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Tenprint fingerprint scanners All you need to know



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I Introduction

Fingerprint scanners are the most popular digital biometric authentication method used in law enforcement, the judiciary, citizen ID, consumer devices, etc. Multiple fingerprint authentication, i.e. all 10 fingerprints, is necessary for applications that demand high throughputs and accuracy. A special fingerprint device known as a "tenprint" or "4-4-2" scanner is used to scan and record all ten fingerprints. The 4-4-2 fingerprint scanning technology has become the standard for law enforcement and investigation agencies to scan and record fingerprints. Various governments employ the method for law enforcement, citizen ID registration, financial services, and border security. INTERPOL made approximately 1,600 identifications in 2019 as a result of increased exchange and comparison of fingerprint data among member countries.

Many governments are now collecting fingerprints of their citizens to streamline their citizen identification processes. The government adaption of fingerprint authentication is one of the main driving factors of the fingerprint market, which is growing at a CAGR of 14.5% during 2020-2027 (Allied Market Research, 2020). The research suggests Fap 30 devices will be the most lucrative ones.

I How and why automated Tenprint scanner become necessary?

To correctly identify a person, all 10 fingerprints must be recorded with the system for law enforcement and citizen ID. This is critical for investigation agencies. The FBI's identification section was established in 1924 to manage the central repository of criminal identification information. By the 1960s, the FBI registered the fingerprints of more than 15 million individuals, apart from 63 million civilian files. The 15 million individual identities contain 150 million fingerprints, which is very large to cross-check a print manually. Subsequently, classification extensions were added to reduce the portion of the criminal file that needed to be searched against each fingerprint card. Nonetheless, the manual method for finding and matching fingerprints was getting to the point where it couldn't keep up with the daily demand.

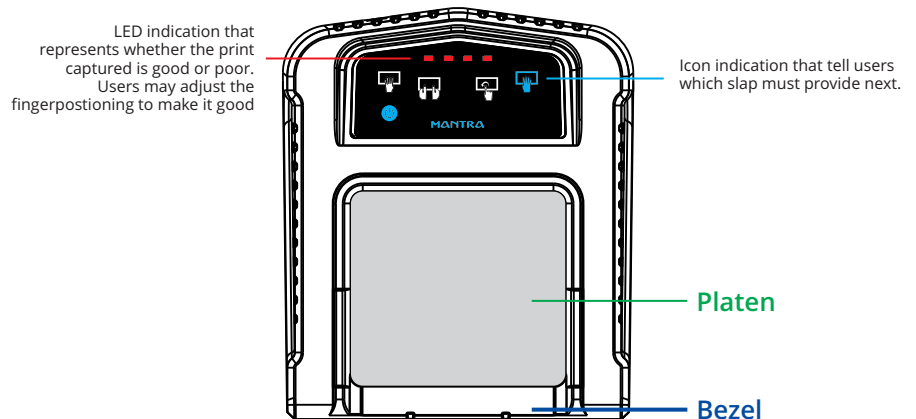
As a result, a new paradigm for registering, searching, and cross-checking fingerprints were required. In 1999, the FBI established the Integrated Automated Fingerprint Identification System (IAFIS), the world's largest database of criminal history data. Over time, the technology changed to add new technical capabilities, comply with legislative directives, and improve the quality and accuracy of their information services.



Eventually, IAFIS modified the "tenprint" scan system to the current 4-4-2 slap fingerprint scan and identification. The 'tenprint'-4-4-2 or "segmented slaps" is now being used for the authorization and verification of civilians. The four fingers of each hand are placed as a "slap" in a straight up-and-down position on a 3-inch high livescan platen in the scanning procedures. Similarly, both thumbs are photographed in one image, giving three photos for ten fingerprints. The resultant image file of the 4-4-2 transaction is easy to store, reduces collection time, and improves the captured-image quality from a content perspective due to the flat, straight, 3-inch placement

General scanning procedure for 4-4-2 prints.

Generally, almost all ten-print fingerprint scanner follows the same procedure for enrolling an individual. A ten-print scanner may have four LED indicators with four slap icons. The four icons depict the following actions: right four-finger slap, right thumb slap, left four-finger slap, and left thumb slap. Each icon indicator illuminates in sequence in which enrolling individuals have to place their fingers.



When the participant places each slap on the device, an LED indicator will illuminate for successful reading, and only then she can press the next set of fingers on the scanner. For example, when the participant places her left four fingers on the scanner, a corresponding LED lights up. If the scanning is successful, she can press her right slap on the reader. For the successful reading of a four-fingerprint slap, the device will check each of the four fingerprints to be readable quality. The indication will turn green only if the four fingerprints of one slap are good quality. Then the participant can move on to scan the thumbs. If the quality was insufficient, the scanner would stay on the same slap until a successful capture or the scanner timed out and moved to the next slap. Once all the ten prints are captured, the software associated with them will show the picture of the captured prints.



Software scanning

The software running on the attached PC to the scanner will show the picture of the captured fingerprints. The majority of this software includes an algorithm for determining image quality. Because the image has to meet some thresholds according to the application it is employed where the quality assessment of the scanner is not enough. Officials can request another round of scanning if the quality is poor; otherwise, officials can store it.

Image quality matters

The 4-4-2 fingerprint scanner scans and records the fingerprints of four fingers in a single picture, which necessitates image quality and clarity. Tenprint applications require an image with sufficient detail to extract the image characteristics of minutiae, the direction of ridge flow, patterns, etc. When pressing the slap with uniform pressure, it should be a clear image that differentiates the ridge shapes, deviations, and pore locations. As per AFIS standards, fingerprints scanned by a tenprint scanner are categorised into poor, fair, and good quality. The quantity of details recovered from a finger image usually determines these classifications.

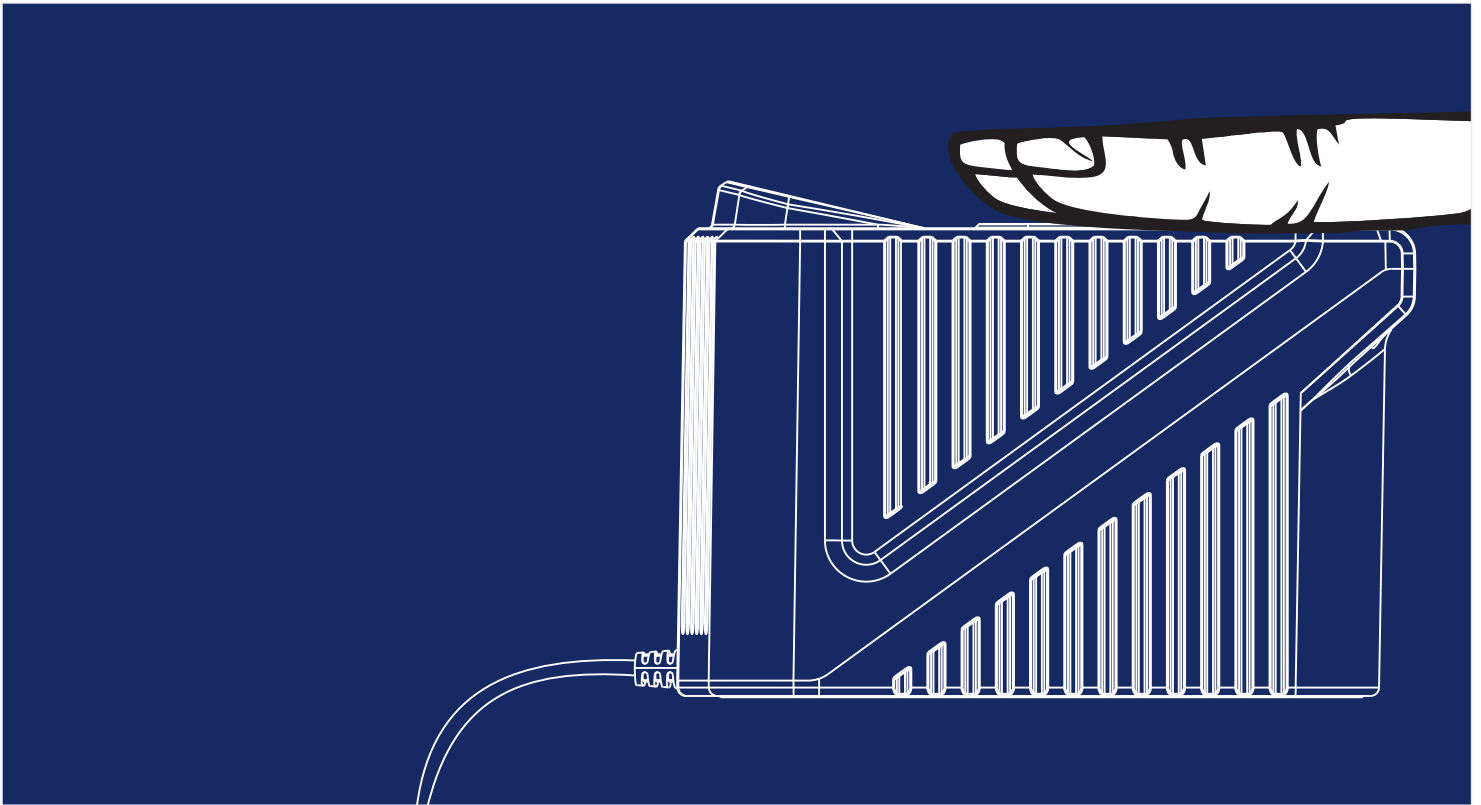
A poor fingerprint might be the result of a missing fingerprint, a bandaged finger, or a flaw with the scanner. However, the fingerprint should re-roll if the image quality is poor. The missing fingerprint might have occurred because of the finger being amputated or bandaged. Fingers that are bandaged or injured may not yield a good fingerprint image. In that case, officials may ask for another scan after the bandage is removed. A fair quality photograph contains enough features to identify a person, but it should be replaced by a good quality image if feasible.

A good print would be clear and adequate for fingerprint detection and comparison. A good print will contain three levels of details:

General ridge flow and pattern configuration: It might include information that allows for orientation, core and delta placement, and the differentiation between finger and palm.

Enable individualisation: It includes detail of formations, defined as ridge endings, bifurcations, dots, or combinations of these.

Dimensional attributes of a ridge: Ridge path deviation, width, shape, pores, edge contour, incipient ridges, breaks, creases, scars, and other permanent details.



Electronic Fingerprint Transmission Specification (EFTS)

EFTS defines the interface and communication protocols that interconnect the 'tenprint' hardware and software. It specifies the file and records content, format, and data codes required for the sharing of fingerprint identification information between federal, state, and local users and investigation agencies. The EFTS is also committed to ensuring image quality. It includes two image quality specifications.

Appendix F: IAFIS Image Quality Specifications (IQS), and **Appendix G:** Interim IAFIS Image Quality Specifications for Scanners. FBI certificate is provided to scanners only if the device meets the requirements of Appendix F or Appendix G. Such equipment includes livescan systems, fingerprint card scan systems, fingerprint card printers (grayscale), and integrated products.

Use cases of Ten print scanner

Forensic applications: Following the FBI, investigating agencies across the globe is using 'tenprint' scanners

The FBI is the pioneer in using 4-4-2 fingerprint scanners. They used the tenprint scanner to record the fingerprints of criminals and civilians to create a fingerprint database. The Automated Fingerprint Identification System (AFIS) is used to compare any fingerprints taken from a crime scene to the database. Law enforcement AFISs must compose two independent subsystems: the criminal identification and criminal investigation system. Each subsystem has a high degree of autonomy, and both are critical to public safety applications.

The 'tenprint' criminal identification system identifies or livescans a person's fingerprints as part of admission or arrest to determine if the individual already has a record. Latent print or criminal identification, on the other hand, is tasked with solving crimes by identifying fingerprints obtained from crime scenes and physical evidence. Devices employed in such circumstances are specially designed to collect and digitally enhance individual fingerprints.

Border security: European Union and the US using FAP device for border security

The European Union directed its member countries to use biometric assistance to record entry and exit from their ports. It is crucial for countries to record all ten fingerprints of a non-EU citizen. Border security authorities use livescan to check the clarity of each print at the point of scanning. Hence, the system includes an integrated display that shows the fingerprint image live during the capture, allowing them to collect fingerprints quickly and precisely.

The US Customs and Border Protection (CBP) law enforcement department has announced the installation of Integrated Biometrics Kojak ten-fingerprint scanners on more than 5,000 workstations at various US ports of entry.



Civil ID: Aadhaar for Civil ID registration in India

Aadhaar is the world's largest biometric citizen identification program, which aims to enrol all Indian citizens with their 4-4-2 fingerprints, an iris image, a photo, and other personal details. As of March 2021, 128.99 crore people have registered on Aadhaar. Aadhaar biometrics is used for the disbursement of government subsidiaries directly into the hands of beneficiaries. Indian citizens can authenticate themselves using either their iris or any of their fingerprints before the government to obtain services. Since all the ten fingerprint pattern has been enrolled in the Aadhaar repository, people can use any of their fingerprints to authenticate. The same facility helps find missing people, identify bodies and find culprits.

Conclusion

Tenprint scanners were developed to read and store fingerprints for law enforcement and forensic purposes. Now, 'tenprint' scanners are gaining traction in the banking and financial industries since registering fingerprints with 4-4-2 scanners allows consumers to authenticate using any of their fingers. 4-4-2 fingerprint reading facilitates forensic identification as well as the distribution of government programmes and financial services.

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