1. Abstract

This project is aimed to implement the paper named Oreste Sgròtt, Daniel Mosconi, Matteo Perenzoni, Gianamaria Pedretti, Lorenzo Gong, and David Stoppa, "A 134-Pixel CMOS Sensor for Combined Time-of-Flight and Optical Triangulation 3-D Imaging," in IEEE JOURNAL OF SOLID-STATE CIRCUITS, VOL. 45, NO. 7, JULY 2010. Instead of using 0.35-μm 2P4M CMOS technology, we verify the idea of the paper with 0.18-μm 1P6M CMOS technology.

The architecture presents a CMOS smart sensor capable of measuring the distance of the objects. The main idea of the sensor is to acquire the optical information with the distance of the object. After the operation of the chip that can eliminate the unnecessary noise, we can get the distance of the object with a high precision.

2. Pixel Operation Principle

We set up the optical system for the pixel array as shown below. By measuring the spot reflected from the target, we can get the target distance Z(p):

\[ Z(p) = \frac{F \cdot D}{p + F \cdot \tan \theta} \]

3. Chip Architecture

The chip architecture, shown in Fig.2, is composed of three parts: Pixels array, Winner-Take-All, and Output Buffer. The following discussion concentrates on two significant circuits – Pixel Array, Winner-Take-All.

A. Pixel Array

The Pixel Architecture, shown in Fig.3, can be divided by three parts: First Stage, Sample-and-Transfer Stage, and Second Stage. We can acquire the desired signal without the background noise by the operation of switches in timing diagram, shown in Fig.4.

4. Simulation & Specification

5. Layout and Chip

6. Conclusion

- The extraordinary characteristic is that we can acquire the 3-D information of the target object by integrating optical system and this circuit design.
- The advantage of this architecture is efficiently eliminate the background noise without using the optical filter and to get the brightest spot position simultaneously.