The Trend of Always On Vision (AONV) Sensor

Nov, 2021
Agenda

- Current CIS application
- AONV smart detection current status
- Low power design for AONV
- What is new for ANOV
Application for CIS now

- Video and Image Capturing
  - Mobile phone
  - NB
  - Automotive
  - PC Camera, Battery Camera, Doorbell, …… etc

- More the image capture - CV and machine learning
  - Always On Vision (AONV) markets
    - Low power is key
    - Sensor + AI processor
  - Smart detection
Leading the Way for Always On Vision

**2016**

- **HM01B0 Announced**
  - Lowest power image sensor for event detection and ULP vision

- **Engaged with ‘lite’ processors**
  - Smart IOT vision devices
  - New milliwatt processors

- **OEM product release**
  - Always On human detection in smart home devices

**2018**

- **Adopted by Google TF-Lite**
  - Promoted by Google in TinyML conference and publication
  - Product release on Sparkfun

- **Early SDK release**
  - Partner companies vision SDK

**2020**

- **HM0360 VGA Announced**
  - Longer range, new auto modes, better event detector, context switch, dual I/F and high NIR

- **Growing vision platforms**
  - Himax WE1+
  - Arduino Arducam

- **HM11B1 HD Announced**
  - Thin bezel Notebook HD sensor with Always On Vision
  - Support Project Athena

**2022**

- **New FHD+ AONV sensors**
  - High quality FHD video with Always On Vision
WiseEye II – Extreme Low Power/Most Powerful Smart Sensing

Always-on in extreme-low-power (1mW~100mW)

• Detection
• Tracking
• Recognition
• Multi-object Counting

Ultra-low-power image sensor
- FHD/ AOS hybrid, HD/AOS hybrid, VGA, qVGA, RGB/NIR
- HM01B0, HM0360, HM11B1, HM2170, HM2230

CMOS Sensor

Vision/Voice/Vibration Algorithm

Mic Array

ASIC

WE-II

- Extreme low active power 100mW running at 400MHz with most powerful computing power
- TinyML most complete ARM SDK/Toolchain for algorithm development
- Most Open platform for Deep-learning and CV
- Most Low power AoS Visual Detection and Recognition total solution

Himax Technologies, Inc. Proprietary & Confidential
More Than Motion Detection

- The solution is not a switch, but an information provider.
- By metadata provided, the system can know the location and number of human.
- By collecting the behavior of human, the system can find the hot zone and distribution of human activity.
Examples for AI edge smart detection

- Motion detect
- Object detection
- Object classification
- Human presence
- People counting
- People tracking
Himax Imaging Enabling Technologies for AONV

Lowest power sensor
- <50mW 720P@60
- <1mW Wake on Motion

Excellent Image Quality
- High quality binning
- >2x NIR Sensitivity

Low Latency
- Fast boot, wake, switch
- Patented Pre-meter correctly exposes every frame at wake up

Low Processor Overhead
- Autonomous operating modes
- Embedded event detection
- On chip oscillator

Privacy
- Dedicated Interfaces for sensing and video

Himax Imaging
Hybrid Video + AONV
How to achieve low power

- Sensor part
  - Just enable the blocks that must be active to achieve the function
  - Intelligently divide the design into different sub-blocks for well control
  - Just design to meet spec, not over-design

- More than sensor
  - Low power Smart Motion Detection
    - Reduce the frequency of activating AI processing
  - Reduce system overhead
    - Fast pre-metering for AE information
    - Well WB information generation
    - Wake up on motion or demand by fast context switch
    - Fast initial setting programming
<1mW AONV Wake On Motion

RAW Data of Scene

AONV Detected Motion Zones

Lowlight (<1lux)  Indoor Office Lighting
Fast Pre-metering Optimizes Every Frame Exposure

Monitoring w/ Premetering

Typ. 20ms

1st Frame 2nd Frame 3rd Frame 4th Frame

Correct Exposure

Monitoring w/ Continuous AE

Overexposed

1sec 2sec

Correct Exposure
Wake on Motion with Fast Context Switch

- On-chip motion detection will “Wake” host processor
  ‣ Sensor issues Interrupt signal
  ‣ Exact location of motion in embedded data line or I²C register access
- Fast context switch updates N+1 frame
  ‣ Single command or GPIO selection eliminates long I²C write cycles
What is new for ANOV?

- More than Smart Detection
  - Image capture and Video recording after detection

- Hybrid Sensor
  - AoS: monitoring all time
  - Video: Recording when necessary

- AoS
  - Detection
  - Pre-rolling

- Video
  - Transitional video recording and image capture

- Key Advantage
  - FOV is the same
Himax Imaging AONV Product Family

- Industry leading power consumption
- Always On Vision (AONV) mode at <1mW
- High image quality performance
- Compact chip size; minimal passives

<table>
<thead>
<tr>
<th>HM01B0</th>
<th>HM0360</th>
<th>HM11B1</th>
<th>HM2170</th>
<th>HM2230 (Est.)</th>
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<tr>
<td>Active Array</td>
<td>320 x 240</td>
<td>640 x 480</td>
<td>1280 x 800</td>
<td>1920 x 1080</td>
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<td>Pixel Size / Technology</td>
<td>3.6µ FSI</td>
<td>3.6µ BSI</td>
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<td>1.12µ BSI</td>
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<td>Enhanced NIR Sensitivity</td>
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<td>Power with IO Load</td>
<td>3FPS QVGA</td>
<td>300µW</td>
<td>400µW</td>
<td>660µW (QQHD)</td>
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<tr>
<td></td>
<td>Full 60FPS</td>
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<td>14.5mW</td>
<td>&lt;50mW (MIPI)</td>
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<td>Package Size</td>
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<td>Interfaces</td>
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<td>CSI2 + SDI</td>
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<td>ES Q3'21</td>
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Drive for better vision