Next Frontier in CMOS Imaging

Always ON Sensing
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CMOS Imaging TODAY

• CMOS type imagers became the default imaging means in consumer electronics

• Dominated by “Capture and Display” (CAD)
  • Smartphones, Tablets, Laptops, or other devices with screen

• New Wave of Battery Operated IoT Devices
  • Place focus on power
PixArt Imaging Technology

• CMOS Imaging is the CORE

• Focus on image analytics type of applications
  • Low Power solutions through pixel and algorithmic detections
  • Incorporate “smart detection” into the sensor

• Product Successes
  • Optical Mouse
  • Wii Switch Gaming Controller
PixArt Imaging Technology Enables Low power visual Sensing Applications

- OFN, PPG Sensor, Optical Touch
  - Optical Mouse
    - Sensor Res: 2 x 2 ~ 40 x 40
    - Op. Power: < 1mW ~ 6mW
  - Optical Tracking
    - Sensor Res: 20 x 20 ~ 80 x 80
    - Op. Power: 1mW ~ 5mW
  - Hand Gesture Recognition
    - Sensor Res: 60 x 60 ~ 400 x 400
    - Op. Power: 8mW ~ 75mW
- Multiple Objects Tracking
  - Sensor Res: 100 x 100
  - Op. Power: < 20mW
- Optical Motion Tracking
  - Sensor Res: 80 x 80
  - Op. Power: 15mW
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Achieving Low Power

• **Global Shutter**
  • Allow for very low fps duty cycle in Low Power Mode
  • Without “rolling shutter” artifact

• **Modularized Blocks (Digital and Analog)**
  • i.e During integration, Digital and Analog blocks can be OFF
  • i.e Skip function allow turning OFF rows not in use
  • Easier said than done!!!

• **Integrated Image Analytics**
  • Data are processed on silicon
  • Allow lowest “Deep Sleep” stage until an event is triggered
  • i.e Built-In Motion Detection
PixArt Imaging Technology

Effect of Heat on Image Sensors

- All image sensor suffers from Dark Current (caused by Heat)
  - Silicon impurities
  - Power dissipation on chip / Ambient Temp.
- Ultimately, power dissipation causes heat, in turn reduces the dynamic range

PixArt
71mW

Competition
100mW

2 Lux ; 70deg Ambient
Camera placed inside of oven

2 Lux ; 70deg Ambient
Camera placed inside of oven
PixArt Imaging Technology

Low power Sensing Available NOW

• Complete Camera Solution that includes:
  • Re-flowable optical lens
  • Low Power Image Sensor

• QVGA (320 x 240) at 30fps : 1.4mW

• QQVGA (160 x 120) at 30fps : 600µW

Sensor Parameters | Value
--- | ---
Array Size | 320 x 240 (QVGA)
Pixel Size | 3.0µm
Shutter type | Global shutter
Interface | Parallel 8-bit ; 4-wire SPI
Signal to Noise Ratio (SNR) | Max 40dB
Dynamic range | 54 dB
Average Operating | 1,400 uW @ 30fps QVGA
 | 600 uW @ 30fps QQVGA
PixArt Imaging Technology

Sample Images

Distance: 1.0m

Distance: 1.2m

Distance: 1.4m
Call to Action

- **Do MORE with LESS….Resolution**
  - Only sustainable way to achieve Always ON state
  - This is NOT a replacement for high resolution cameras

- **Use for Detection, Trigger, decision making, object counting and etc.**

- **Low Power Edge Processing is CRUCIAL**
  - Camera CANNOT address all variations of analytics on silicon
  - NOT scaleable and NOT realistic

- **Begin the discussion…..**
  - Partitioning / Optimization in terms of power
Thank You!

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