



IrLED based

3D Touch Sensor Signal Processing Technology

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TECHNOLOGY BRIEF

3D Touch Sensor Signal Processing Technology

■ Technology Overview

- Compact 3D multi-touch sensor system based on motion recognition low-powered IrLED (Infrared LED)
- Technology that uses one IrLED and four PD to recognize vertical, horizontal, and pushing hand movements
- PD signal processing AFE (Analog Front-End) and motion recognition engine technology.
- SoC technology can control electronic device with 3D hand gestures without touching



□ Keywords

Infrared sensor, motion recognition, 3D touch

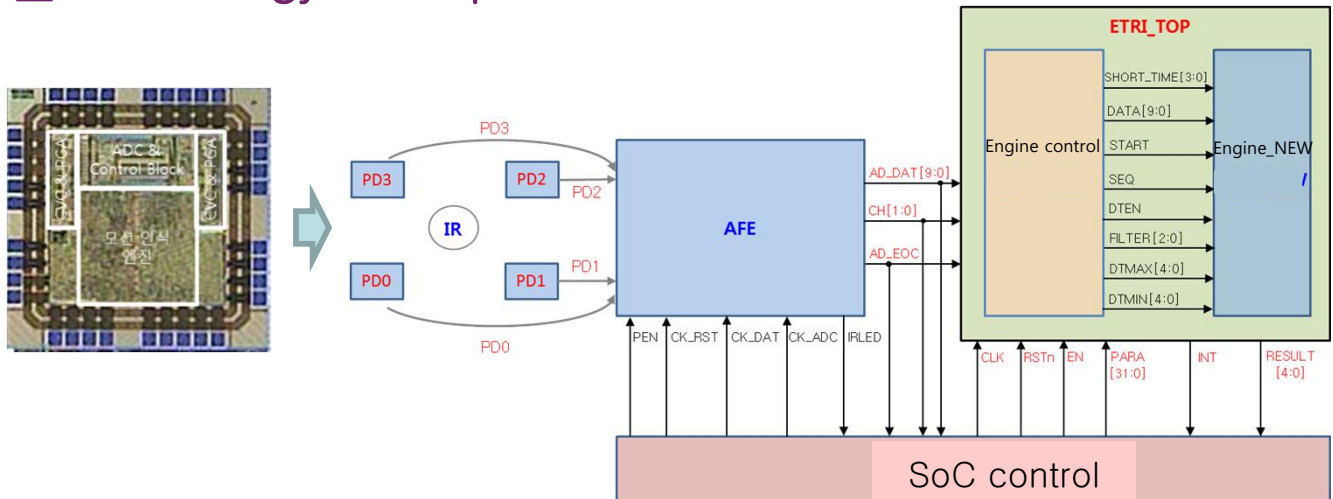
□ TRL

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TECHNOLOGY BRIEF

3D Touch Sensor Signal Processing Technology

Technology Description



Technology details

- Low-powered (200uA or below) hand motion sensor using one IrLED
- PD-based multichannel low-powered / compact analog front-end technology
- Low-powered biasing technique using V_{th} from MOS rather than an amplifier
- Double-sampling structured PGA to remove noise and offset
- Asynchronous SAR structured 10bit analog-to-digital converter(ADC)
- Recognition algorithm based on comparing directional signals
- Time window method to solve noise problems
- Remove Low-pass filter that solves noise problems to reduce unnecessary space, decrease power consumption, and improve output delay

Application Fields

Products that provides UI/UX using hand movements

New market aside from smartphones



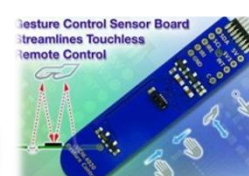
PC aiding input device



Control vehicle infotainment system



Control lighting



Remote controller

▣ Competitiveness of Technology

▶ Limitations of previous technology

- High power consumption because camera based motion sensor needs camera to be on at all times
- Compared with camera based method, the IrLED method uses simple motion sensor signal that has advantages in power consumption and its small size.
- Using only one IrLED is a much better method than using multiple IrLED in both size and power consumption

▶ Outstanding Features

- Low-powered (200uA or below) hand motion sensor using one IrLED
- Double-sampling structured PGA to remove noise and offset
- Use time window method to solve noise problems rather than low-pass filter to reduce unnecessary space, decrease power consumption, and improve output delay
- Has more than 97% direction recognition rate following TTAK.KO-10.0692 guidelines.

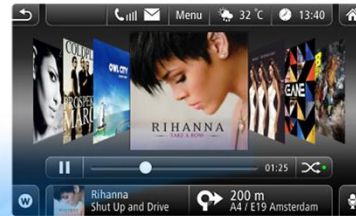
▣ IPR Status

Korean Patents: 4 articles applied

No.	Country	Application Number (date)	Status	Title
1	US	14/605877	Applied	Light signaling interface
2	US	9341713	Registered	Hand motion sensor method
3	US	9274214	Registered	IrLED control method

□ Technology Trend

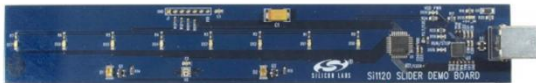
- Recently, UI/UX are key factors in competitiveness of mobile devices
 - Need compact sensor parts based on low-powered IrLED motion sensor to apply on 3D touch UI/UX core technology development



Most smartphones use Proximity / ambient light sensors
 -> Limited usages and dependent on all imports

UI/UX are key factors in competitiveness of mobile devices

Need development of motion sensor system containing proximity / ambient light sensors
 -> UI/UX core technology for 3D touch



Motion sensor using IrLED arrangement
 -> form-factor inadequate for mobile device

Motion sensor using front camera ->
 Power consumption problem caused by CMOS image sensor

Need development of low-powered, compact motion sensor

□ Korea

- Electronics and Telecommunication s Research Institute, ABOV semiconductor, Hysonic, HANA Micron, R@ mote Solution, Sejong University developed a 3D multi-touch sensor system using IrLED with detection angle of 30 degrees or more in September of 2014.
- ABOV semiconductor developed proximity sensor and ambient light sensor for smartphones

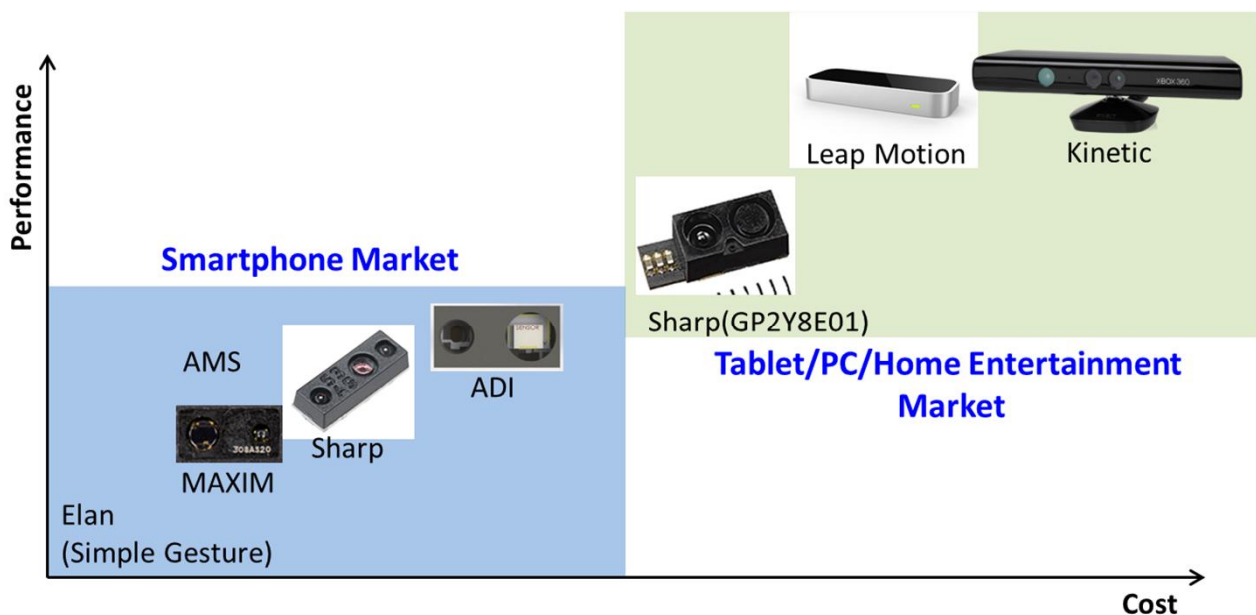
□ Global

- MAXIM semiconductor commercialized a 2mm x 2mm x 0.6mm product that supports both proximity sensing and ambient light sensing using one IrLED and PD.
- ROHM Co. developed a product that supports proximity sensing, ambient light sensing, gesture sensing using 3 IrLED and PD.

Market Trend

Gesture Sensor Industry Trend

- Attach on Samsung smartphone and note product
- Galaxy S4 and Note 3 uses MAXIM semiconductor and Galaxy S5 uses AMS product
- Applied in some smartphone models in China
- Some models such as BBk and Coolpad use AVAGO product



Positioning of developed products in gesture sensor market

Market Leaders

World leading vendor

- Maxim semiconductor, AVAGO, AMS, Sharp, ADI

Domestic leading vendor

- No commercialized company using SoC product
- ABOV semiconductor, Hysonic, HA NA Micron have experienced developing related technology

Technology Demand

Application

Smartphone proximity sensor and gesture sensor chip / module manufacturer; infotainment for vehicles, home appliances, and remote manufacturer

Industry

Gesture sensor, proximity sensor, UI/UX device

□ Scope of Technology Transfer

- PD signal processing Analog Front-End technology
 - Schematic / layout technology
 - Gain control circuit schematic / layout technology
 - High-resolution analog-to-digital converter schematic/ layout technology
- Digital signal processing technology based on hard-wired motion engine
 - Sensing algorithm technology based on signal comparison
 - PD signal extracting technology not interfered by noise
- I2C interface technology
 - I2C interface schematic / layout technology for digital I/O
- Motion sensor algorithm
 - Comparing directional signals
 - Use time window method
- Key design documents and related IPR (TM, TDP, patent) license

□ Applications and Effects

► Applications

- Smartphone and PC aiding input device
- Vehicle infotainment system
- Appliance and lighting control
- Touchless remote controller



► Effects

- Market for touchless hand motion recognition products expands
- Market for smart product for UI/UX expands.