

## International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 5, May 2018

# Under Display Finger Print Scanner for Bezel-Less Displays

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**ABSTRACT:** A fingerprint in its narrow sense is an impression left by the friction ridges of a human finger. Fingerprints are easily deposited on suitable surfaces (such as glass or metal or polished stone) by the natural secretions of sweat from the eccrine glands that are present in epidermal ridges. These are sometimes referred to as "Chanced Impressions".

Synaptics is using under-display CMOS image sensor that is significantly faster than iPhone X 3D facial recognition. We played with Samsung's Iris scanner too, that works quite well but it gets confused by a bright sun. A fingerprint sensor is prone to that and it is not a big secret that placing it under the display makes perfect sense. The sensor works whether your finger is dry or wet and the heat and cold do not affect performance and precision. The whole unlocking process looks like magic. There is a fingerprint animation on the display, you place the finger and the under-display CMOS image sensor lights up your fingerprint, capture an image of it, then unlocks your device. It is as secure as a traditional finger print reader that sits under the display, or on the rear side of the phone. Qualcomm is also working on its solution, but so far, Synaptic might be the first to ship its solution. Fingerprint scanners were mostly used on business level laptops with normal consumers ignoring it for most of the part. But, with cyber crimes soaring on one hand and user's proclivity for storing sensitive information on smart phones are increasing on the other hand, fingerprint scanners have become a viable form of authentication.

**KEYWORDS:** Fingerprint, Chanced Impressions, Qualcomm, Synaptic-recognition

### I. INTRODUCTION

As smartphone manufacturers shrink the bezels around a screen, there's less space for a fingerprint sensor on the front of the phone. Fingerprint sensors are used to unlock smartphones, and even access sensitive content like a banking app. Many Android manufacturers place these sensors on the back of the phone, so it doesn't affect the bezel-less trend. Some companies like OnePlus, LG, and Samsung offer facial unlocking technology via the selfie camera. Synaptics' Clear ID FS9500 is a mass-production-ready sensor the company will sell to smartphone manufacturers. It works under OLED displays, which most flagship smartphones use, and it's quite different from a traditional sensor. The fingerprint sensor on your phone now is capacitive, using electric current to capture your imprint. Clear ID is an ultra-thin optical sensor that captures your print with light emitting from the OLED panel on the smartphone. The full process works like this: The sensor detects the finger, the OLED display lights up the finger, the sensor scans the fingerprint, and the "matcher" verifies the image and confirms the imprint is yours, granting you access. The sensor can be placed anywhere on the screen the manufacturer wants, though Synaptics offers some general guidelines. The Clear ID sensor can work on rigid or flexible displays, and the company told Digital Trends it should work even if the phone has a screen protector, or if the screen is wet. Synaptics said the sensor is two times faster than 3D facial recognition, unlocking at about 7 milliseconds, that's on par with traditional fingerprint sensors today.

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It's unclear just how secure this under-glass fingerprint sensor is compared to present-day sensors, but Synaptics claims a 99 percent spoof attack rejection rate. It said the technology uses machine learning to help verify when there's an attempted spoof taking place.

## II. RELATED WORK

After years of waiting, it's finally here, an in-screen fingerprint reader. In spite of persisting rumours of Apple and Samsung working on the tech, Chinese manufacturer Vivo is the first to reveal a device with an under-glass fingerprint scanner, courtesy of a year-long partnership with synaptics.

The 6-inch phone doesn't have an official name yet, although it looks and feels very much like a near-final smartphone. It'll be headed to Asian markets next quarter, but the real showstopper here is that scanner, called the Synaptics Clear ID in-display optical fingerprint sensor, also known as the FS9500, which is positioned between the display glass and OLED panel. At Mobile World Congress Shanghai 2017, Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated (NASDAQ: QCOM), today announced Qualcomm® Fingerprint Sensors, next-generation ultrasonic fingerprint solutions which bring new and enhanced features to the previous generation Qualcomm Snapdragon Sense ID fingerprint technology. The suite of features consists of sensors for Display, Glass and Metal, detection of directional gestures, and underwater fingerprint match and device wake-up. It is also the first commercially announced integrated ultrasonic-based mobile solution to detect heart beat and blood flow for improved mobile authentication experiences. Fingerprint Sensors for Glass and Metal are the first commercially announced to scan through up to 800  $\mu\text{m}$  of cover glass and up to 650  $\mu\text{m}$  of aluminium, an improvement over the previous generation's 400  $\mu\text{m}$  capability for glass or metal.

The new suite of features, compared to the previous generation, supports more design flexibility for operators and original equipment manufacturers (OEM) by making it easier to differentiate products with unique form factors and advanced features and designs. Qualcomm Fingerprint Sensors for Glass and Metal are expected to be available to OEMs this month, and are expected to arrive in commercial devices in the first half of 2018. Qualcomm Fingerprint Sensor for Display is expected to be available for OEMs to evaluate in the fourth quarter of 2017.

## III. UNDER DISPLAY FINGERPRINT TECHNOLOGY

Synaptics had announced that they are working towards this futuristic technology. However, the smart phone maker has not provided any details about the smart phone. According to an image shared by the company's official Facebook page, the actual smart phone model will come with the new fingerprint technology. However, it is just a hint. Synaptics had said that they are working with top five OEM and they have started mass producing the FS9500 optical in-display fingerprint sensor. The FS9500 fingerprint sensors have the ability to sit underneath the display. Other benefits of the scanner will be that it is scratch-proof and waterproof. With such new technology in place, Vivo will be the first OEM to work with such kind of technology. Unlike optical fingerprint sensors used for access control and public biometric identity verification, the advanced FS9100 sensor leverages unique Synaptics optical technology developed for mobile devices and breaks through key technical barriers with an extremely thin form factor and minimal power consumption.

FS9100 optical fingerprint sensors feature Synaptics Sentry Point technology, offering OEM a wide-range of unique and highly secure authentication features including Quantum Matcher with Pure Print anti-spoof technology. Pure Print examines fingerprint images using unique artificial intelligence technology to distinguish between fake and actual fingers.

### ADVANTAGES:

1. Users do not have to pick the phone up to unlock the system.
2. It can be used for making fingerprint payments point of view.
3. It is being more secure in comparison to the other fingerprint scanner technologies.
4. Fingerprint scanners are unique and highly secure and they are easier, cheaper and faster to setup.

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5. The online transactions become more convenient when you tap the screen with your finger for maybe a fraction of seconds.
6. The sense ID is capable of working through glass, sapphire and aluminium so it can be integrated on various places on the smart phone.
7. Its interface solutions offer the ease of use and intuitive interaction that users demand.
8. The small, thin size of our interface solutions enables our customers to reduce the overall size and weight of their products in order to satisfy consumer demand for portability.
9. The low power consumption of our interface solutions enables our customers to offer products with longer battery life or smaller battery size.
10. It's interface solutions offer advanced features, such as force sensing, virtual scrolling, customizable tap zones, edge motion, and tapping and dragging icons, to enhance the user experience
11. The reliability of its interface solutions satisfies consumer requirements for dependability, which is a major component of consumer satisfaction.

## IV. OVERVIEW OF SYNAPTICS AND QUALCOMM TECHNOLOGIES

The most interesting announcement made earlier is vivo Under Display, a new ultrasonic fingerprint scanning technology. Based on Qualcomm's Fingerprint Sensors technology, vivo Under Display technology takes advantage of ultrasound waves to create a 3D map of the fingerprint. This technology captures far more information than standard capacitive-based fingerprint sensors in the market today.

More importantly, vivo Under Display's ultrasonic fingerprint sensor is capable of scanning through OLED displays of up to 1.2mm thick, allowing it to be placed beneath the screen. This means there is no longer a need for a dedicated button for a fingerprint scanner, and the promise of a "true" bezel-less smart phone in a fully integrated uni-body.

On top of that, Vivo under Display also improves waterproofing since there are fewer exposed parts on a smart phone. It is also usable underwater, with support for fingerprint gestures.

Apart from that, vivo has also introduced its very own digital signal processor for smart phone cameras. The new RK1608 dual-core DSP chip with 256MB integrated RAM is said to improve back lighting, low light photography, as well as selfie shots.

By increasing the photo processing speed by three times, multi frame processing on a smartphone is now possible. The DSP allows a smart phone camera to take multiple RAW pictures, which will later be processed and composed into a single RAW image, and then exported to the JPG format. Qualcomm Fingerprint Sensors are designed as both an integrated solution with Qualcomm® Snapdragon™ Mobile Platforms, and as standalone sensors that can be used with other non-Snapdragon Platforms. Qualcomm Fingerprint Sensors for Glass and Metal are designed to be compatible with the recently announced Snapdragon 660 and 630 Mobile Platforms, and Qualcomm Fingerprint Sensors for Display, Glass and Metal are designed to be compatible with future Snapdragon Mobile Platforms and non-Snapdragon platforms.

## V. FUTURE IMPLEMENTATION

The New suite of features, compared to the previous generation, supports more design flexibility for operators and original equipment manufacturers (OEM) by making it easier to differentiate products with unique form factors and advanced features and designs.

The experience to satisfy customers demanding design specifications and other requirements with numerous benefits, including the following:

- More ease of system integration.
- Reduce its product development cost.
- Shorter product time to market.
- Compact and more efficient platforms
- Improved product functionality and utility;
- Product differentiation.

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Its collaborative efforts with their customers to reduce the duplication and overlap of investment and resources, enabling our OEM partners to devote more time and resources to the market development of their synaptics in a claim last month highlighted that as many as 70 million units of in-display fingerprint sensors will be available this year. Mainly developed for thin-bezel OLED display panels with the taller-than-usual 18:9 aspect ratio, the Synaptic Clear ID sensors are mainly designed to replace the widely available fingerprint sensing solutions.

## VI. CONCLUSION

Nowadays, every mobile manufacturer is going in for bezel-less displays because of which the demand for the fingerprint sensors has also increased. For all the full-screen devices, the under-display fingerprint sensor is the most practical method to unlock the device.

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