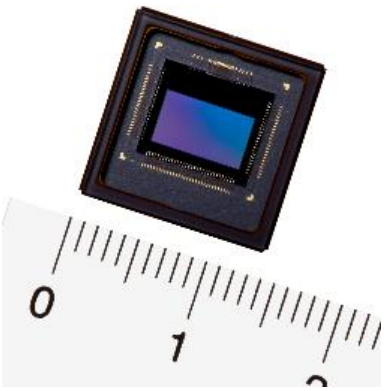
Event-based Vision Sensor

Gen4.1

1. Description

The Gen4.1 is a Type1/2.5" 920K effective pixel (1280 (H) × 720 (V)) Event-based Vision Sensor.
This sensor detects brightness changes that exceed the set thresholds independently for each pixel, and asynchronously outputs the coordinates (X, Y) of detected pixels, the detected times (timestamp), and the brightness change polarity information in the order detected.
This enables high-speed, low-latency (100 µs or less @ 1 klux) output.
Output of only brightness changes enables to swiftly capture moving subjects, and areas without brightness changes are not output, realizing a sensor that enables efficient data extraction.
The sensor also features pixel characteristics where the output voltage is output logarithmically relative to the input light intensity, which enables event output with a high dynamic range of 110 dB or more.
This sensor can be used for a wide range of machine vision applications in the industrial machinery and security fields, as well as digital still cameras, camcorders, and IoT devices, etc.



2. Features

- Pixel ROI
- Digital crop
- Event compression
- Region number of events monitor
- Event queue monitor
- Timestamp clock synchronization
- Global reset
- Digital event mask (pixel mask)

<Auxiliary functions>

- Temperature sensor
- Illuminance Meters (absolute value, relative value)
- Contrast sensitivity (threshold) adjustment function
- Latency adjustment function
- Dead time adjustment function
- High Pass Filter function
- Event Signal Processing
- Multiple sensor synchronization function(master/slave)

3. Target Specifications

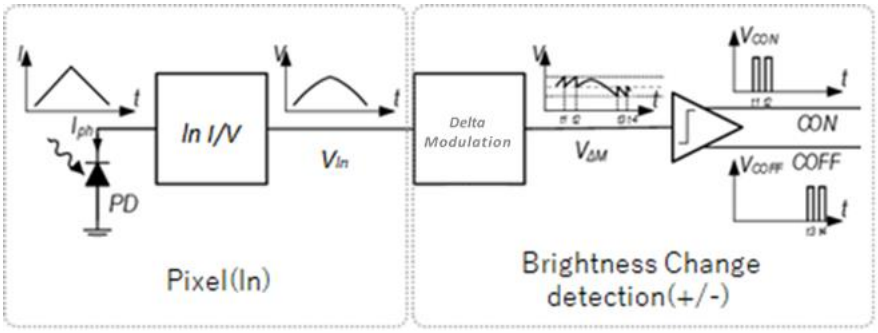
Resolution		HD:0.92M Pixel(1280(H)x720(V))
Pixel Size		4.86µm x 4.86µm
Optical format		1/2.5"
Package		Ceramic LGA package 13mm x 13mm/14mm x 14mm
Technology node		Stacked 90nm(BI-CIS)/40nm(Logic)
Power supply		3.0V,2.5V(Analog),1.8V(IO),1.1V(Digital)
Power consumption	Static[1]	115mW
	Max event rate(w/ESP)	200mW
Nominal Contrast Threshold (ln)		25%
Nominal Latency	ROI[2]	<100us@1klux, <1000us@5lux
	Subsampling[3]	<220us@1klux, <1000us@5lux
Max Event Rate / readout throughput		1.06 Geps
Dynamic Range		>86 dB (5 -100,000 lux)[4]
Background Rate		0.1Hz@1klux/10Hz@5lux
Chip I/F		Input: I2C (400kHz/1MHz), Output: MIPI D-PHY(2x1.5Gbps)
Event Signal Processing (ESP)		Anti-flicker (AFK) Event filter (Spatio-Temporal Contrast Filter, TRAIL Filter) Event Rate Controller (ERC)

Note: target specifications, not guaranteed.

[1] No contrast change under 100lux stationary light
[2] ROI 9x9 = 81 pixels
[3] Subsampling 1/5 (Horizontal)
[4] Minimum light condition is specified at 5lux to secure other specifications. The low-light cut-off is 0.3 lux (dynamic range >110dB.)

4. Principle of Operation

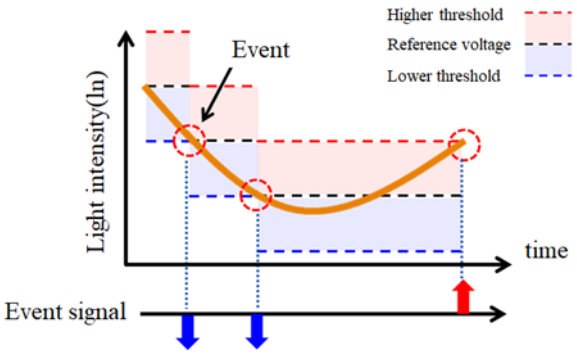
Event-based Vison Sensor detects relative changes in brightness independently for each pixel.
Each pixel contains a photodiode (PD) that transduces incident light into a photoelectric current which is converted to a voltage (Vln) by a logarithmic I/V converter circuit in continuous time.
An in-pixel brightness change detector, built around a level-crossing sampling Delta Modulation circuit, continuously monitors the Vln signal and generates polarity-discriminated events CON/COFF that represent a relative increase or decrease in light intensity exceeding tunable thresholds. The occurrence of these events is sensed by voltage comparators.



Pixel block diagram

Following figure shows the relationship between brightness changes and event generation.

After generation of an event, the Delta Modulation circuit resets its reference level and continues to monitor changes relative to the new brightness level corresponding to the emitted event. For this, the Delta Modulation output voltage signal VΔM is continuously compared to preset positive and negative threshold levels by voltage comparators. An event detection signal CON/COFF is emitted as soon as one of the two threshold levels is reached, and a new Delta Modulation reset is executed.



Brightness change vs Event signal