PIONEERING TOF SENSORS FOR EASY-TO-USE 3D CAMERA APPLICATIONS

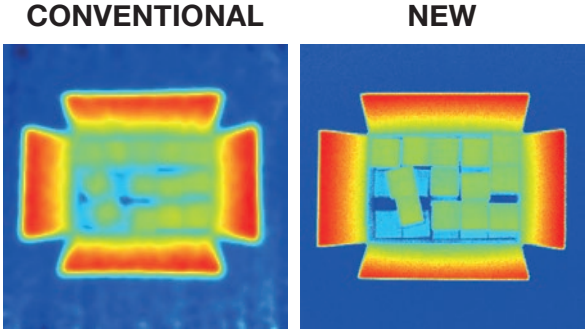
Time of Flight (ToF) sensors are becoming more and more important in many vertical markets, especially for 3D applications. Logistics is just one of the many promising applications taking advantage of this technology. New ToF sensors are finding their way into smart phones, drones, gaming consoles, self-driving vehicles, factory and warehouse robots, and many other machines and applications that interact with their environments.

In addition to imaging in X and Y directions, ToF 3D image sensors also provides Z-direction information, enabling 3D sensing. This is done by measuring the time between light that is emitted from the sensor to reach an object and then reflected back to the same sensor. 3D sensing enables the detection of objects that are difficult to see with conventional 2D images, such as determining the shape or volume of a box or identifying overlapping items. It is a promising technology for applications looking to retrieve distance information in real time.

SONY'S DEPTH SENSING SOLUTIONS WITH TOF SENSORS

New Sony ToF sensors such as IMX556 and IMX570, provided and supported by FRAMOS, further improve the accuracy, precision, and speed of ToF technology. Application designers benefit from more accurate depth information when implementing these sensors into their 3D devices.

Sony's IMX556 DepthSense™ ToF sensor brings the accuracy and precision of 3D sensing to new levels. With the unique DepthSense™ pixel structure, Sony's ToF sensor is able to more reliably reconstruct objects in 3D with more detail and with faster frame rates. This ToF sensor combines advanced technologies that provide fast and reliable real-time 3D imaging. By utilizing current assisted photonic demodulator (CAPD) technology with their high-performance backside illuminated pixel structure, Sony is able to realize maximum ToF performance.



ToF Sensors Versus Traditional Stereo Vision Camera Systems

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Time of Flight (ToF) technology presents a new set of opportunities for those developing 3D imaging systems. For indoor environments with target working distances of 0.5 to 6 meters, such as warehouses and factories, ToF technology provides a compact solution that can overcome certain lighting and object texture challenges where other 3D technologies could not. For applications that demand real-time object detection, ToF technology enhances 3D depth performance and simplifies application complexity over traditional stereo vision camera systems.

Sony's big innovation over existing TOF sensors is that they are smaller and can capture depth information at greater distances. Its back-illuminated technology is considered state of the art for converting photons into electrons. An intriguing aspect of this ToF technology is that it provides a better identification of faces for mobile phones.

WHAT IS CAPD

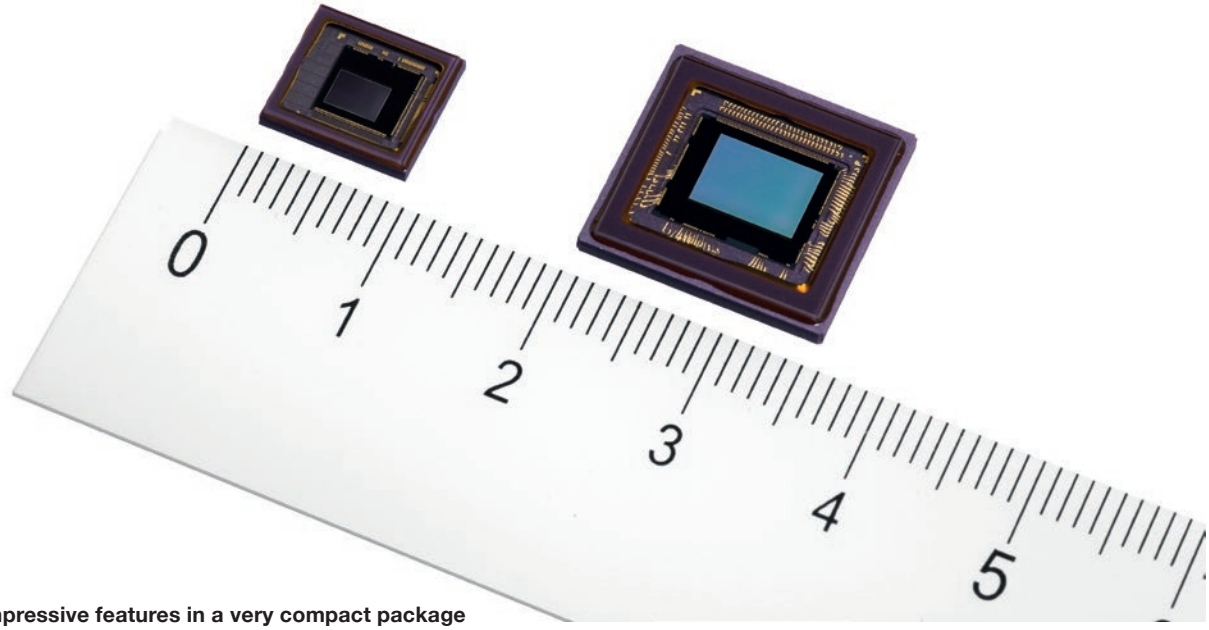
ToF sensors measure the distance by measuring the time needed to reflect light off an object or plane. The light is typically generated by a laser or an LED on or near the sensor which is then captured by this same sensor. There are two main types of ToF implementations: Direct ToF (dToF) which involves a simple, direct measurement of the time before a reflection is detected: and, Indirect ToF (iToF) which measures distance by collecting reflected light and discerning the phase shift between emitted and reflected light.

In order to accurately calculate the phase-shift, the IMX556 utilizes a current assisted photonic demodulator (CAPD) pixel structure that samples incoming light synchronously with emitted light modulation. CAPD provides an effective way of demodulating and collecting electrons inside the photodiode. Sony's backside illuminated (BSI) technology ensures the maximum amount of light reaches the photodiode. This allows for better light collection efficiency.

Because the IMX556 is a CMOS based sensor, it performs better against smearing and blooming versus CCD based ToF sensors, thus reducing unwanted image artifacts.

SONY'S TOF PRODUCTS – A GREAT PROGRESS IN 3D VISION

Sony's iToF image sensors detect distance information through each pixel, creating highly accurate depth maps. These sensors are built with a pixel technology which accurately detects reflected light, combined with the back-illuminated CMOS image sensor technology with high sensitivity and low-noise. Advances such as multilayer wiring also enable faster processing. Greater efficiency of collecting reflected light and faster processing speed lead to higher accuracy of distance measurement.



Impressive features in a very compact package

PIONEERING TOF SENSORS FOR EASY-TO-USE 3D CAMERA APPLICATIONS

Sony's IMX556/IMX570 sensors are especially effective in high-speed, high-resolution 3D imaging of objects over both short and long distances.

MODEL NAME	IMX556	IMX570
Resolution	0.3M	0.3M
Number of effective pixels	642(H) x 484(V)	648(H) x 488(V)
Image size	type 1/2	type 1/4.5
Max. frame rate	60 fps	30 fps
Recommended light source wavelength	850nm or 940nm	850nm or 940nm
Pixel size	10µm × 10µm	5µm × 5µm
Modulation frequency	4~100MHz	2~120MHz
Interface	MIPI	MIPI

All in all, Sony's DepthSense™ ToF sensors enable reliable, accurate, and precise 3D measurements. The combination of the innovative CAPD drift field technology and Sony's expertise in back-illuminated CMOS make these DepthSense™ sensors excellent choices for industrial camera integrations.

Delivering High-Resolution 3D Images

iToF pixel and back-illuminated CMOS image sensor technologies from Sony enable high resolution, high accuracy and smaller sensor sizes for ToF systems. The sensors are ideal for high-precision object recognition in tight spaces, such as on a robotic arm.

Suppressing Motion Blur

Unlike mechanical laser scanning, the ToF system does not use any moving parts. This allows fast frame-by-frame acquisition of 3D depth maps with less motion blur from moving objects, such as products on high-speed conveyor belts.

Reducing Processor Loading

Using ToF sensors, distance information is obtained through simple on-chip processing. This makes it easier to build a depth-sensing environment, compared to conventional camera imaging that requires external processors to get the same information from multiple images and/or cameras. Even when omni-directional or multi-angle images are generated from several cameras in real time, sensing can still be performed with a low processing load-based system configuration.

Improving Robustness in all Environments

IMX556/IMX570 can be used for both indoors and outdoors applications, including under low light environments such as unlit warehouses, or equally in bright sunlight.

PIONEERING TOF SENSORS FOR EASY-TO-USE 3D CAMERA APPLICATIONS

A GREAT VARIETY OF APPLICATIONS

Sony DepthSense™ Solutions provide ToF technology for consumer electronics, automotive and industrial applications. FRAMOS has developed tools to help customers build imaginative and intuitive applications based on these sensors.

Logistics

Ideal for optimizing material handling lines to measure positions, sizes and loading rate of pallets or cargos, and for autonomous mobile systems such as AGVs and last-mile robots.

Factory Automation

Intrusion detection into hazardous areas, operation monitoring and object location detection for robotic pick-and-place are some common uses for this technology.

Crowd Monitoring and Control

Easy and accurate measurement of crowd levels at stores, airports, theme parks and other public locations as well as sophisticated access control can be easily managed with ToF based cameras.

Farming and Agriculture

Quality control and productivity improvement, such as for automated milking, body condition scoring, feed amount detection, automatic fruit picking, and other shape related applications benefit from leveraging Sony's DepthSense™ based sensors.

Environmental Features or Object Detection

Vision systems with these sensors can support driver assistance, vehicle automation, site visualization/ documentation among other many other applications.

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