SEIR™ Optic Technology

SecuGen's fingerprint technology is based on the advanced SEIR™ (Surface Enhanced Irregular Reflection) optic technology developed and patented by SecuGen. SecuGen's SEIR technology is used to obtain very high contrast fingerprint images with very low distortion. High contrast and low distortion are the hallmarks of excellent image quality, which is crucial for the accuracy and performance of a fingerprint biometric system. SecuGen's SEIR technology consists primarily of scattering principles combined with an innovative optical design. To understand the advantages of the SEIR technology over other methods, it is helpful to first understand the basics of traditional optical methods.

Basics of Traditional Optical Fingerprint Methods

Traditional optical fingerprint methods use the well-known principles of FTIR (Frustrated Total Internal Reflection) and the absorption of light. To produce a fingerprint image, a light source shines light on a finger placed at the surface of a prism, and the light that is scattered from the surface forms a fingerprint image. The behavior of light after it hits a fingerprint ridge or valley makes it possible to convey the contrast between ridges and valleys in the image.

How Fingerprint Image Contrast is Formed

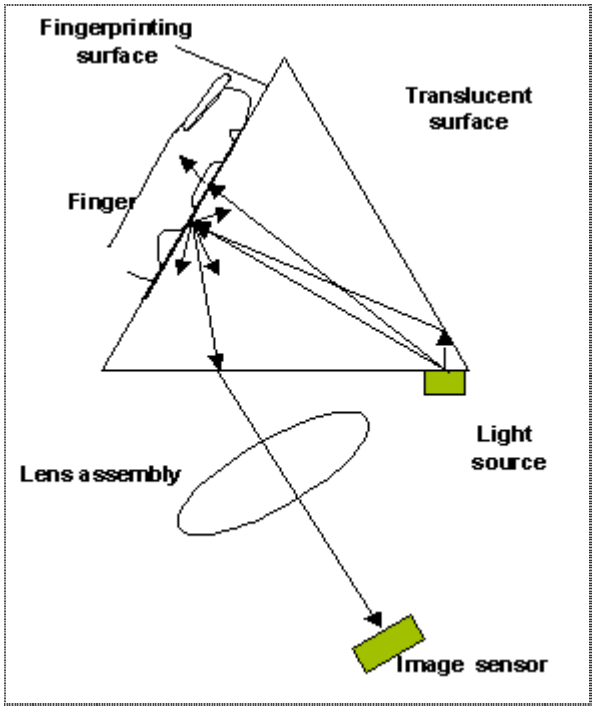
Under Total Internal Reflection conditions, when the light hits the valley of a fingerprint, the light is totally reflected, and therefore the valley appears as a bright spot in the image. When the light hits the ridge of a fingerprint, the light is partly absorbed by the ridge and become less intense when it reflects, and therefore, the ridge appears as a dark spot in the image. The contrast between the dark and bright spots of the image distinguishes the ridges from the valleys, respectively, and is influenced by the relative intensities of light reflected and collected by the image sensor.

Why Contrast is Important

Ideally, in a high contrast raw (not yet processed) image, fingerprint ridges should appear completely black while the valleys appear completely white. That way, when the computer processes the raw image, there would be no ambiguity between the black and white regions of the image and subsequently no loss of speed or efficiency in enrollment and matching. If some regions of the raw image were gray (i.e. low contrast), the computer would have to carry out decision-making steps to determine if the gray region belonged to the black or white regions. This would not only reduce the efficiency of the biometric system, but it would also introduce potential errors in matching if fingerprint features were incorrectly added or deleted from the raw image.

Problems with Traditional Methods

In reality, the ridges in an image are not completely dark but instead often have gray areas. The gray areas are caused by the fact that although most of the light that hits a ridge gets absorbed, some residual light is scattered from the ridge. This scattered light is collected by the image sensor and produces a non-uniform intensity of dark spots or gray areas in the image. As a result, fingerprint images generated by methods based on FTIR and absorption usually suffer from efficiency and accuracy problems arising from low contrast images.



SecuGen Sensor Diagram

Basics of SEIR Technology

SecuGen's SEIR technology shares some features in common with traditional optical fingerprint methods. To produce a fingerprint image, a light source shines on a finger placed at the surface of a prism, and the light that is scattered from the surface forms a fingerprint image. Similarly, the contrast between ridges and valleys of a fingerprint are brought about by the difference in behavior of light after hitting the ridges and valleys. However, SEIR technology overcomes the problems of low contrast inherent in FTIR methods. Additionally, SEIR technology overcomes the problems caused by distortion, found in many other optical systems.

How Fingerprint Image Contrast is Formed

SEIR technology uses scattering rather than total internal reflection and other optic/geometric conditions to produce a different kind of image contrast found in traditional methods. With SEIR, if the light hits the ridge of a fingerprint, the light is reflected and scattered. Most of the scattered light is collected, and therefore the ridge appears as a bright spot in the image. If the light hits the valley of a fingerprint, the light completely passes through the surface and does not scatter. Therefore, since no light is reflected from the valley, it appears as a dark spot in the image.

SEIR Forms High Contrast Images

SEIR technology overcomes the contrast problem inherent in traditional methods by allowing nearly all the light reflected and scattered from ridges to be captured by the image sensor and by not letting any light reflect from the valleys. This produces bright areas, corresponding to ridges, with relatively high intensity compared to the dark areas, corresponding to valleys. SEIR-based images have significantly higher contrast than images made from most other methods including other scattering methods. Such high contrast images directly increase the efficiency and accuracy of SecuGen sensors – which translate into faster enrollment and matching and lower rates of false rejection and failure to enroll.

SEIR Technology Produces Low Distortion Images

The optic design incorporated into SEIR technology also eliminates much of the distortion commonly found in most conventional absorption and scattering type optical methods.

Why is Distortion a Problem?

Typical distortion of a fingerprint image occurs when part of the image is stretched, compressed, or out of focus in proportion to the rest of the image. Distortion can cause serious errors when trying to match a distorted fingerprint against an enrolled, undistorted fingerprint, or vice versa.

Distortion can be caused by many factors. For example, in some absorption systems, the relatively greater size of the fingerprint area compared to that of the first lens in the lens assembly can result in blurry edges caused by non-parallel light paths that correspond to the edge of the image. In a scattering system, the angle between the fingerprinting surface and the lens assembly is often such that the path length of light reflected from one part of the finger is longer or shorter than the path length of light reflected from another part of the finger, and this difference in path lengths can cause part of the image to be wider than the rest of the image. Distortion can also be caused by the curvature of the lens assembly, whereby the outer edges of the image appear curved or out of focus. Furthermore, if a finger is placed on the surface in a position that's slightly different from where it was placed before, this could exacerbate the distortion problem, making it harder to match and causing a false rejection. As a result, users may be forced to precisely place their fingers in the same position each time their fingerprint is captured.

SEIR Helps Solve Distortion Problem

By simply adjusting the shape, size, and position of the lens assembly relative to the prism, distortion can usually be reduced but not without a cost to other factors such as image contrast and focus and size of sensor/lens assembly. However, the optic method and design embodied in SEIR technology work together with SecuGen's proprietary image processing algorithms to reduce the image distortion to very low levels without sacrificing image quality. SecuGen's current sensors yield images with less than 0.1% non-linear distortion, which helps SecuGen's fingerprint recognition systems perform more efficiently when verifying or identifying users.

