

# 非侵入式電梯樓層偵測器

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# 大綱

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- ▣ 目的與動機
- ▣ 實作方法與架構

# 動機

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- ▣ 現代人常常習慣性地搭乘電梯，即使是往返樓層只有一層樓。

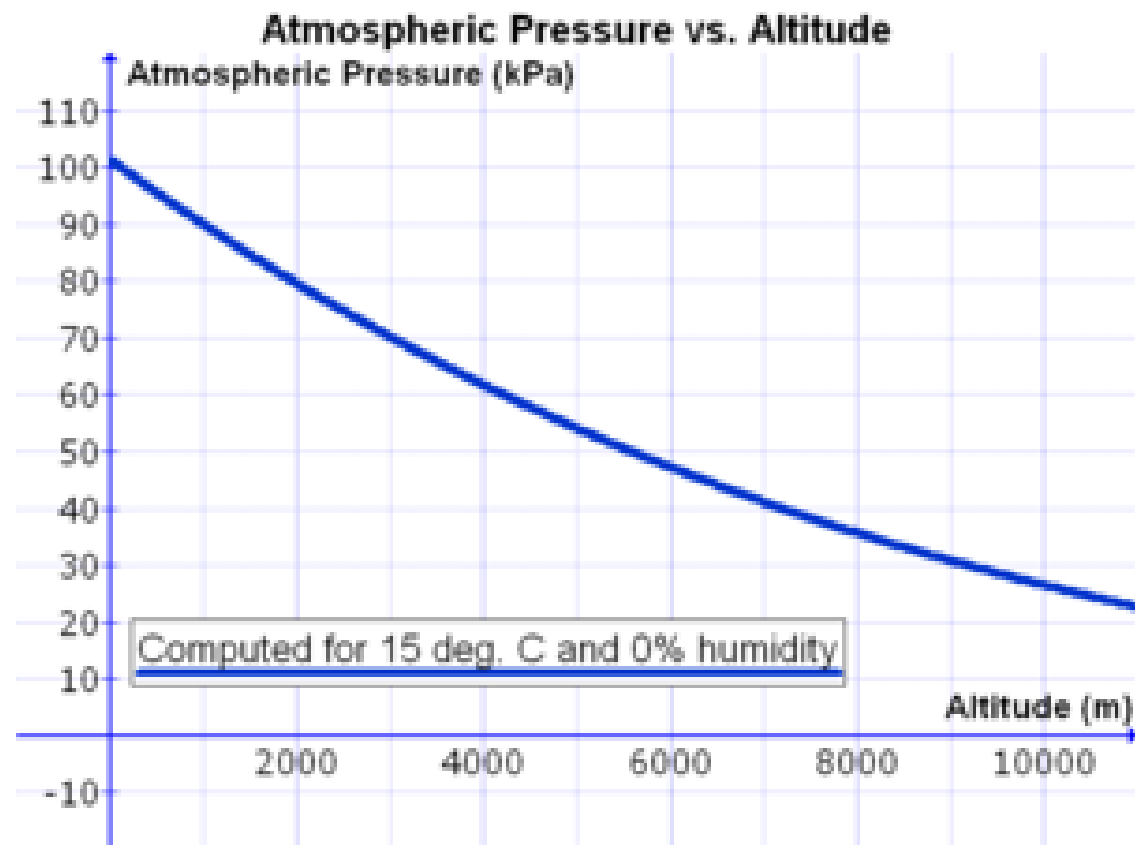
# 研究目的

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- 藉由曾測使用者的電梯搭乘，來提醒使用者，若往返一層樓時，可以走樓梯，達成節能的目的。

# 高度與氣壓的關係

上升0.9公尺 氣壓下降100pa



# Barometric formula

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$$p = p_0 \cdot \left(1 - \frac{L \cdot h}{T_0}\right)^{\frac{g \cdot M}{R \cdot L}} \approx p_0 \cdot \left(1 - \frac{g \cdot h}{c_p \cdot T_0}\right)^{\frac{c_p \cdot M}{R}} \approx p_0 \cdot \exp\left(-\frac{g \cdot M \cdot h}{R \cdot T_0}\right),$$

Parameter	Description	Value
$p_0$	sea level standard atmospheric pressure	101325 Pa
$L$	temperature lapse rate, = $g/c_p$ for dry air	0.0065 K/m
$c_p$	constant pressure specific heat	~ 1007 J/(kg•K)
$T_0$	sea level standard temperature	288.15 K
$g$	Earth-surface gravitational acceleration	9.80665 m/s <sup>2</sup>
$M$	molar mass of dry air	0.0289644 kg/mol
$R$	universal gas constant	8.31447 J/(mol•K)

# 實際公式

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$$\text{altitude} = 44330 * \left( 1 - \left( \frac{p}{p_0} \right)^{\frac{1}{5.255}} \right)$$

# 實作方法-樓層偵測

# GY-63 MS5611 High-Resolution Atmospheric Pressure Height Sensor Module

**Made by MEAS Switzerland**





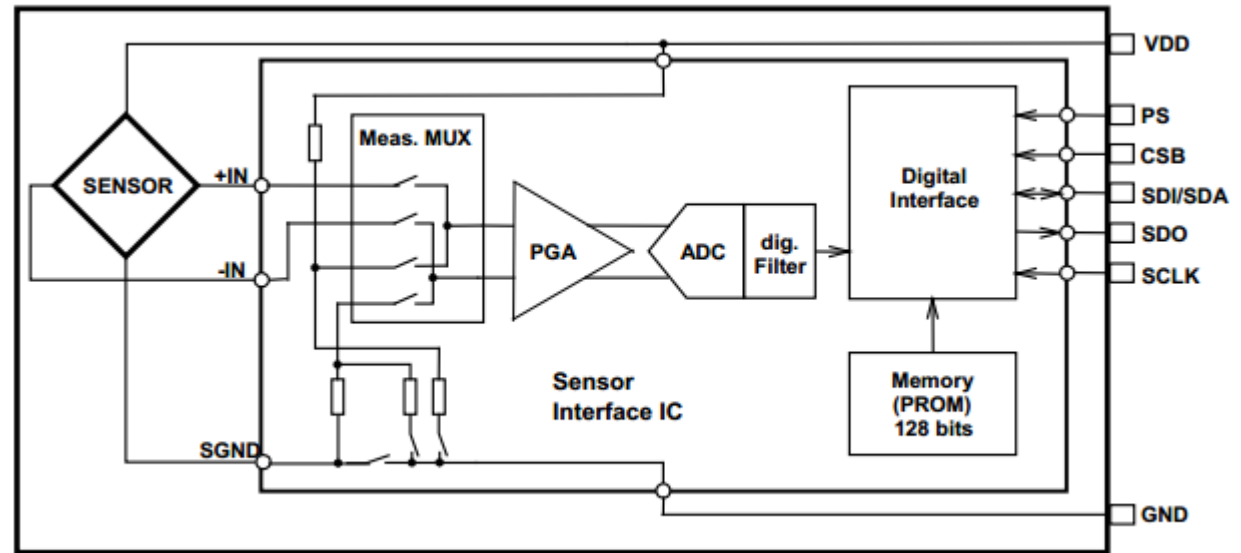
# GY-63 MS5611

- High resolution module, 10 cm
- Fast conversion down to 1 ms
- Low power, 1  $\mu$ A (standby < 0.15  $\mu$ A)
- Supply voltage 1.8 to 3.6 V
- Integrated digital pressure sensor (24 bit  $\Delta\Sigma$  ADC)
- Operating range: 10 to 1200 mbar, -40 to +85 °C
- I2C and SPI interface up to 20 MHz
- No external components (Internal oscillator)
- Excellent long term stability

## TECHNICAL DATA

Sensor Performances ( $V_{DD} = 3\text{ V}$ )				
Pressure	Min	Typ	Max	Unit
Range	10		1200	mbar
ADC	24			bit
Resolution (1)	0.065 / 0.042 / 0.027 / 0.018 / 0.012			mbar
Accuracy 25°C, 750 mbar	-1.5		+1.5	mbar
Error band, -20°C to +85°C 450 to 1100 mbar (2)	-2.5		+2.5	mbar
Response time (1)	0.5 / 1.1 / 2.1 / 4.1 / 8.22			ms
Long term stability		$\pm 1$		mbar/yr
Temperature	Min	Typ	Max	Unit
Range	-40		+85	°C
Resolution		<0.01		°C
Accuracy	-0.8		+0.8	°C
Notes: (1) Oversampling Ratio: 256 / 512 / 1024 / 2048 / 4096 (2) With autozero at one pressure point				

# GY-63 MS5611



# 氣壓誤差更正

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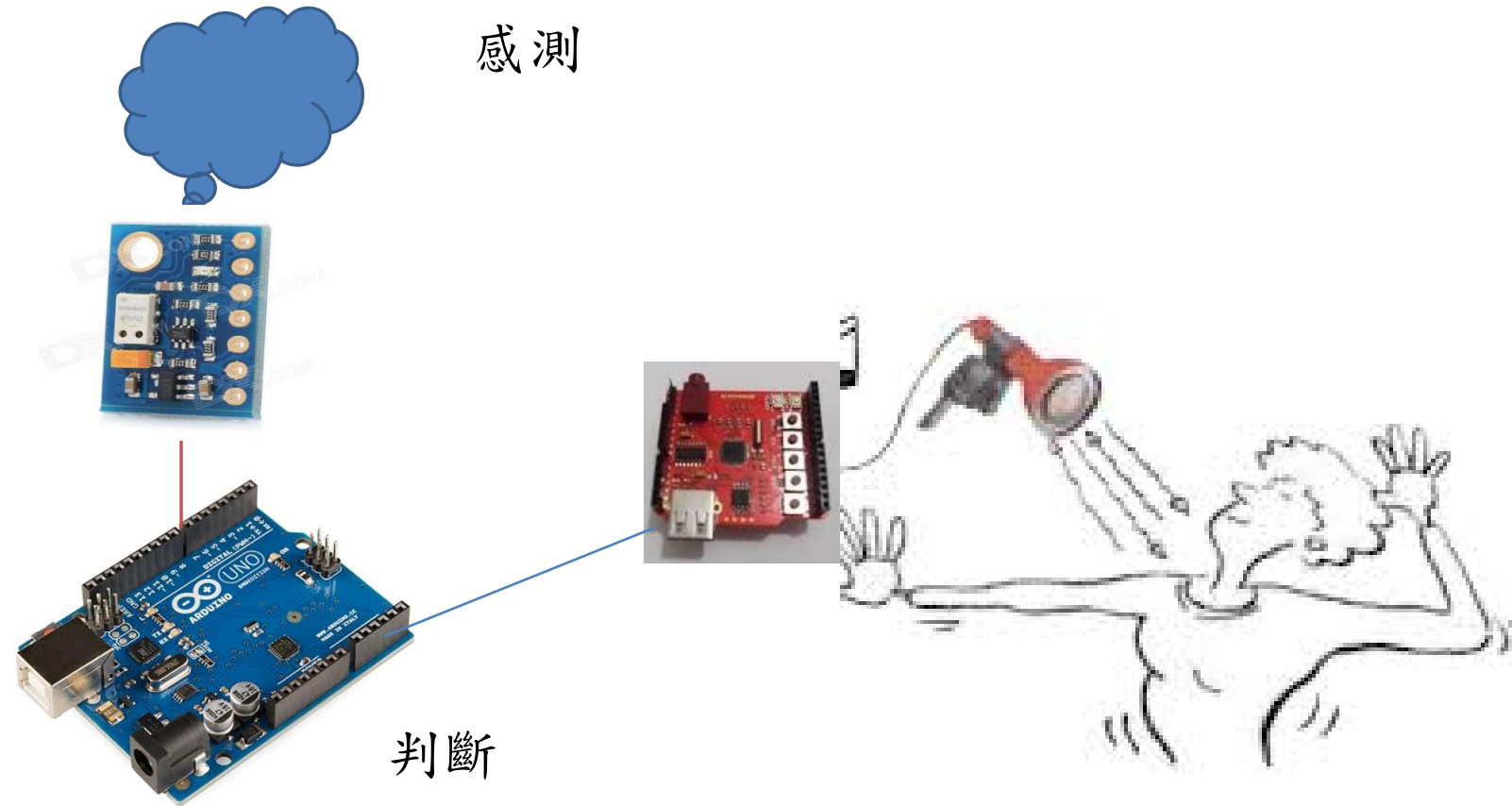
- ▣ 每個地點的海拔不同，如：中興的海拔為84m，因此我們是計算相對高度。

# 對於電梯停止的判斷

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- ▣ 判斷兩秒內的高度差，如果小於0.6就代表電梯停止於該樓層。

# 系統架構



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END