the Qur'an and religious texts, the concepts of the afterlife and the regeneration of beings constitute a significant portion of the content. Some Qur'anic verses address the occurrence of the Day of Judgment, while others describe the recreation of humans in the same form and with the same initial characteristics. Among the names for the Day of Judgment are *Yawm al-Jazā* (Day of Retribution) and *Yawm al-Ḥisāb* (Day of Reckoning). The first prerequisite for accounting, in order to reward or punish individuals, is the accurate identification and verification of their identities. The question arises: How is it possible to identify and recognize individuals on the Day of Judgment?

أَيَحْسَبُ الْإِنْسَانُ أَلَّنْ نَجْمَعَ عِظَامَهُ * بَلَى قَادِرِينَ عَلَى أَنْ نُسَوِّيَ بَنَانَهُ (القيامة/4-3)

Does man suppose that We shall not put together his bones? Yes indeed, We are able to proportion [even] his fingertips! (Q. 75:3-4)

In this verse, God emphasizes not only the reassembly of decayed bones but also the reconstruction of the fingertips. The word *banān* in this verse carries a specific semantic load, and Qur'anic exegetes have offered various interpretations. Some believe that *banān* refers to the entire finger, while

others associate it with the unique lines and ridges on the fingertips (i.e., fingerprints). This precise choice of words by God, and its connection to the concept of identity verification, raises the question of whether the reconstruction of *banān* means the restoration of each individual's unique fingerprint.

With the advancement of science and technology, methods of identity verification have evolved from traditional approaches towards more accurate and reliable ones, such as biometric systems based on fingerprints. However, it is noteworthy that the Qur'an, revealed over 1400 years ago, refers to a subject that seems to have a deep connection to this new scientific knowledge. This interdisciplinary research with a descriptive-analytical method examines the congruence between Qur'anic concepts and scientific findings in the field of fingerprint identification. So far, many interdisciplinary researches have been conducted in the field of Qur'an and various sciences (Koutb 2022; Zare et al. 2023; Jafari 2023; Karami et al. 2023; Razi & Torkzadeh 2023). The primary objective of this research is to answer the question of whether the reconstruction of the fingertips in the afterlife can be interpreted as a scientific prediction in the Qur'an. To this end, several questions must be addressed: Given the disagreement surrounding the word *banān* in these verses, can it be said that the sole or predominant meaning of *banān* is fingerprints? Why, among all the unique characteristics of humans, does the Qur'an specifically mention the reconstruction of fingerprints? From a scientific standpoint, can it be said that fingerprints are the best method of identity verification? Since when has the use of fingerprints as a method of identification been recognized? Is the Qur'an pioneering in its reference to fingerprints as a tool for identity verification, or has this issue been raised historically before the Qur'an?

This research, through a comparative study of Qur'anic verses, narrations, the views of interpreters, and scientific findings in the field of biometrics, will attempt to gain a deeper understanding of this issue.

2. Lexical and Interpretative Analysis

Verses 3 and 4 of Surah al-Qīyāmah delve into the profound theological concept of resurrection and the intricate process of human reconstruction in the afterlife. The Qur'anic text poses a challenge, questioning whether human believes that divine power is incapable of reassembling human bones. Moreover, the verses assert God's ability to meticulously reconstruct even the finest details of the human body, such as the fingertips.

A comprehensive lexical and interpretive analysis of these verses offers

a profound insight into their underlying meanings and conceptual framework. Through this analysis, we can address the central research question of this study.

2.1. ʿIẓām

The word *ʿiẓām* is the plural form of *ʿaẓm*, derived from the root *ʿ-ẓ-m* which connotes greatness, strength, and power (Ibn Fāris 1979, 356). It is also used to refer to bones in contrast to *laḥm* (flesh), as bones are the hardest and strongest part of the body (Muṣṭafawī 1989, 8: 175). The word *ʿiẓām* occurs 13 times in the Qur'an, predominantly in connection with the afterlife. However, in some instances, it is used in describing the stages of fetal development.

2.2. Nusawwī

The term *nusawwī* is derived from the root S-W-Y, which denotes rectitude, correctness, and equilibrium between two things (Ibn Fāris 1979, 496). Sawā' is either a verbal noun (Muṣṭafawī 1989, 5: 278) or an infinitive (al-Rāghib al-Iṣfahānī 1991, 1: 439) and means equality (al-Jawharī 1990, 7: 235; al-Zabīdī 1965, 38: 322).

Regarding *taswīyah* (infinitive from the form *tafʿīl*), it is said to mean making equal and arranging. *Taswīyah* apparently refers to harmony among the body's parts (Q. 87:2 & Q. 18: 37). In Q. 82:7, *sawwāka* seems to imply the soundness of the limbs, placing each member in its proper place, and being in the state of perfect creation. Alternatively, it could mean that creation is established according to what wisdom demands (al-Rāghib al-Iṣfahānī 1991, 1: 439). Muṣṭafawī (1989, 5: 278) states that *taswīyah* is placing something in a moderate state with action, order, planning, and completion. It is also interpreted as strengthening (al-Ṭabrisī 1993, 10: 720) and placing each body part in its appropriate place, according to wisdom (Tabataba'i 1996, 20: 265). In conclusion, most interpreters have chosen the meaning of equilibrium with order and planning for *taswīyah*, which is consistent with the structure of fingerprints, where order and planning prevail.

2.3. Banān

According to lexicographers, the root meaning of *banān* is connection and attachment, accompanied by stability (Ibn Fāris 1979, 191; al-Farāhīdī 1988, 8: 373; Muṣṭafawī 1989, 1: 339). The mention of fingers and their tips

is merely a specific example (al-Farāhīdī 1988, 8: 373; Muṣṭafawī 1989, 1: 339). Some scholars have exclusively defined *banān* as fingers (al-Rāghib al-Iṣfahānī 1991, 1: 147; al-Zamakhsharī 1986, 4: 57; al-Bayḍāwī 1997, 5: 265), while others have included fingertips (Ibn Fāris 1979, 110; al-Fīrūzābādī 2003, 1088; al-Ṭurayḥī 1996, 6: 217).

Al-Farāhīdī (1988, 8: 373) not only mentions the meaning of necessity but also defines *banān* as fingertips and interprets it in the Qur'an as limbs and joints (hands and feet). Al-Jawharī (1990, 110) in addition to the aforementioned meaning, interprets the term *banīyyāt al-ṭarīq* as the side roads branching off from the main road. Ibn Manẓūr (1993, 13: 60), citing evidence from poetry and hadith, confirms the above meanings (fingers and fingertips). Muṣṭafawī suggests the possibility of *banān* being a verb that later evolved into a noun referring to fingers, hands, and feet, i.e., all the limbs through which the body remains connected and stable. He states that the term *banān* means the side, referring to the four movable limbs of the human body. Both the upper limbs (hands) and the lower limbs (feet) are called *banān* due to their connection to the body and the body's stability resulting from them (Muṣṭafawī 1989,1:339). If the comprehensive meaning is the side, it may apply to all instances, as hands and feet are the sides of the body, and fingers are the sides of the hand, and the tips of the fingers are the sides of the fingers.

The word *banān* appears in two verses of the Qur'an, Q. 8:12 and Q. 75:4. After examining it in these two verses, it appears that in Q. 8:12, *banān* refers to the limbs of the body, such as hands and feet. However, in Q. 75:4, *banān* is more likely to refer to fingers or fingertips. This is because the context of Q. 75:4 subtly hints at the intricate and precise act of re-creation, a description that is more closely associated with fingers and fingertips than with larger and more general body parts like hands and feet. On the other hand, Q. 8:12 is in the context of war and refers to striking the enemies, where *banān* can be interpreted as parts of the hands and feet. It is interesting to note that lexicographers and interpreters, despite mentioning different meanings for *banān* in these two verses, have also considered the meaning of fingers and fingertips as probable in both verses.

2.4. Nusawwī Banānah

Interpreters, like lexicographers, have differing opinions on the specific meaning of *banān*. Most interpreters consider *banān* to mean fingers (al-Ṭabarī 1985, 29: 219; al-Zamakhsharī 1986, 4: 459; al-Qurṭubī 1985, 19: 62), while some interpret it as fingertips (Ibn Kathīr 1998, 8: 284; Kāshānī 1989, 10: 80; al-Baḥrānī 1994, 5: 534; Tabataba'i 1996, 20: 165; al-Ṭanṭāwī

al-Jawharī 2004, 10: 181; Makarem Shirazi 1995, 25: 279).

Regarding why *banān* is specifically mentioned among body parts and what is meant by *nusawwī banānah* various interpretations have been proposed. Al-Zājjāj, al-Jubbā'ī, Abū Muslim, and others have argued that just as God can restore fingers or fingertips with such precision and smallness, He can certainly restore larger bones after decay to their original state (al-Ṭabrisī 1993, 26:100; al-Ṭabarī 1985, 29:111). Other commentators, such as Ibn ʿAbbās, Qatādah, Mujāhid, and ʿIkrimah, have interpreted *nusawwī banānah* as meaning to make the fingers and toes of humans similar to those of animals, which would naturally deprive humans of the ability to perform various tasks (al-Qurṭubī 1985, 19:94; al-Zamakhsharī 1986, 4: 660).

Al-Ṭūsī and al-Ṭabarī have interpreted *nusawwī banānah* as restoring human fingertips to their original state. They have emphasized the mention of fingers due to their precision and numerous components. They argue that a being capable of reassembling tiny bones is even more capable of reassembling larger ones (al-Ṭabarī 1985, 26:100; al-Ṭūsī 2010, 10: 19). Al-Zamakhsharī (1986, 4: 660) believes that fingers are exclusively mentioned in the verse because they are the last part of the body to be fully formed. Al-Rāzī (1999, 30:722) suggests that the purpose of mentioning fingers is to draw attention to the other body parts and to emphasize the Creator's ability to recreate. Abū Ḥayyān (1999, 10:346) considers bones to be the fundamental framework of creation and fingers to be the most precise and fragmented part of the skeletal system. He rejects the interpretation that suggests transforming human fingers into animal hooves, as it contradicts the apparent meaning of the verse. Al-Ālūsī (1994, 15:152) interprets *nusawwī banānah* as recreating fingers and their joints with the utmost precision and detail, without any defects or differences from the original state. He considers the phrase "Surely, We are Able" (Q. 75:4) to be an emphasis on the act of reassembly, as it implies a power that is capable of such a feat.

The recreation of the smallest part of the body can signify the recreation of all details and is proof of the recreation of bones and fingertips, followed by the rest of the parts, including veins, nerves, flesh, and skin (Ibn ʿĀshūr 1999, 29: 316). Contemporary commentators have emphasized that the word *banān* means the tips of the fingers and that *nusawwī banānah* refers to shaping them in exactly the same way we see them now (Tabataba'i 1996, 20:165; al-Ṭanṭāwī al-Jawharī 2004, 10:181; Qutb 1991, 6:3769). Perhaps the reason why fingers were specifically mentioned among all body parts is to draw attention to the wonder of their creation.

It has been said that the mention of *banān* to mean both fingers and fingertips indicates that God not only gathers human bones and restores them to their original state but also places the small and delicate bones of the fingers in their proper places and even restores the fingertips in their original, patterned form (Makarem Shirazi 1995, 25:279).

Considering the meaning of *banān* in lexicons and the opinions of commentators regarding *nusawwī banānah* in the verse in question, the mention of these two words indicates the recreation of fingertips based on wisdom, planning, and a specific purpose, with the same worldly characteristics. Most commentators consider the expression *nusawwī banānah* to be a subtle reference to the fingerprints of humans. These fingerprints, as we will explain in the following sections, have two important characteristics: they are unique to each individual and remain with the person from birth to death. This meaning can also be derived from the root of the word *banān*, as permanence and stability are two important features of this word, which are entirely consistent with the results of modern scientific research. In summary, the verb *najmaʿa*, used with *ʿiẓām*, signifies gathering. However, regarding *banān*, the verb *nusawwī* is employed, meaning arrangement. This suggests something beyond mere collection, possibly alluding to the ordered arrangement of fingerprint lines.

2.5. Balā

Based on interpretations, understanding the word *balā* is crucial for comprehending the relevant verses and their interrelationship. *Balā* consistently counters a negative statement, negating it. In the verse Q. 75:4, *balā* follows the negative and reproachful interrogative sentence: Does human suppose that we shall not put together his bones?

Furthermore, emphasizing the arrangement of *banān* clarifies its specific mention; it serves to dispel the audience's oversight. That is, following the affirmation *balā*, by introducing the arrangement of *banān* and using this specific term, the listener's attention is drawn to this unique and distinctive body part, whose lines and patterns conceal a world of secrets and mysteries.

3. Authentication Methods

In general, identification methods are divided into three categories. In the first category, the identity of each person is recognized through a concept called token. A token is something that every person carries with him and at

the same time it is his identity document, which includes smart cards, magnetic cards, keys, passports and birth certificates. These objects have defects such as being lost, not having documents, subject to being worn out or forged, which increases the risk of using them. In the second category, the identity of each person is confirmed through the knowledge he has memorized and is with him, such as password and PIN code. Of course, this category also has shortcomings such as forgetting and leaking. The third category of methods are based on biometrics. These methods use human physiological and behavioral characteristics for identification. This category no longer has the disadvantages of the previous methods and has increased security and accuracy to a great extent.

A good biometric identifier that can be used as a feature in the biometric system should have the following characteristics.

- Uniqueness: Each person has that characteristic uniquely and distinctly from others.
- Extractability: that feature can be obtained easily, at a high speed and without the need of many processes for each person.
- High discriminability: It means that the difference of this characteristic in the case of two different people is very large so that they can be easily distinguished.
- Stability: It means that the extracted feature remains unchanged over time and due to the changes, that occur in a person during his life.

Generally, there are two different types of people characteristics, which are used for identification in biometric systems. The first one is physiological parameters, which is based on the identification, measurement and analysis of a person's fixed characteristics such as fingerprints, the retina, the iris and the hand geometry. The second type is behavioral parameters, in which specific behavioral patterns of a person such as signature, sound and the intensity of a person's impact on the keyboard are the basis for his identification.

3.1. Biometric Technologies

A wide variety of technologies such as fingerprints, finger veins, footprints, hand geometry, retina, iris, face recognition, signature recognition, voice recognition, DNA testing, hand vein recognition, the temperature charts of the face, gait recognition, the intensity of hitting on the keyboard, the shape of the ears and the smell of the body are used to identify people, some of the most important of which are mentioned below.

3.1.1. Fingerprints

One of the oldest and the most well-known identification methods is fingerprint identification. The tip of the finger has a series of lines that continue from one side of the finger to the other side. These lines have a series of characteristic points which are called minutiae. These details include arcs, spirals, the rings, end of edges, branches, points (grooves close to the edges), islands (two branches close to each other), intersections (crossing point of two or more edges) and pores. In fact, the patterns generated from these details are compared in identification systems.

3.1.2. Finger Veins

Identifying people through finger veins is almost the latest and most advanced technology in the field of biometrics, and it is used in hospitals and military applications that require a high level of security. The ID verification process is very fast and without the need to contact a specific member. By using light radiation technique, the structural pattern of the vessel can be identified, recorded and finally confirmed. Many believe that identification using finger veins can have a higher accuracy rate than using fingerprints and it is impossible to fake them. With its unique features, the finger veins biometry is growing faster compared to the other ones such as DNA, iris, ear and smell. Another reason for the rapid growth of hand vein biometrics is its very low rejection and false acceptance rate. Vein patterns are unique for each person and there is no change except in their size over time, so it is difficult to challenge this technology. It is very interesting that the false rejection rate of this technology is about 0.01% and its false acceptance rate is about 0.0001%. The authentication process using this method takes about 2 seconds (Hou, Zhang & Yan 2022).

3.1.3. Face Recognition

The geometric form of a face is also one of the parameters measured in biometric systems, but it cannot be said that it is part of the unique characteristics of people. Therefore, this method is suitable in places where the number of users is small and sampling times are not long, it is also used to increase accuracy in multibiometric systems. In a basic mode of this method, certain fixed points of the face, such as parts of the eyes, around the nose and mouth, parts of the face, and those that surround the cheekbones are registered and recognized, which show the least sensitivity and change over time. In general, such systems do not have high accuracy because the

faces are not completely unique and sometimes it happens that two people (especially twins) are similar in terms of face. Therefore, such systems are only used in places where high security is not required (Wang and Deng 2021).

3.1.4. Iris Recognition

The iris is the colored part of the eye, which is a combination of a type of reticular tissue containing a series of radial, layered or net-like lines. These nets include a series of characters such as lines, rings, holes, grooves, strings and spots that can be measured. In the human body, the iris of the eye has an external structure, but it is somehow protected. It is a member that does not change over time, which makes it ideal for identification than other methods. It can be said that everyone's iris is different from each other.

Identity recognition based on iris images analyzes the characteristics that are located in the colored tissue of the eye enclosed between the pupil and the iris. The image of the iris is usually captured by a monochrome infrared camera (700 to 900 mm) such as CCD cameras. This method has a good ability to recognize people, but the volume of patterns in this method is very high. Implementing iris recognition technology requires an upfront investment in specialized hardware, and infrastructure installation and maintenance costs can be very high, making it prohibitively expensive for small businesses or organizations with limited resources. Due to its high accuracy, iris identification is widely used in military, government buildings and research centers that use advanced security facilities (Malgheet, Manshor & Affendey 2021).

3.1.5. Gait Recognition

Usually, this method is used in places where direct communication with people is not possible, especially in airports and security passages. In this method, body movements and characteristics such as stride length, limb angle, and walking speed are analyzed to create a unique biometric profile. This system can identify people from a distance of 50 meters even with their backs turned or their faces covered. The accuracy of gait recognition systems is reported to be 88%. Gait analysis cannot be fooled by limping, walking with open legs or hunching, because it analyzes all the characteristics of a body (Álvarez-Aparicio et al. 2022).

3.1.6. Hand Geometry

Instead of imaging the palm, hand geometry is a type of biometrics that uses the length, width, thickness, and surface area of fingers and hand as measurement criteria. In this system, the hand is placed in a certain place. Then, using a CCD digital camera with a good quality of about 32,000 pixels, the image of the hand is taken from the top and side views, which produces a 3D silhouette image of the hand. At least 90 measurements are taken and 31000 points of the generated silhouette image are analyzed.

Hand geometry recognition is the longest implemented biometric method and is widely implemented due to its ease of use, general acceptance, and integration capabilities. However, one of the shortcomings of the hand geometry feature is that it is not very unique, and the applications of the hand geometry system are limited only to the verification (of the persons whom data is stored in the system before). Hand geometry is highly reliable when combined with other forms of identification such as ID cards or personal identification numbers.

3.1.7. Conclusion of Biometrics

Each of biometric methods has its own advantages and disadvantages, which are listed in Table 1. According to the methods discussed in this section, it seems that the using fingerprint is easier and more available than other legal biometrics for many reasons.

1. It is one of the fastest and easiest authentication methods. In other used methods, the possibility of error in the identification system is high and the identification process is more complicated.
2. The level of security in using the fingerprint method is much higher than other methods.
3. Fingerprints are usually unchangeable and they usually return to their original shape and pattern over time or after injury.
4. Usually, other parts of the body that are used to identify people have at most one pair like them, such as the iris, the sole of the foot, etc., but in the method of using fingerprints, the lines on each finger are unique. And this case greatly increases the possibility of using this organ in identification (Shaheed et al. 2021).

Table 1. The advantages and disadvantages of biometrics (Shaheed et al. 2021)

Biometry	Fingerprint	Hand Geometry	Iris	Face	Retina	Voice	Sign
Ease of Use	High	High	Medium	Medium	Low	High	High
Error Factors	Age Dryness Pus	Injury Age	Insufficien t light	Light Age Hair	Glasses	Noise Sickness Weather	Sign change
Performance Accuracy	High	High	Very high	High	Very high	High	High
Cost	Low	High	Very high	High	Very high	High	High
Acceptance Rate	Medium	Medium	Medium	Medium	Medium	High	Medium
Security	High	Medium	Very high	Medium	High	Medium	Medium
Stability	High	Medium	High	Medium	High	Medium	Medium

3.2. Fingerprint Uniqueness

The uniqueness of each person's fingerprint can be proven either experimentally or theoretically. In the experimental method, first, a number of fingerprint samples are selected as representatives. Then the fingerprint matching system compares them with each other. The accuracy of the system will indicate the uniqueness of the fingerprint. According to Table 2, this work was done for the following records and it was found that the correct acceptance rate of this system is over 97% and its wrong acceptance rate is about 0.01%, which is due to the lack of quality of the captured images.

Table 2. Comparison of fingerprint images in different scales

Test Case	Comparisons	Dataset Size	No. of Comparisons
Large	A collection of 1 to 10 images of finger positions (such as flat, rolled and round)	About 48000 images	1.044 billion set to set comparisons
Medium	A picture of each finger (from the flat and round right index finger)	10000 images	100 million image-to-image comparisons
Small	A picture of each finger (from the flat position of the right index finger)	1000 images	1 million image-to-image comparisons

In the theoretical method, all the factors that can be effective in the individuality of fingerprints (both in relation to itself or another finger) are

considered, and by using a similarity scale, the probability that two fingers are exactly the same is calculated. In this method, the degree of freedom of fine points (local features) is checked along with some other fingerprint parameters such as Galton and Osterburg areas. In this way, during several years of investigation, the probability that two fingerprints are completely similar to each other are obtained according to Table 3.

Table 3. Probability calculation of the exact sameness of two fingerprints during years

Person	Formula	Probability
Galton (1982)	$\frac{1}{16} * \frac{1}{256} * (\frac{1}{2})^R$	$1.45*10^{-11}$
Pearson (1930)	$\frac{1}{16} * \frac{1}{256} * (\frac{1}{2})^R$	$1.09*10^{-41}$
Henry (1900)	$(\frac{1}{4})^{N+2}$	$1.32 * 10^{-23}$
Balthazard (1911)	$(\frac{1}{4})^N$	$2.12 * 10^{-22}$
Boze (1917)	$(\frac{1}{4})^N$	$6.87 * 10^{-22}$
Wentworth & Wilder (1918)	$(\frac{1}{50})^N$	$6.87 * 10^{-62}$
Cummins & Midlo (1943)	$\frac{1}{31} * (\frac{1}{50})^N$	$2.22 * 10^{-63}$
Gupta (1968)	$\frac{1}{10} * \frac{1}{10} * (\frac{1}{10})^N$	$1.00 * 10^{-38}$
Trauring (1963)	$(0.1944)^N$	$2.47 * 10^{-26}$
Osterburg (1980)	$(0.766)^{M-N} * (0.234)^N$	$1.33 * 10^{-27}$
Stoney (1985)	$\frac{N}{5} * 0.6 * (0.5 * 10^{-3})^{N-1}$	$1.20 * 10^{-80}$

4. The History of Fingerprinting

The first scientific and substantiated identification of fingerprints was obtained in the West at the end of the 17th century. In 1684 AD, the English morphologist, Nehemiah Grew, studied the protrusions and ridges, grooves and voids of human hands and feet. His writings were sent to the London Scientific Society. In addition, he provided detailed sketches of finger

groove patterns and palm areas.

In 1686, a professor of anatomy and plant morphology at Bologna University in Italy named Marcello Malpighi, when he was studying the use of the skin of the hand, examined the grooves and different patterns of the fingers and stated that the grooves details can be divided into rings and screws. Czech professor of anatomy and physiology, Johannes Evangelista Purkinje from the University of Breslau, was the first person to present a system for classifying fingerprints. In his dissertation, published in 1823, he described nine types of fingerprint patterns in visible detail, including an arc, a tentacle, two rings, and five types of spirals. He named each of these patterns and provided rules for categorizing each of them - many of which are still in use today. For the first time, he scientifically showed that fingerprints can be unique for each person.

William Herschel was the first European to realize the value of fingerprints as a means of personal identification. He took the first recorded image of fingers and palm for identification in 1858, when he was working for the Indian Civil Service. He recorded a picture of each person's right palm print to distinguish him from the rest of the employees so that others could not introduce themselves instead of another person when paying salaries. In fact, he established the concept that people can be distinguished from each other regardless of their name and whether they are literate or illiterate. Herschel introduced the use of fingerprints as a way to control forgery and developed character forgery in the distribution of rights. Over the years, by collecting a large collection of fingerprints, he experimentally proved that each person's fingerprint is permanent and unique over time.

In 1880, the Scottish physicist and surgeon, Dr. Henry Faulds, took a big step in the history of fingerprinting and the use of fingerprints. He studied fingerprints while working at Taukiji Hospital in Tokyo. He claimed that the details of the grooves of each individual's fingers are unique and therefore can be classified and used in solving crimes. In this way, by examining fingerprints, a criminal can be acquitted or his identity determined by comparing the fingerprints left at the crime scene.

Parallel to Faulds's studies, the famous English anthropologist Francis Galton was working on a book about the use of fingerprints in identification. Galton recognized the limitations of Alphonse Bertillon's method and published his definitive work. Today, many people know him as the father of fingerprinting for his contributions in this regard. One year after the publication of his book, the English urban police used fingerprinting as a method for crime detection, and in 1901, the body measurement method was banned for identifying people.

Between 1850 and 1931, Edward Henry closely followed the work and method of Bertillon and continued his work by adding the image of the left thumb to the measurement scales. Henry was sent to India as a high-ranking police officer in 1873 and, while working with Bengal officers, devised a fully functional and practical system of 1024 primary classifications. His efforts and works were neglected until years later. Finally, Henry published the use and classification of fingerprints in 1900. His classification system was used as a standard method until the introduction of automatic fingerprint identification system.

Edmond Locard was a medical and legal student and one of Bertillon's students. In 1918, he invented the first rules to prove that two fingerprints are the same, in order to calculate the minimum number of ridges that must be the same in two fingerprints to show that they are the same. Locard explained that if there are twelve matching points in two clear images with precise edges of fingerprints, the two fingerprints are certain to be the same.

Automatic fingerprint identification system is an automatic identification process that many countries use today. This system does the process using computer technology and especially coded digital images that can be searched and compared. Answering the question of who exactly invented the first automatic fingerprint identification system is not an easy task.

In 1986, the National Institute of Standards and Technology (NIST) in cooperation with the American National Standards Institute (ANSI) published a standard for the principle of exchange by means of fingerprint details. This standard is the first version of the exchange principle protocol that is used today by law enforcement officers around the world (Win et al. 2020).

4.1. A History of Understanding Fingerprint Significance

As mentioned in the previous section, the scientific findings about the uniqueness of fingerprints definitely and substantiated go back to the 17th century AD, and for this reason, it has been more important and investigated. But since the age of human attention to the lines on the finger goes back to BC, it is appropriate to discuss a little about this issue here.

Fingerprints have been discovered on various ancient artifacts, including clay tablets, seals, and pottery from various cultures. In ancient China, officials used fingerprints to authenticate government documents, while in Babylon around 200 B.C., fingerprints were employed to sign written contracts. As silk and paper became common in China, individuals began to impress their handprints on legal contracts. Additionally, during the Qin

dynasty in China, officials recorded fingerprints and other impressions as crime scene evidence (Barnes 2011).

4.2. Arab Knowledge of Fingerprints before Islam

Before Islam, the Arabs were familiar with some sciences, one of each was face recognition, which they could get some information from the face of a person. For example, from the shape and image of people, they recognized their family relationship to each other, or by recognizing footprints, hoofs, or shoes on the dirt and sand, they would find out the owner, so that they could find fugitives and lost livestock. The Arabs were so skilled in recognizing traces or footprints that they distinguish the footprints of young and old, men and women, maidens and widows from each other. There is no substantiated evidence that pre-Islamic Arabs paid attention to fingerprints as a distinguishing feature (Hawthorne et al. 2021).

Examining the above historical evidence, it seems that the remains of fingerprints discovered before Christ cannot be an indicator of human knowledge about the uniqueness of fingerprints at that time, and at most it can be said that it could be used to match a case in a limited area of people. Because from the time of finding the first historical documentary proof that humans realized the importance of fingerprints to the first substantiated discoveries after Christ, about 1200 years have passed, and this shows that mankind has only been interested in distinguishing fingerprints. Also, in all the discovered effects of finger lines, it can be seen that the clarity of these motifs was not high and it was used only to get confessions from people and to make it clear that the handwriting belongs to a specific person.

5. Conclusion

This research has explored the intriguing intersection between the Qur'anic concept of *banān* and the modern scientific field of biometrics, specifically fingerprint identification. By examining the Qur'anic verses Q. 75:3-4, conducting a lexical and interpretative analysis, and reviewing historical and scientific developments, the study has shed light on the potential significance of this connection.

The exploration of authentication methods has evolved significantly, encompassing various techniques such as passwords, biometric scans, and, notably, fingerprint recognition. Among these, fingerprint authentication offers rapid and straightforward identification with high security, permanence, and unparalleled uniqueness, making it a preferred choice in biometric systems.

Historically, humans have shown an awareness of the significance of fingerprints, dating back to ancient civilizations that used them as marks of approval or as identifiers in legal documents. This early understanding laid the groundwork for a systematic investigation into the uniqueness of fingerprints, which began to gain traction in the 17th century. As research progressed, the unique characteristics of fingerprints were eventually formalized in the 19th century by figures such as William Herschel and later institutionalized with the contributions of Edward Henry and Edmond Locard.

The Qur'an emphasizes the meticulous reconstruction of the human body, including fingertips, in the afterlife, using the term *nusawwī banānah*. While the exact meaning of *banān* has several interpretations, the general consensus leans towards its association with fingers and fingertips. The phrase *nusawwī banānah* is interpreted by most commentators as a subtle reference to reconstruction of human fingerprints, emphasizing their unique and permanent nature. This interpretation is supported by the etymology of *banān*, signifying permanence and stability, and aligns with modern scientific understanding. The contrast with the term *najmaʿa ʿiẓāmah* (gathering bones) highlights the specific, ordered arrangement implied by the unique patterns of fingerprints.

The study suggests a potential correlation between the Qur'anic concept of *banān* and the modern scientific understanding of fingerprints. This correlation highlights the potential foresight of the Qur'an in recognizing the unique nature of fingerprints for identification purposes, even centuries before their scientific validation.

Acknowledgements

The authors are deeply grateful to Interdisciplinary Qur'anic Studies Research Institute at Shahid Beheshti University for their invaluable financial support and guidance throughout this research project. The insights and expertise provided by the faculty members at the Institute have been instrumental in the successful completion of this study.

References

Abū Ḥayyān, Muḥammad ibn yūsuf (1999). *al-Baḥr al-Muḥīṭ fī al-Tafsīr*. Beirut: Dār al-Fikr.

Al-Ālūsī, Maḥmūd (1994). *Rūḥ al-Maʿānī fī Tafsīr al-Qur'ān al-ʿAẓīm*. Beirut: Dār al-Kutub al-ʿIlmīyyah.

Al-Baḥrānī, Hāshim ibn sulaymān (1994). *al-Burhān fī Tafsīr al-Qur'ān*. Qom: al-Baʿthah.

Al-Bayḍāwī, ʿAbdallah ibn ʿUmar (1997). *Anwār al-Tanzīl wa Asrār al-Ta'wīl*. Beirut: Dār al-Iḥyā' al-Turāth al-ʿArabī.

Al-Farāhīdī, al-Khalīl ibn Aḥmad (1988). *Kitāb al-ʿAyn*. Qom: Hejrat.

Al-Fīrūzābādī, Muḥammad (2003). *al-Qāmūs al-Muḥīṭ*. Beirut: Dār al-Iḥyā' al-Turāth al-ʿArabī.

Al-Jawharī, Ismāʿīl ibn Ḥammād (1990). *al-Ṣiḥāḥ Tāj al-Lughah*. Beirut: Dār al-ʿIlm lil-Malāyīn.

Al-Qurṭubī, Muḥammad ibn Aḥmad (1985). *al-Jāmiʿ li-Aḥkām al-Qur'ān*. Tehran: Nasir Khosro.

Al-Rāghib al-Iṣfahānī, Ḥusayn ibn Muḥammad (1991). *Mufradāt Alfāẓ al-Qur'ān*. Beirut: Dār al-Qalam.

Al-Rāzī, Fakhr al-Dīn Muḥammad (1999). *Mafātīḥ al-Ghayb*. Beirut: Dār al-Iḥyā' al-Turāth al-ʿArabī.

Al-Ṭabarī, Muḥammad ibn Jarīr (1985). *Jāmiʿ al-Bayān*. Beirut: Dār al-Fikr.

Al-Ṭabrisī, Faḍl ibn Ḥasan (1993). *Majmaʿ al-Bayān fī Tafsīr al-Qur'ān*. Tehran: Nasir Khosro.

Al-Ṭanṭāwī al-Jawharī (2004). *al-Jawāhir fī Tafsīr al-Qur'ān al-Karīm*. Beirut: Dār al-Kutub al-ʿIlmiyyah.

Al-Ṭurayḥī, Fakhr al-Dīn (1996). *Majmaʿ al-Baḥrayn*. Tehran: Mortazavi.

Al-Ṭūsī, Muḥammad ibn Ḥasan (2010). *al-Tibyān fī Tafsīr al-Qur'ān*. Beirut: Dār al-Iḥyā' al-Turāth al-ʿArabī.

Álvarez-Aparicio, C. et al. (2022). Biometric recognition through gait analysis. *Scientific Reports*, 12(1). https://doi.org/10.1038/s41598-022-18806-4

Al-Zabīdī, Muḥammad Murtaḍā (1965). *Tāj al-ʿArūs min Jawāhir al-Qāmūs*. Kuwait: al-Turath al-ʿArabī.

Al-Zamakhsharī, Maḥmūd ibn ʿUmar (1986). *al-Kashshāfʿan Ḥaqā'iq Ghawāmiḍ al-Tanzīl*. Beirut: Dār al-Kitāb al-ʿArabī.

Barnes, J. G. (2011). Chapter 1: History. In *Fingerprint Sourcebook*. United States: National Institute of Justice

Hawthorne, M., Plotkin, S. & Douglas, B. A. (2021). *Fingerprints: Analysis and Understanding the Science*. CRC Press. https://doi.org/10.4324/9781003037361

Hou, B., Zhang, H. & Yan, R. (2022). Finger-Vein Biometric Recognition: A Review. *IEEE Transactions on Instrumentation and Measurement*, 71. https://doi.org/10.1109/TIM.2022.3200087

Ibn ʿĀshūr, Muḥammad ibn al-Ṭāhir (1999). *al-Taḥrīr wa al-Tanwīr*. Beirut: al-Tārīkh al-ʿArabī.

Ibn Fāris, Aḥmad (1979). *Muʿjam al-Maqāyīs fī al-Lughah*. Beirut: Dār al-Fikr.

Ibn Kathīr, Ismāʿīl ibn ʿUmar (1998). *Tafsīr al-Qur'ān al-ʿAẓīm*. Beirut: Dār al-Kutub al- ʿIlmīyyah.

Ibn Manẓūr, Muḥammad ibn Mukarram (1993). *Lisān al-ʿArab*. Beirut: Dār al-Fikr/Dār Ṣādir.

Jafari, M. (2023). Study on Possibility of Miracle in the Qur'an Verses 55:19-22: How Qur'an Has Revealed the Formation Process of Pearls and Coral from River to Sea. *Journal of Interdisciplinary Qur'anic Studies*, 2(1). http://dx.doi.org/10.37264/jiqs.v2i1june2023.5

Karami, M., Talebpour, A., Tajabadi, F., & Hajimohammadi, Z. (2023). Emotion Detection from the Text of the Qur'an Using Advance Roberta Deep Learning Net. *Journal of Interdisciplinary Qur'anic Studies*, 2(1). http://dx.doi.org/10.37264/jiqs.v2i1june2023.8

Kāshānī, Muḥmmad ibn Murtaḍā (1989). *Tafsīr al-Muʿīn*. Qom: Marʿashī Najafī

Koutb, M. (2022). Water Breakdown during Photosynthesis and Transpiration in Plants as a Scientific Miracle in the Qur'an. *Journal of Interdisciplinary* Qur'an*ic Studies*, 1(2). http://dx.doi.org/10.37264/jiqs.v1i2.9

Makarem Shirazi, N. (1995). *Tafsīr-e Nimūnah*. Tehran: Dār al-Kutub al-Islāmīyyah

Malgheet, J. R., Manshor, N. B. & Affendey, L. S. (2021). Iris Recognition Development Techniques: A Comprehensive Review. *Complexity*. https://doi.org/10.1155/2021/6641247

Muṣṭafawī, Ḥasan (1989). *al-Taḥqīq fī Kalimāt al-Qur'ān al-Karīm*. Tehran: Ministry of Culture and Islamic Guidance.

Qarai, Ali Quli (2007). *The Qur'an: With a Phrase-by-phrase English Translation*. London: ICAS.

Qutb, Sayyid (1991). *Fī Ẓilāl al-Qur'ān*. Cairo: Dār al-Shurūq.

Razi, E., & Torkzadeh, J. (2023). Sustainability of Social Systems Based on the Holy Qur'an: A Multi-Study Mixed-Methods Research. *Journal of Interdisciplinary* Qur'an*ic Studies*, 2(1). http://dx.doi.org/10.37264/jiqs.v2i1june2023.10

Shaheed, K. et al. (2021). A Systematic Review on Physiological-Based Biometric Recognition Systems: Current and Future Trends. *Archives of Computational Methods in Engineering*, 28(7), 4917–4960. https://doi.org/10.1007/s11831-021-09560-3

Tabataba'i, M. H. (1996). *al-Mīzān fī Tafsīr al-Qur'ān*. Qom: Jāmiʿah Mudarrisīn.

Wang, M. & Deng, W. (2021). Deep face recognition: A survey. *Neurocomputing*, 429, 215–244. https://doi.org/10.1016/j.neucom.2020.10.081

Win, K. N. et al. (2020). Fingerprint classification and identification algorithms for criminal investigation: A survey. *Future Generation Computer Systems*, 110, 758–771. https://doi.org/10.1016/j.future.2019.10.019

Zare, F., Jaladat, A. M., & Baghbani, M. (2023). Being Awake at Dawn: A Religious Austerity or a Hygienic Recommendation (A Scrutiny Based on the Holy Qur'an, Traditional Persian Medicine and Modern Medicine). *Journal of Interdisciplinary Qur'anic Studies*, 2(1). http://dx.doi.org/10.37264/jiqs.v2i1june2023.12