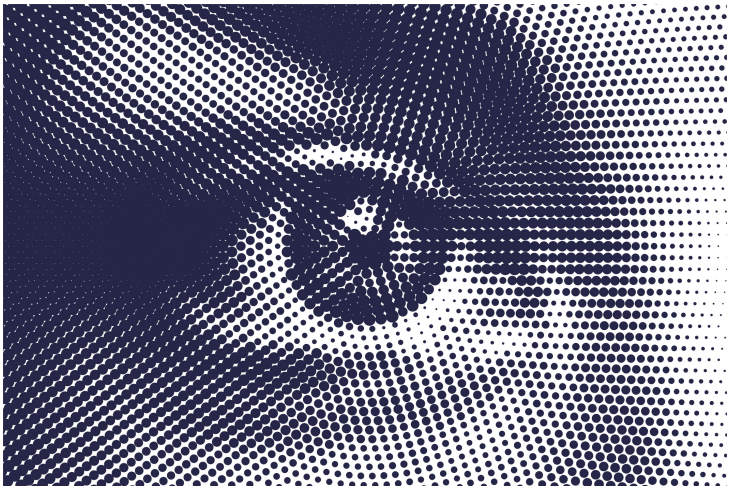
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

# Simultaneous Imaging And Energy Harvesting Pixel Structure For The Self-Sustained CMOS Image Sensor

**TECHNOLOGY NUMBER: 7765**



## OVERVIEW

A complementary metal-oxide-semiconductor (CMOS) integrated circuit

- Capable of simultaneously generating power and capturing images
- Useful for internet of things (IoT) devices in power-limited circumstances

## BACKGROUND

Complementary metal-oxide-semiconductors (CMOS) image sensors are useful in devices such as digital cameras, smartphones, and medical imaging systems. The desire for continuous monitoring via distributed sensors has increased with the expanded penetration of the Internet of Things (IoT). Still, the requirement for a separate power source to run CMOS image sensors limits their portability and convenience, stimulating research into self-sustained devices. One route for achieving this goal would include development of ultra-low power sensors, though interest persists for a self-sustaining operation via energy harvesting. A natural route for energy harvesting would be to convert light energy into electricity through a photovoltaic process, though poor efficiency due to a low fill factor makes this difficult in practice. So, a need exists for an improved method to manufacture self-sustained CMOS image sensors.

### Technology ID

7765

### Category

Hardware
Engineering & Physical Sciences
Semiconductor, MEMS, and Electronics

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## INNOVATION

Researchers have devised a technology that provides a new complementary metal-oxide-semiconductor (CMOS) integrated circuit that can generate power and capture images at the same time. The device uses an array of 100 X 90 pixels, each of which have an area of 5 X 5 square microns. The pixel structure stacks two diodes vertically in the same pixel, one of which acquires a positive charge and acts as the image sensor while the other collects electrons while operating as the energy harvester. The first pixel structure can generate more power than it consumes when operating at 15 frames per second (fps) if the illuminance is greater than 50 klux, while the second pixel structure requires 70 klux for generation to match consumption at 7.5 fps. The device provides photovoltaic energy harvesting via this pixel structure with a high fill factor of up to 47% for the imaging photodiode and 94% for the photovoltaic diode, a significant improvement over existing technologies. Further refinements may include a lower medal option in the CMOS fabrication process which could lead to higher energy-harvesting efficiency.

## PATENT APPLICATION

Number: PCT/US2019/19263

## References

1. Park S, Lee K, Song H, and Yoon E. , Simultaneous Imaging and Energy Harvesting in CMOS Image Sensor Pixels. IEEE Electron Device Letters, vol. 39, no. 4, pp. 532-535, April 2018