TECHNICAL INSIGHTS

MICROELECTRONICS

TECHNOLOGY ALERT

IMAGE RECOGNITION CAPABILITIES FOR FLEXIBLE ELECTRONICS

Leading consumer electronics companies are developing new products and slated to radically change the ways users can interact with their gadgets. While touch screens are becoming a standard feature in modern smartphones and tablets, vision-based gesture recognition is a promising alternative due to intuitiveness and ease of use. Developments in this area are motivated by manufacturers' constant search for new ways to win customers.

Researchers from the Johannes Kepler University Linz, Austria, have demonstrated what is said to be the first flexible image sensor that offer benefits of breakthrough form factor, transparency, and low thickness. The sensor surface uses a luminescent concentrator (LC) polymer, based on fluorescent particles, to detect incoming light. It does not require any additional electronic component to operate. The polymer film is able to capture light of a specific wavelength and channel it to an array of sensors surrounding its surface. To assess location where light enters the surface, the sensor relies on calculating the extent to which the signal diminishes before approaching the sensor.

As Oliver Bimber, one of the researchers who developed the technology, explained during an interview for Technical Insights, "Light that enters the film, for example, the light of an image that is being focused on the film's surface, is partially trapped inside the film and transported toward the film's edges. At the film's edges, we measure the amount of light that is transported inside the film toward each edge position, coming from each direction. With these measurements, we reconstruct the focused image just like a computer tomograph reconstructs images from X-ray measurements." To achieve such functionality, the team cut the edges of the film into small area triangles, each one acting as a simple one-dimensional pinhole camera. The array of these triangles allows recording a two-dimensional light field inside the film from which the image can be reconstructed.

Currently, the device can acquire grey-scale images in the resolution of 64 × 64 pixels. Researchers believe the use of better photodiodes will lead to further improvements in the device's capabilities. Bimber said, "The biggest challenges are related to manufacturing. The simple pinhole camera triangles are easy to cut into the film--but they are not very light efficient. Because of this, we need to measure with long exposures that reduces the maximum resolution we can reconstruct. We are working on a new optical design with printed optics and light fibers that improves our sensor."

Interesting opportunities are expected to emerge from integrating several sheets of polymers, each sheet optimized for a different light spectrum. This could lead to production of multicolor image sensors with high resolution, as layers sensing different bandwidth can be placed on top of each other. This is in contrast to the conventional approach, in which pixels sensing different colors are integrated alongside. The other area for improvement is in the speed of reconstructing the image. Faster computation algorithms will be critical for improving resolution of the sensor.

The advantage of the technology developed by the researchers is its low-cost fabrication, even for large area designs. As such, the technology might be layered on screens to provide enhancement for televisions with gesture recognition capabilities. Mobile electronics, such as, tablets, or smartphones, can especially benefit from this development due to its low weight and thin form factor. The possibility of touch-free and transparent interface provides incentive for developers of consumer products to integrate the technology in their products. The consumer market has provided traction to image sensing technology, as new smartphones and tablets are incorporated with cameras with cutting edge performance for increasingly demanding customers. However, the flexibility of the light sensitive film allows the technology to tackle applications beyond flat displays. The sensor

material can be attached to complex surfaces and scaled to different sizes, leading to innovative products not possible even with current state-of-art image sensor technology.

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