Sensor characteristics

FYS3231/4231

Mobile technology

Typical smartphone today:

Imaging camera—takes still photo and video.
Microphone—detects sound mostly in the audible frequency range.
Accelerometer—detects motion of the MCD and direction of the gravity force.
Gyroscope—measures spatial orientation of the MCD.
Magnetometer (compass)—detects strength and direction of magnetic fields.
GPS—an RF receiver and processor for identifying global coordinates.
Proximity detector—detects closeness of the MCD to the user's body.

Emerging application areas

Industrial for detecting noncontact temperature, thermal imaging, humidity, air flow, ionizing radiation, smell, dielectric constant of objects, material composition, range (distance), air pressure, produce freshness, etc.

Medical for the inner (core) and skin body temperatures, thermal imaging, arterial blood pressure, EKG, blood factors (glucose, cholesterol, hemoglobin oxygen saturation), deep body imaging, smell (e-nose), behavior modification, etc.

Military for night vision, detecting poisonous gases, proximity, ionizing radiation, explosives, chemical and biological agents, etc.

Consumer for the body core temperature, heart rate, radon gas, pregnancy detection, breathalizer for alcohol and hydrogen sulfide, food composition, behavior modification, proximity, UV level, electromagnetic pollution, surface temperature, etc.

Table 3.1 "*10 Commandments*" of mobile sensor design

1	Intelligent sensor: built-in signal conditioner and DSP
2	Built-in communication circuit (I^2C, NFC, Bluetooth, etc.)
3	Integrated supporting components (optics, thermostat, blower, etc.)
4	High selectivity of the sensed signal (reject interferences)
5	Fast response
6	Miniature size to fit a mobile device
7	Low power consumption
8	High stability in changing environment
9	Lifetime stability: no periodic recalibration or replacement
10	Low cost at sufficiently high volumes

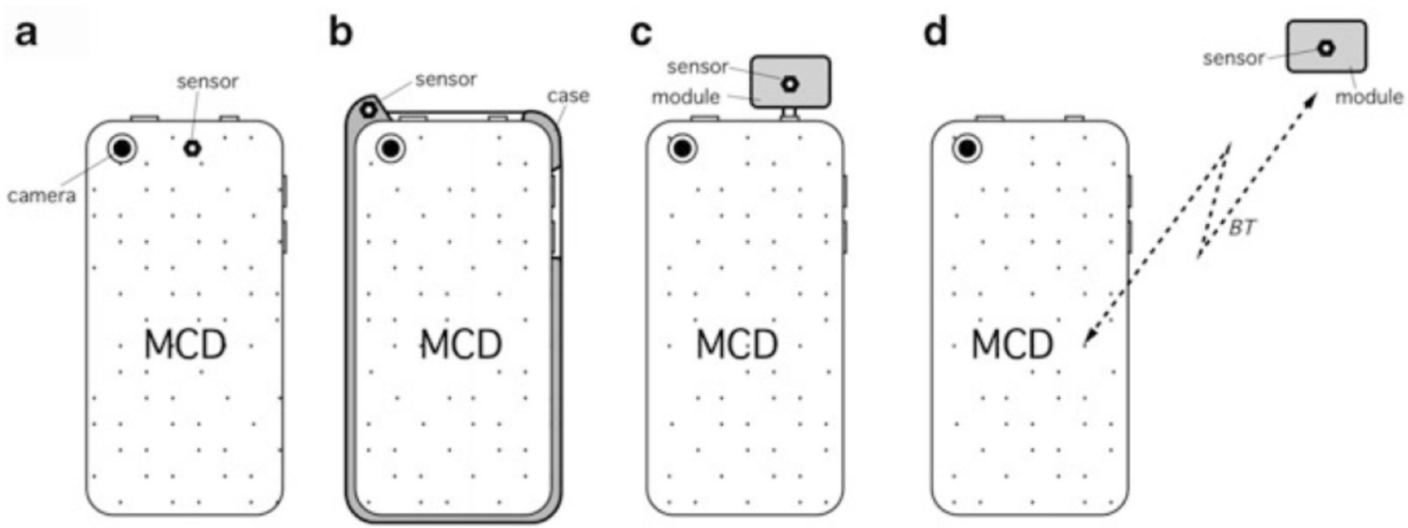

Fig. 3.1 Four possible ways of coupling sensing module to mobile communication device

IR-sensor for mobile unit

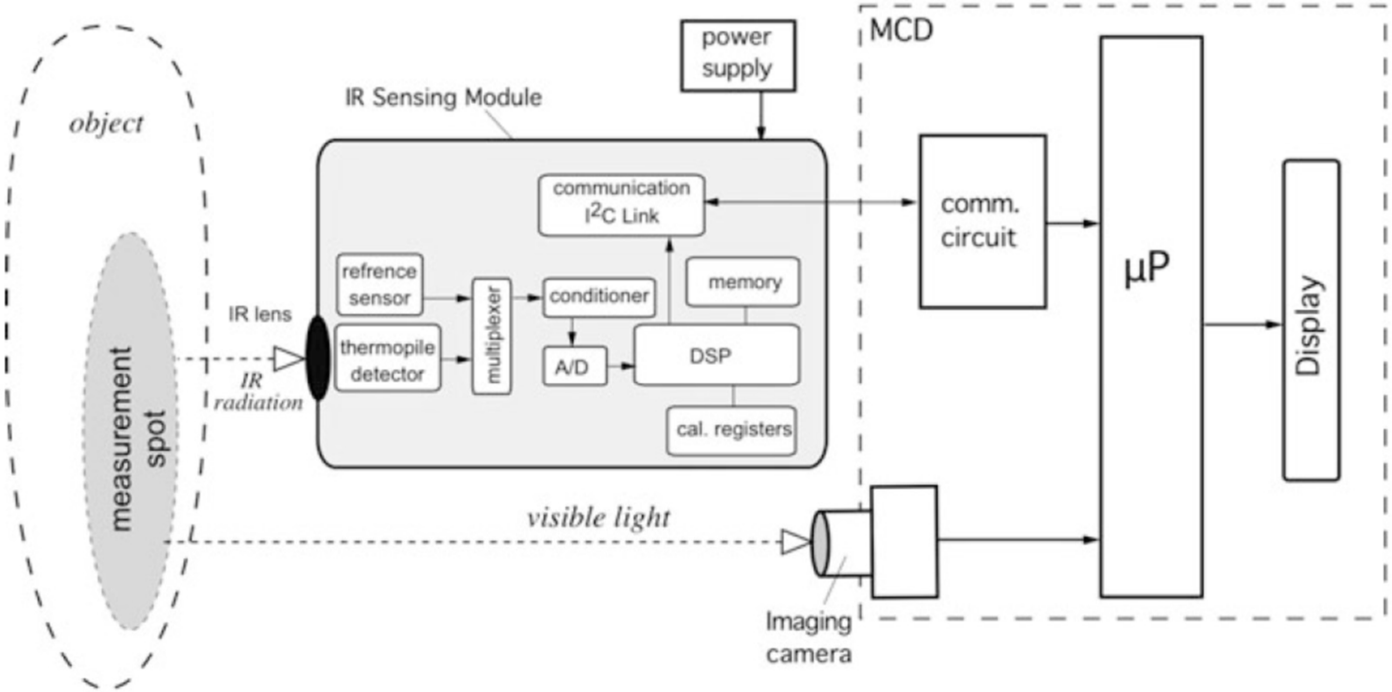

Fig. 3.2 Block-diagram of thermal radiation (IR) sensing module for MCD

Matematiske modeller

Les selv ...

Kirchhoffs lover

Table 3.4 Mechanical, thermal, and electrical analogies

Mechanical	Thermal	Electrical	
Mass M $F = M\frac{d(v)}{dt}$	Capacitance C $Q = C\frac{dT}{dt}$	Inductor L $V = L\frac{di}{dt}$	Capacitor $i = C\frac{dV}{dt}$
Spring k $F = k\int v\,dt$	Capacitance C $T = \frac{1}{C}\int Q\,dt$	Capacitor C $V = \frac{1}{C}\int i\,dt$	Inductor L $i = \frac{1}{L}\int V\,dt$
Damper b $F = bv$	Resistance R $Q = \frac{1}{R}(T_2 - T_1)$	Resistor R $V = Ri$	Resistor R $i = \frac{1}{R}V$

Eks 1: Innkapslet varme-element: $\frac{dT_h}{dt} + \frac{T_h}{rC} = \frac{Q_1}{C} + \frac{T_a}{rC}$

Eks 2: Masse, fjær demper (akselerometer): $M\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = M\frac{d^2y}{dt^2}$