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Currently Used Swipe Fingerprint Sensors

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Abstract

This article is dealing with state-of-the-art in the field of swipe fingerprint sensors. It is trying to found out which sensor technology is the most produced nowadays. As it turns out the most used is some variation of the capacitive technology. This technology is the most promising for the future research.

Keywords*: swipe fingerprint sensors, sensor manufacturers, sensor technologies*

1. Introduction

Despite usage of the new touch fingerprint sensors in some smartphones, it is swipe technology that is the most used in fingerprint sensors that many people use every day. They are part of smartphones, tablets, laptops, ultrabooks and other personal electronics. It is because swipe sensor thanks to their small area of sensing are very cheap. Because you need to move your finger vertically through the sensor you also cleaning the sensor each time you use it. On the other hand this movement needs to have constant speed and steadiness or it creates inaccuracy when whole image is reconstructed. Because of that they are hard to use when compared to other types of fingerprint sensor. Consequently there have to be not only recognition algorithm, but also fingerprint image reconstruction algorithm that creates whole image from fragments that are scanned by the sensor as we can see in Figure 1.

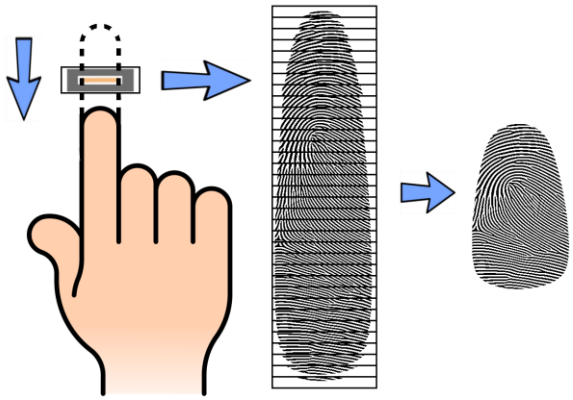

Figure 1. Sweep Sensing Technology Principle

2. Technologies Used in Swipe Fingerprint Sensors

There are several methods that can acquire fingerprint. If we talk generally we can list these technologies: optical, capacitive, thermal, ultrasonic, pressure, e-field, electro-optical, photonic crystals, optical coherence tomography. Not all of them are suitable

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form swipe sensors. Below are described technologies that are capable to be used in swipe sensors. [1, 2]

2.1. Optical Technology

They are based on Frustrated Total Internal Reflection (FTIR) principle. Figure 2 shows us this technology in detail. The finger is placed at the protective glass so that ridges touch the glass and valleys are in the distance. The ray from the light source is reflected by the ridges and absorbed (scattered) at the valleys. The reflected rays are channelled through the optics to CCD or CMOS camera. The protective glass is illuminated by the light source like we see in Figure 2. When protective glass is replaced by transparent roller tube and optics, camera and light source are in it then we have simple swipe optical sensor. It is also possible that roller is working like optics and camera with light source is beneath it. [1, 2]

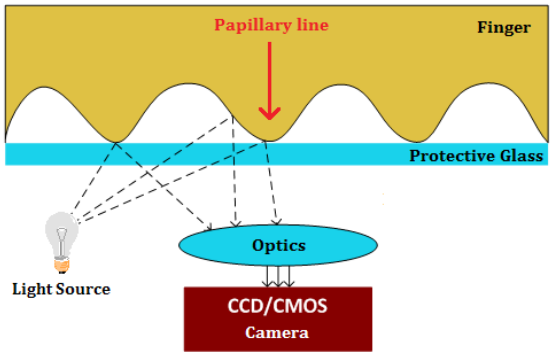

Figure 2. Optical Technology Principle

2.2. Capacitive Technology

The capacitive sensor is created by a two dimensional array of micro-capacitors plate. Ridges and valleys create the second part of these micro-capacitors. In Figure 3 we can see the difference between distances of a ridge and a valley and because of that capacitors have another electrical behaviour which can be measured. When is one of the dimension small we get a swipe sensor.

However there is one modification of capacitive sensor that is worth mentioning. It is combination of e-field and capacitive technology. It uses low radio frequency signal and because of that it is often known as RF technology. This signal is send to the skin, because of that between signal references plane and live (conductive) layer of the skin RF electric field is created. Its equipotential contours are mimicking shape of the live layer of the skin so when it is measured by antennae array we get fingerprint image. This principle we can see in Figure 4 [1-3].

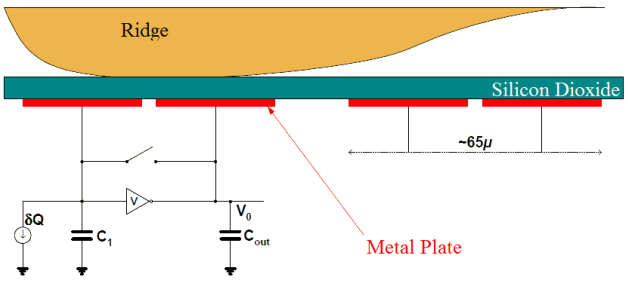

Figure 3. Capacitive Technology Principle

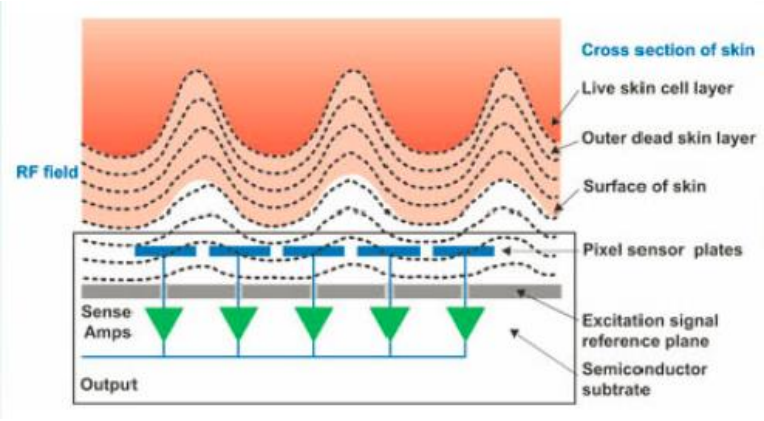

Figure 4. AuthenTec Inc. TruePrint Technology. Example of the RF Capacitive Technology Principle

2.3. Thermal Technology

Thermal technology is based on a different thermal radiation. Pyroeletric materials generate current according to various temperatures. Ridges have higher thermal radiation than valleys so they have higher temperature. Since temperatures quickly equalize, it is necessary to use sweeping sensors. Principle is shown in Figure 5. Despite of quick equalization there is company that is using heat pulse and provide touch thermal sensor. [1, 2, 6]

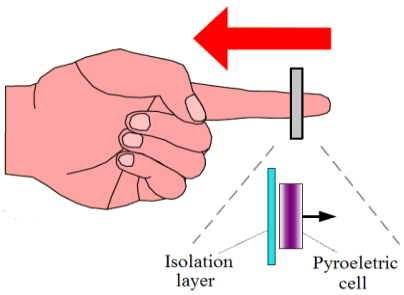

Figure 5. Thermal Technology Principle

2.4. Pressure Technology

If tactile MEMS (micro electro-mechanical system) is used it is possible to create a swipe pressure sensor. Zoomed picture (right) and overall principle (left) is shown in Figure 6. The user sweeps his finger along the sensor which consists of three rows of piezoresistive gauges. Their parallel deflection will create a voltage variation which is measured and transformed into the fingerprint. Resulting image is only binary-coloured which is big disadvantage of this type of sensor technology [1, 2].

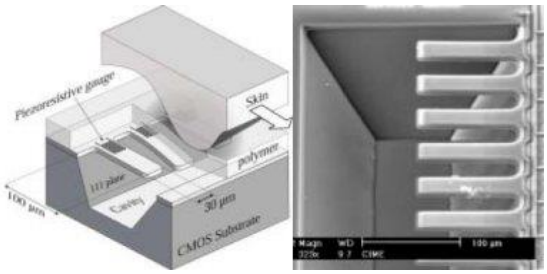

Figure 6. Tactile MEMS Technology Principle

3. Available Sensor Technologies

When determining which is currently the most used fingerprint sensors there are several approaches. First method is just to find recent relevant articles and sum them up. Unfortunately only one article of this kind was available and it was huge market research article which because of its extent and economic value was very expensive. Second method is attempt to find all producer of biometric sensor and evaluating their offers. This is method that will be described below. Third method is to find several big and influential companies and contact them for information about which fingerprint swipe sensor technology they using in their products. This method is probably the most accurate one but it relies on the answers of big commercial subjects. These subjects have some special contact form, but they are primarily for users that have some difficulties using their devices. For this purpose it is necessary to contact technology manager or research and development manager not some help desk assistant. Contact information for these high-ranking people are usually unavailable and only ways to contact them try to guess their e-mail address and hope for their answer.

With the chosen second method there are some issues. First is how to find ideally all fingerprint sensors producers. There are some lists of fingerprint producers that was used for this purpose [4, 5]. Some of the producers where found by other methods (using google, copying from e-shops, *etc.*,). Many fingerprint sensors producers do not have websites or their websites are not updated, only in the Chinese language, etc. In this environment it is really difficult to get relevant information. Found companies also often did not create sensor itself but was using technology of someone else. Last issue was that companies are buying other companies which leads to mixing their products lines and confusing when trying to find them.

As a note in several occasions determining if company is using standard capacitive or RF capacitive technology was very difficult. They usually described it as new leading technology of capacitive sensing and it was not possible in all cases to find if it is RF technology or upgraded standard capacitive. Below is the Table 1 of all producer that was found and sensor they are using. Information about which sensing technology they are using was found on each producer respective website.

Table 1. Sensor Producers and their Prevailing Technologies

Crossmatch	Capacitive
Idex	Capacitive
Synaptics	RF capacitive
Bio-Guard	Capacitive
Egis Technology	Capacitive
Nec	Optical
Fingerprints	RF capacitive
Sonavation	RF capacitive
Shenzen Cama Biometrics	Capacitive
Id3 Technologies	Thermal

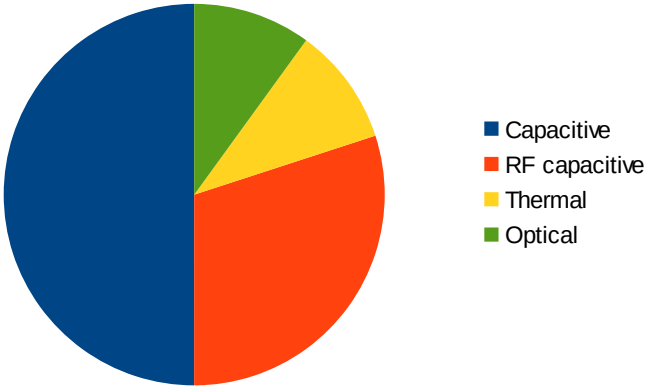

Figure 7. Distribution of the Used Sensing Technologies

4. Conclusion

From the Figure 7 it is safe to say that capacitive sensor is the most used sensor technology nowadays. The question is if it is standard capacitive or RF capacitive sensors. There are pretty much in same ration that is because Idex company uses SmartFinger technology but we cannot be certain if it is RF capacitive technology or not. It should be also said that thermal sensor was included in many simple ready-made solution (usually with Atmel sensor but that company is not active for 7 years). On the other hand in smartphones and notebooks it is usually used some capacitive sensor.

It is certain that it would be great to prove these results by third mention method, that is contact companies that uses fingerprint devices in large scale and gather their opinion on which sensor are their the most used or the most advanced.

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