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Backgrounder

Ranging at the Speed of Light

Touchscreens have revolutionized the smartphone market, enabling image zooming and fast switching between apps, among other indispensable features. In fact, according to a recent study[1], smartphone users spend more time browsing the internet (25 minutes a day), social networking (17 minutes), listening to music (16 minutes) and playing games (14 minutes) than they do actually making or receiving calls (12 minutes).

Unfortunately, touch-sensitive screens can also cause calls to be terminated because of accidental contact between the screen and the user's body. For this reason, smartphones have added proximity sensors to deactivate the touchscreen when the phone is being used as a phone, which is usually indicated by the phone being brought close to one of the user's ears.

However, even the best proximity sensors used in current smartphones don't actually **measure** the distance between the phone and the user's body; instead they **estimate** it by periodically emitting pulses of invisible infra-red light and measuring how much of this light is reflected back to an infra-red detector adjacent to the emitter. As the phone's emitter/detector moves closer to an object (such as the user's face), more light is reflected back and the touchscreen is deactivated when the reflected light level reaches a certain threshold.

The problem: the amount of light reflected back depends on factors other than distance, including hair color and head coverings that vary widely around the world. As a result, in some circumstances, the phone may "think" it is further away from the user's face than it actually is and not deactivate the touchscreen. In addition to the unnecessary battery drain incurred by the screen remaining active when the user is not looking at it, the result can be a frustrating terminated call if, for example, an earlobe makes contact with the "end call" icon on the screen.

ST's innovative F**light**Sense™ technology takes a completely different approach. It accurately measures the time it takes for the light to travel to the nearest object and be reflected back to the sensor. The advantage of this "Time-of-Flight" approach is that the time for the light to make the return journey is

[1] http://news.o2.co.uk/?press-release=making-calls-has-become-fifth-most-frequent-use-for-a-smartphone-for-newly-networked-generation-of-users

dependent only on the distance travelled, rather than the amount of light reflected back.

The keys to ST's patented new solution are an infra-red emitter that sends out particular patterns of light pulses, a sensitive light detector that picks up the reflected pattern of pulses, and electronic circuitry that accurately measures the time between the emission of a pulse pattern and the detection of its reflection.

This approach enables rapid, accurate distance measurements independent of the characteristics of the target object; from deep black to bright white, from rough to polished surfaces, the system consistently measures the same distance.

This is not the only benefit that ST's new F**light**Sense Time-of-Flight technology brings to smartphones. The ability to measure the distance from the phone to a hand or other object opens up new user-interaction scenarios that phone manufacturers and app developers can rapidly exploit. For example, one innovative application demonstrated by ST at the 2013 World Mobile Congress allows users to control the volume of ambient music by simply passing a hand over a nearby smartphone, with the distance between the hand and the phone determining the music volume.

ST's VL6180, the world's first Time-of-Flight proximity sensor, also integrates an Ambient Light Sensor (ALS), which is used to control the brightness of the screen under all ambient light conditions to maintain the optimum balance between the user's screen experience and the smartphone's power consumption. Although all smartphones now include this sensor, integrating it into the VL6180 reduces cost and improves performance.

Combining these three optical technologies into a single package required a significant collaboration between experts across the company, including specialists in technology development, product design and packaging innovation. As a result, the ready-to-use architecture with intrinsic robustness to optical cross-talk is easy to integrate and eliminates the need for smartphone manufacturers to undergo long optical and mechanical design optimizations and costly manufacturing and calibration.

ST's radical new distance measurement technology is not limited to smartphones and the Company sees many other potential new applications in areas ranging from healthcare to factory automation. The first implementation of this technology focuses on sub-15cm distance measurement for the smartphone market, but ST's roadmap includes extending the distance range to as much as 5m for both 1-dimensional and 3-dimensional range-finding applications.

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