

**ADVANCE™
SYSTEMS**

Workforce
Management
Solutions

Multi-Spectral Fingerprint Technology



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Introduction

Multispectral imaging is a sophisticated technology that was developed to overcome the fingerprint capture problems conventional imaging systems have in less-than-ideal conditions. The core problem was that conventional technologies rely on unobstructed and complete contact between the fingerprint and the sensor, a condition that is elusive in the real world.

The more effective solution was based on using multiple spectrums of light and advanced polarization techniques to extract unique fingerprint characteristics from both the surface and subsurface of the skin. The nature of human skin physiology is such that this subsurface information is both relevant to fingerprint capture and unaffected by surface wear and other environmental factors.



The net result is that Lumidigm sidesteps the problems that conventional technologies face in real world conditions. Additionally, our subsurface capability allows us to discriminate a real finger from an imposter or “spoof” fingerprint, making Lumidigm a leader in Liveness Detection.

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Dispelling some Myths about Biometrics

There are many misconceptions related to biometric technology that fuel its criticism. Consequently, we tend to overlook the many benefits that biometrics can offer.

Here we look at some of the most common myths that we have come across:

Biometrics and the Real World



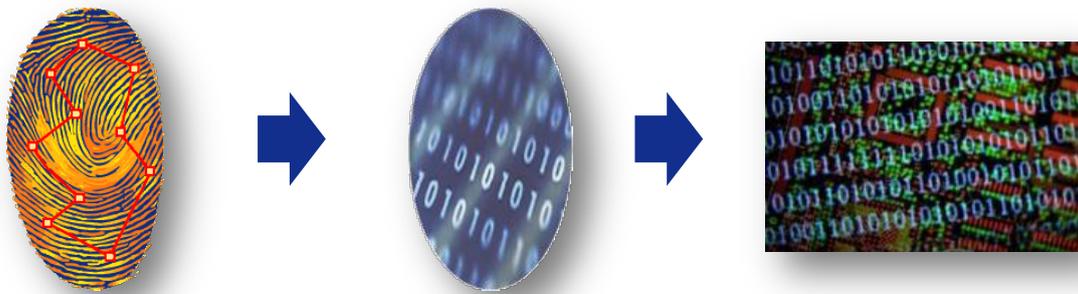
Many people believe that biometric fingerprint scanners won't work with dirty, greasy or wet hands, in addition to hot or cold environments – which is largely due to bad experiences they have had in the past with biometric systems.

This is certainly the case with conventional or older biometric technologies as they rely on clear and complete contact between a fingerprint and the sensor (which isn't always possible when you consider real-world, everyday situations).

However, the latest biometric systems utilise Multispectral Imaging – which takes unique fingerprint characteristics from both the surface and subsurface of the skin.

This subsurface information is unaffected by skin damage and other environmental factors.

Biometrics and Personal Security



Fingerprint Processing Representation

When an employee enrolls via a Mitrefinch biometric clocking terminal, the system saves a mathematical representation of key features in the fingerprint and then stores this as a template.

The template is then checked against those stored by the reader, for a possible match. If one is found, the employee's registration is accepted - otherwise it is rejected.

Contrary to popular belief, this biometric template cannot be reconstructed back to the original fingerprint image and is completely different to the fingerprint information stored, for example, by Police OR Corrective Services

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Spooing Biometric Systems

Unfortunately, traditional fingerprint identification and biometric systems can be easily circumvented. These outdated systems capture only the image of the fingerprint ridge surfaces that come into contact with the sensor.

These ridges are easy to imitate using common household products and ingredients. For example, a gummy bear that costs a few pence can make a very accurate fingerprint that will “spoo” a traditional fingerprint imaging device.

Since multispectral imaging technology observes the internal structures that conform to and dictate the external fingerprint ridge patterns, internal details can be compared to the surface pattern. The multispectral imaging technology used by Mitrefinch can verify that the “internal fingerprint” matches the external one.

Multispectral imaging technology is hard to fool. The inexpensive and readily-available films and prostheses that easily defeat conventional fingerprint devices are rendered ineffective against this cutting edge technology used in all Mitrefinch biometric systems.



SpooF Fingers

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What is Multi-Spectral Imaging?

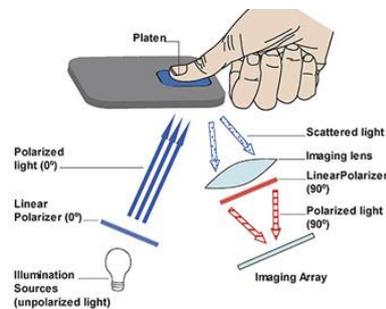
Further, since multispectral imaging technology observes the internal structures that conform to and Multispectral imaging is a sophisticated technology that was developed to overcome the fingerprint capture problems of conventional imaging systems in less-than-ideal conditions. The core problem was that conventional technologies depend on unobstructed and complete contact between the fingerprint and the sensor, a condition that is elusive in the real world.

The more effective solution was based on using multiple spectra of light and advanced polarization techniques to extract unique fingerprint characteristics from both the surface and sub-surface of the skin. The nature of human skin physiology is such that this sub-surface information is both relevant to fingerprint capture and unaffected by surface wear and other environmental factors.

The Technology

Multispectral imaging looks at and beyond the skin surface to the sub-surface foundation of the fingerprint ridges. Different wavelengths of visible light interact with the skin in different ways enabling significantly enhanced data capture. The fingerprint pattern on the skin's surface echoes the sub-surface structures from which they arose during development.

Multispectral imaging exploits the dependent relationship between surface and sub-surface fingerprint patterns. Sub-surface data collected by multispectral imaging technology supports and augments surface data to create the highest-quality fingerprint image available.



Schematic of a multispectral imaging fingerprint biometric sensor

The basic operation of the multispectral sensor is straightforward. The sensor consists of two main components: a light source, which provides the light to illuminate the finger resting on a platen; and an imaging system, which images this region of the platen onto a digital imaging array. While these components are similar to those of a conventional optical fingerprint sensor, the configuration of the multispectral sensor is expressly designed to avoid the optical phenomenon of total internal reflectance (TIR), used in a conventional sensor which depends on unobstructed and complete contact between the fingerprint sensors and the platen.

The multispectral illumination system consists of a source of multiple illumination wavelengths rather than the quasi-monochromatic illumination commonly used for TIR imaging. Linear polarizers are used in the illumination and detection portions of the sensor. The polarizers are arranged in an orthogonal configuration (a.k.a. polarizer-analyzer) to amplify the light that penetrates the surface of the skin. This then undergoes multiple scattering events before emerging from the skin towards the image array.

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What is a Fingerprint Template?

A fingerprint reader is not able to use fingerprint images (Fig. 1) because they are too large to store and take too long to process when doing a search to match one fingerprint with another.

Instead, the fingerprint readers use a special algorithm to find unique points such as where two lines meet or there is a break in a line. These points are called Minutiae (Fig. 2).



Figure 1



Figure 2

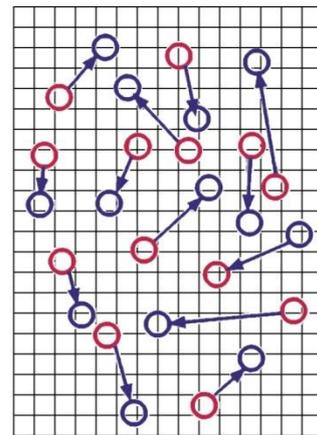


Figure 3

The coordinates and direction of each Minutiae (Fig. 3) are stored to form a template as a series of numbers relating to the coordinates. These numbers make a template much smaller than a fingerprint image as there is substantially less data making the search them much quicker.

One of the main advantages of using minutiae for fingerprint templates is that because they contain so little data, compared to a fingerprint image, they can never be used to recreate the fingerprint – neither by the manufacturer nor the police. This provides extra piece of mind in the fight against identity theft.

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Capturing a Fingerprint Template

In order for an Employee to be recognised by Mitrefinch Biometric Systems they must first have a Fingerprint Template Stored; this uses the Mitrefinch Fingerprint Enrolment Utility.

Enrolment can be performed from a Mitrefinch Biometric Time and Attendance Terminal, or by using a USB Fingerprint Enroller attached to a Computer to gather the Fingerprint Templates. Note: A TMS Supervisor login is required to add or remove Fingerprint Templates.



Fingerprint Enroller

Once the Fingerprint Enrolment Utility has loaded and the Supervisor has chosen the 'Enrol' Option they will be required to enter an employee's badge number and which finger is being enrolled. After this is completed the employee will be required to present their finger to the USB Fingerprint Enroller or terminal 3 times.

The quality of the Fingerprint Template produced will be rated on a 5 Star system (5 Stars being the highest quality). For accuracy, it is suggested that any Templates rated 3 Stars or below are redone. Should the Template be rated consistently low, ensure the employee's finger placement is correct. After the first finger has been enrolled it is suggested a second finger is also enrolled (usually from the other hand) following the same process as for the first.

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Using a Fingerprint Template

Fingerprint Templates can be used in two different ways: Identification and Verification:

- **Identification** — This takes a detailed image of the finger presented at the Fingerprint Reader and searches through the fingerprint template database (stored at the reader) to find the closest match to the captured image. The security level of the reader defines how close the match to the finger has to be to the Template stored in the database in order to be accepted.
- **Verification** — This requires an employee to identify themselves by presenting a Badge or entering their Employee Number at the Clocking Terminal before presenting their finger. As with identification, a multi-spectral image of the presented finger is captured. However, instead of searching the entire database, the finger is only compared with the template stored under the entered Badge / Employee Number. Since this is a match against only one template and not a search across the entire database this has a higher success rate of biometric matching; there is also a reduction in the read time in Verification mode.

A large number of false positives observed in a customer installation is normally a symptom of poor enrolment of a number of employees. This may be due to poor training of enrolment supervisors and them instructing employees to place their fingers incorrectly. Quality ratings of templates stored in the database can be reviewed, and subsequent re-enrolments can be actioned. If an employee continually suffers rejection, after re-enrolling, they should ensure they have positioned their finger correctly on the fingerprint reader (see Correct Finger Placement document). It should also be checked that the employee leaves their finger on the sensor long enough for it to capture a complete image (around 3 seconds).

There is also an option for Fallback Mode on every Mitrefinch Biometric Installation; this is particularly useful when an employee is constantly rejected by a Clocking Terminal due to their Fingerprint Template being of a poor quality or inconsistent finger placement.

There are two ways Fallback Mode can operate:

- **Fallback to Verify** — When in Identification Mode, the terminal will automatically put the Fingerprint Reader into Verification Mode when a user swipes a badge or enters their Employee Number on the keypad. Because verify only matches against a single Fingerprint Template, rather than searching the entire database, it is more reliable and so accuracy is increased.
- **Fallback to Badge Only** — In either Identification or Verification Mode, the terminal can be set up so that certain employees (with known 'Poor Enrolments') are able to clock using their Badge or Employee Number only. This has to be configured in Mitrefinch TMS, and is under the control of Supervisors to whom this feature will be given.

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Fingerprint Templates & Security

Fingerprints are stored neither locally nor remotely by any Mitrefinch System. Instead, Fingerprint Templates created from the coordinates of Minutiae are used for the biometric identification and verification of employees. These fingerprint Templates cannot be used to recreate an image of the original fingerprint by anyone; therefore secure storage for Fingerprint Templates it is not necessary.

Template Encryption & Storage

Fingerprint Templates which are captured during enrolment are not encrypted but are stored in a standard international proprietary data format called ANSI 378; this is an industry standard data format for the representation of Fingerprints using Minutiae.

The templates are stored remotely in a database on a Server and locally in each of the fingerprint readers. The local storage is frequently updated by the Server with the contents of the remote database. Neither of the storage locations need to be exceptionally secure since the stored Fingerprint Templates contain so little information about the original fingerprint that they are of no use to anyone.

Data Security

The remote database (normally SQL) is subject to all security features of the customers database, and as such only system administrators have access to read and modify the data it contains. This means that only trusted people, assigned by a company, will have access to its employees Fingerprint Templates. It is the responsibility of Supervisors to maintain the Template database.

This involves enrolling new employees and removing the Fingerprint Templates of any leavers, although the supervisors do not have direct access to the templates themselves. The Mitrefinch Application Suite does not offer the automatic removal of past employees although this could be achieved at a database level through the execution of scripts.

Accessing the local fingerprint template database, stored in the fingerprint readers, is exceptionally difficult. This would require the physical removal of a Fingerprint Reader (that has the database stored in it), the production of a specialist cable harness to connect the Fingerprint Reader to a PC via a USB or COM port, and a computer program capable of copying the Fingerprint Templates from the reader. Even if access were gained to the Fingerprint Templates stored inside the reader, little information would be obtained, because it is impossible to recreate a fingerprint from a Fingerprint Template.

Data Processing

Data processing is only carried out at Fingerprint Readers when a presented finger is matched with one stored in the Fingerprint Template Database. In Identification Mode this process consists of the Fingerprint Reader taking a Multi-Spectral Image of the finger and using a specialist algorithm to identify Points-Of-Interest (Minutiae) in the image. The Fingerprint Template Database is then searched to find a template which is closest to the image as possible. All Processing is done at the Mitrefinch Terminal.

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About Advance Systems

Advance Systems is Ireland's leader in employee management technology. Our on premise and cloud-based time and attendance system has earned us accolades from organisations of all industries and sizes.

With thousands of customers, our Time Management System (TMS) is now one of the most widely used systems of its kind. Through Advance Systems, companies are able to use TMS to drive performance and save millions of euro every year.

Our full range of products includes:

- Time & Attendance Systems
- Rostering & Employee Scheduling
- Cloud Hosted Solutions
- Absence Management
- HR Management Software
- Employee Self Service
- Biometric Systems
- Mobile Phone Clocking-In
- Performance Management / Job Costing
- Auto ID Card Production
- Fire Evacuation
- Visitor Management

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