

# Capturing High-Quality Fingerprint Images: A Guide for Law Enforcement

Capturing good quality fingerprints is a challenge, as there are many circumstances that influence the image quality — whether they are behavioral, environmental, physiological or device related. Studies from the National Institute of Standards and Technology (NIST) have proven that image quality has a direct impact on finding a match. Poor image capture leads to three consequences:

1. Missed identification/verification of subject
2. The need to recapture prints, which leads to additional workload
3. Possibly additional fingerprint examiner workload due to efforts to inspect fingerprint images manually

This white paper explains the problems related to poor image capture and offers possible solutions to capture high quality fingerprint images at all times.

# Image Quality Is Important to Get the Highest Matching Results

Automated fingerprint identification systems are only as good as the fingerprints they are fed. This means that proper identification and good matching results can only be achieved if the captured fingerprint is high quality, which is defined by two different criteria:

## STANDARDS DEFINE THE BASIC REQUIREMENTS

Each fingerprint scanner used for enrollment must be certified to fulfill the FBI's standards as defined in Appendix F of the Electronic Biometric Transmission Specification (EBTS), which includes requirements for image quality, format and size. However, while most scanners can achieve good enough quality under the best conditions, they still struggle to produce good quality in adverse conditions

## HIGH CONTRAST OF RIDGES AND VALLEYS IS IMPORTANT

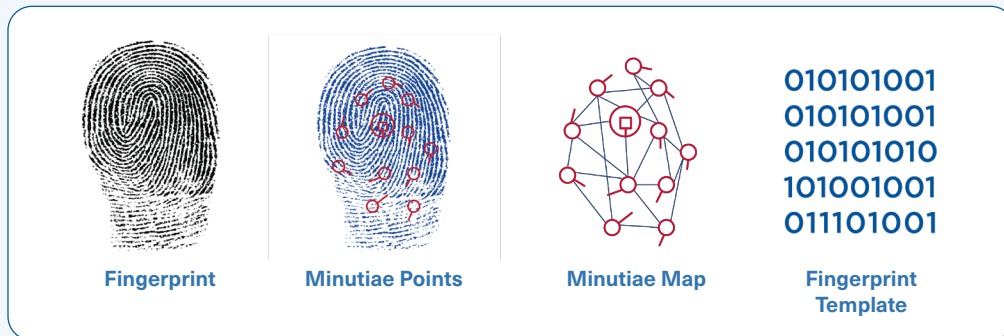
A high quality image is achieved when the ridges and the valleys of a fingerprint have high contrasts. When a high contrast is achieved, the processing software can better detect the unique patterns of a fingerprint. All fingerprint images are sent to the Automated Fingerprint Identification System (AFIS), which creates fingerprint templates for matching by extracting unique features of a fingerprint — the so-called minutiae points. The images will be retained so they can be examined by fingerprint experts for criminal cases if needed at a later stage. During identification, the AFIS or Automated Biometric Identification System (ABIS), compares the templates against the databases to check if there's a match.



# Capture as Many Minutiae Points as Possible for Superior Image Quality

Minutiae points are used to define the uniqueness of a fingerprint. Therefore, a superior image quality allows for a greater number of minutiae points which enforces the matching accuracy. Capturing enough minutiae in a fingerprint image is crucial. A good quality fingerprint image can have 25 to 80 minutiae.

When a fingerprint scanner cannot capture a good image, not enough minutiae points can be determined. As a result, the matching capabilities are lower. This is where fingerprint scanners differ in providing high image quality as well as features that facilitate the capturing of high quality images.



*Illustration of the process of how a template is extracted from a fingerprint image*

## COMMON ISSUES DURING FINGERPRINT CAPTURE AND SOLUTIONS



*Wet print vs. normal print*

### **Issue: Wet, Oily or Moist Fingers**

When a subject has oily fingers, the contrast between the ridges and the valleys can be too low, so that the white part between the ridges is not visible anymore. As a result, not enough minutiae points can be identified in the image to provide an adequate match. Similar effects can be seen with wet and sweaty fingers. This can cause a problem because the prints will change when the subject's fingers are cleaned, resulting in wrong matching results.

### **Solution: Discriminate the Moisture of the Finger in the Image**

Often, sweaty fingers will require drying between each capture to ensure consistency, as the print can change almost instantaneously as the applicant sweats, making the capture of like prints difficult. When a subject's fingers are moist, their fingerprint valleys can be filled with water instead of air. This can cause light to be absorbed by fingerprint valleys, instead of reflected, which leads to dark prints with poor contrast. Some fingerprint readers provide distinctive features, such as Moisture Discrimination Optic (MDO), to facilitate the capturing of wet, oily or moist fingers.

### **Issue: Dry Fingers**

Dry fingers are a common problem for the fingerprint capture process. A report from the World Health Organization (WHO) stated over 125 million people suffered from a dry skin condition. One reason is that fingers dry out due to the natural aging process. Another reason can be the occupation of a subject, which might cause a worn ridge structure. Dry fingers are also a common problem for those who sanitize their hands frequently and for travelers as the air in an airplane is very dry. According to an article from Reuters Health, adults with dry hands are four times as likely to fail a computerized fingerprint verification test than adults with normal skin.

### **Solution: Increase Contact Between Finger and Platen**

Although many fingerprint readers claim to be able to capture high fingerprint images from dry fingers, doing so requires specific technology. One method is to enhance the capabilities of the sensor through an additional layer on the platen. A silicone membrane, for example, increases the contact area between the finger and the platen, allowing better contrast between the fingerprint ridges and valleys without ever needing to interrupt the capture process again to apply hand lotion or ridge builder. A silicone membrane also can eliminate finger slippage when capturing rolls.

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### **Issue: High Temperature Difference Between Inside and Outside**

When the temperature outside differs largely from the temperature inside an office or station, the capturing of high quality fingerprints can be a challenge, as there can be water condensing from the fingers which often leads to a steam halo around the actual image. The halo effect diminishes the quality of the image, leading to lower quality search results.

### **Solution: Reduce Halo Effect in the Image**

A heated platen reduces the condensation on the platen and minimizes the halo effect for a consistent image quality regardless of ambient and hand temperatures. Thanks to the heated platen, a consistent image quality can be achieved at all times.

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### **Issue: Dirt or Scratches on the Platen**

Dirt, such as dust and scratches on the platen, in addition to the condensation of water as described above, can diminish the quality of an image, as the scanning area captures the fingerprint surroundings as well. The surroundings or noise prevent the software from recognizing the edges of the fingerprint, causing lower matching results.

### **Solution: Extraction of the Fingerprint Image**

The ability to eliminate the noise around a fingerprint image leads in better matching results. This feature automatically cleans the irrelevant areas around the fingerprint, letting the matching algorithms focus on what's most important. Dirty pixels from the final image will also be removed.



*Example of an image before and after the elimination of the noise*



*Example of a superior user guidance with pictograms on HID® Guardian™ tenprint scanner*

### **Issue: Long Capture Process Due to Wrongful Behavior**

Improper user behavior during the fingerprint acquisition process is the prime reason why fingerprints get rejected. An improperly placed fingertip, removing the fingers too quickly, and unsteady finger placement may cause fingerprints to get rejected.

### **Solution: Intuitive, Detailed User Guidance Through the Capture Process**

Nearly all fingerprint scanners offer user guidance features, although there are differences. Basic user guidance usually includes LED lights that show when to place slaps and thumbs. Pictograms, on the other hand, allow for all ten fingers to light up, indicating which finger to place next.

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### **Issue: Roll Direction Detection**

Capturing a high quality image from a rolled finger is a challenge. The enrollee needs to make sure that the finger stays on the platen with equal pressure during the entire roll. Often the finger is rolled too quickly, the roll is not wide enough, or the finger is not rolled uniformly.

### **Solution: Automated Image Quality Assessment**

The issue can be solved by opting for a fingerprint scanner with an automated image quality check. The continuous quality check during the entire process eliminates the guesswork of whether the image quality meets the required standards.

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### **Issue: Not Enough Print Details to Find a Reliable Match**

A crime scene does not always provide as much information about the criminal as law enforcement would like. In some cases, only partial latent prints can be found, and these prints do not contain enough information to effectively match minutiae points from a print to properly identify a suspect.

### **Solution: Capture Level 3 Details**

In these cases, capturing level 3 details of fingerprints, such as sweat pores, can be the key to identify the suspect. Level 3 details are used in visual fingerprint comparison by fingerprint examiners. As the measurements and location of sweat pores is even more random than the minutiae points, level 3 details are excellent for adding more evidence to an expert's conclusion.



# High Quality Scanners Produce High Quality Images

Quick, efficient capture of high quality fingerprint images ensures fast, accurate identity verification. Choosing a low end scanner might result in an image that may meet the minimum standards, but fail to capture enough details to produce any matches. High quality image capture, addressing the common issues outlined in this white paper, produces the results necessary to help law enforcement keep citizens safe and the country secure.

**Learn more** about how HID's biometric systems allow law enforcement to easily capture the highest quality images for fast, accurate identity verification.



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2023-05-18-eat-achieve-superior-image-quality-wp-en PLT-05628

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