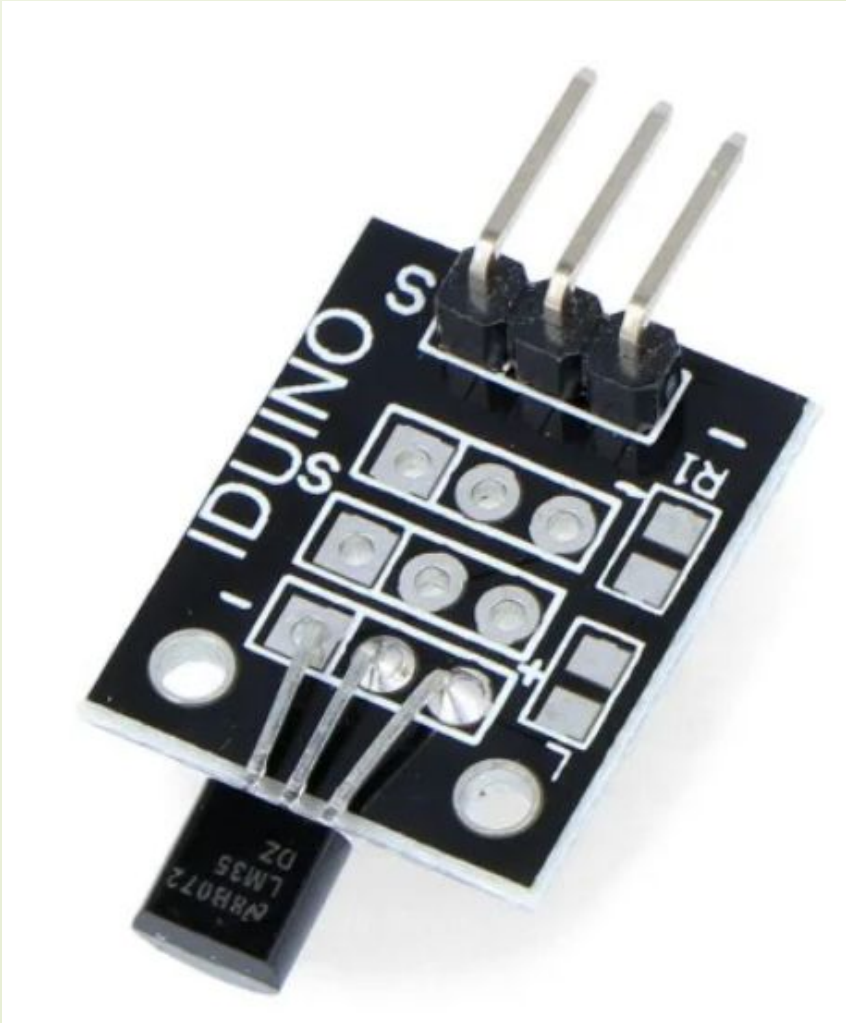
Introduction to Sensor and Actuator

Learning Objectives

- Types of Sensor
- Different Actuators
- Wi-fi Module
- Display Devices

Temperature Sensor LM35

The module with analog temperature sensor LM35. Powered with the voltage of the 5 V. It can read the temperature in the range from -55°C to 150°C with the accuracy of up to 0.5°C.



Temperature Sensor DS18B20

Temperature sensor chip

Stainless steel tube 6mm diameter by 30mm long

Cable is 36″ long / 91cm, 4mm diameter

Uses 1-Wire interface- requires only one digital pin for communication

Unique 64 bit ID burned into chip

Multiple sensors can share one pin

Temperature Sensor PT-100

- Precise measurement in extreme environments.
- Fast response time.
- Ease of application and use.
- Engineered to withstand extreme temperatures to + 600ºC.
- High-quality stainless steel probe: waterproof, moisture-proof and anti-rust.
- International industrial standards.
- Greater engineering efficiency due to linear output.

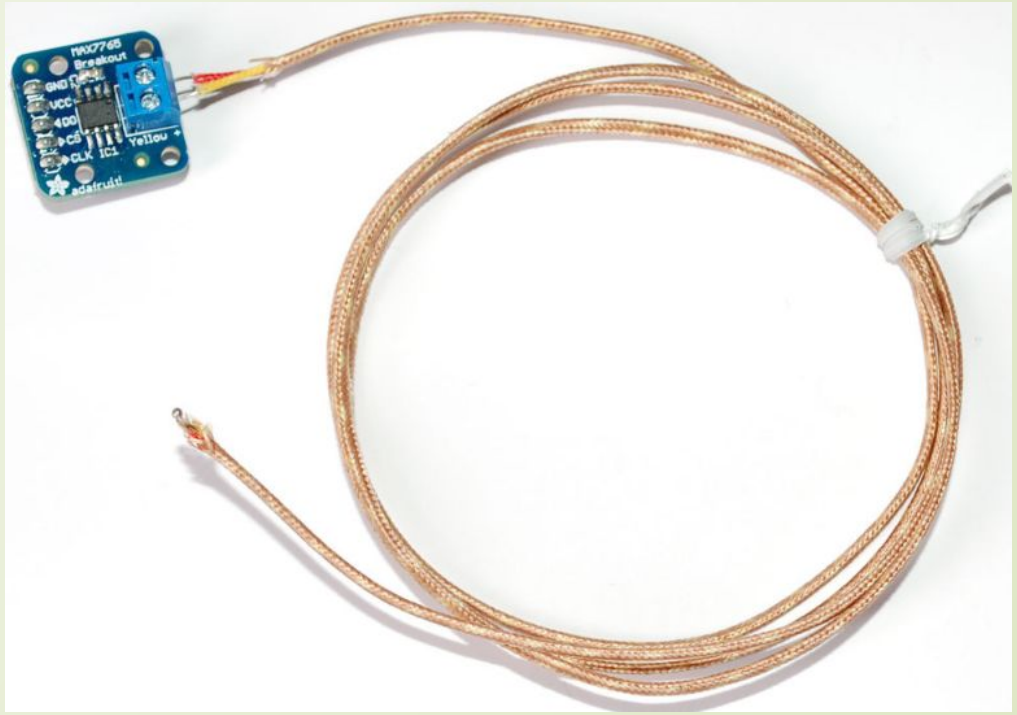
Temperature Sensor MLX90614 -contact less

- It is accessible in lesser size and less costly.
- It can be effortlessly incorporated.
- It is obtainable in large no of temperature range such as -40 to 125 °C is used for temperature instruments and -70 to 380 °C for measurement of the different object's temperature.
- It delivers high exactness on different temperature choices such as 0 to 50 °C.
- It has a resolution value of 0.02°C.
- It works on 3v and 5V temperature range.
- It exists in single and twice over varieties.
- For the evaluation of temperature on consistent basis System Management Bus control Pulse Width Modulation.
- It can transform for such devices which works on 8 to 16V temperature.

Temperature Sensor Thermocouple MAX 3155

This is for a K-type thermocouple with glass overbraiding

- **Size:** 24 gauge, 1 meter long (you can cut it down if desired)
- **Price:** $10 at the adafruit store
- **Temperature range:** -100°C to 500°C / -150 to 900°F (After this the glass overbraiding may be damaged)
- **Output range:** -6 to +20mV
- **Precision:** +-2°C
- Requires an amplifier such as MAX31855



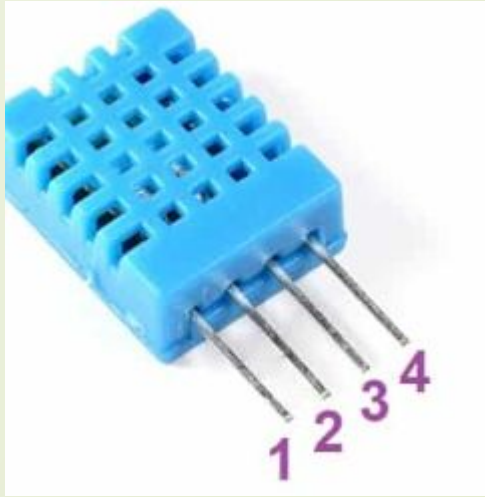
Temperature humidity Sensor HYT-271/221

Product Name	HYT271
Operating humidity range	0 % RH to 100 % RH
Operating temperature range	-40 °C to +125 °C
Accuracy humidity	± 1.8 % RH at + 23 °C
Accuracy temperature	±0.2 °C
Digital interface	I²C, default address 0x28
Operating voltage	2.7 V to 5.5 V
Current consumption	< 1µA in sleep mode, < 22µA at 1Hz measuring rate
Dimensions	10.2 x 5.1 x 1.8 mm
Connections	SIL RM
Wire dimensions	10.5 x 0.5 mm (LxW)

Temperature humidity Sensor DHT-11/DHT-22

Features of DHT11/DHT22

- The operating voltage is between 3 to 5.5 volts.
- The operating current is <2.5mA
- The accuracy for measuring temperature is ±2°C.
- The accuracy for measuring humidity is ±5%.
- It can transmit the signal up to 20m.



Temperature humidity Sensor SHT 3X

1. High reliability and long-term stability
2. Industry-proven technology with a track record of more than 15 years
3. Designed for mass production
4. High process capability
5. Low signal noise
6. Output: I2C, Voltage Out
7. Supply voltage range: 2.4 to 5.5V
8. RH operating range: 0 – 100% RH
9. T operating range: -40° to +125°C (-40° to +257°F)
10. RH response time: 8 sec (tau63%)

Output	I^2C, Voltage Out
Supply voltage range	2.15 to 5.5 V
Energy consumption	4.8µW (at 2.4 V, low repeatability, 1 measurement / s)
RH operating range	0 – 100% RH
T operating range	-40 to +125°C (-40 to +257°F)
RH response time	8 sec (tau63%)

Temperature ,Humidity Barometric Pressure and VOC Sensor- BME 280

Features of BME280

1. Interface: I2C & SPI
2. Supply Voltage: 1.71V to 3.6V
3. Temperature Range: -40 to +85°C
4. Humidity Range: 0% to 100% rel. humidity
5. Pressure Range: 300hPa to 1100hPa
6. Humidity sensor and pressure sensor can be independently enabled/disabled

Applications

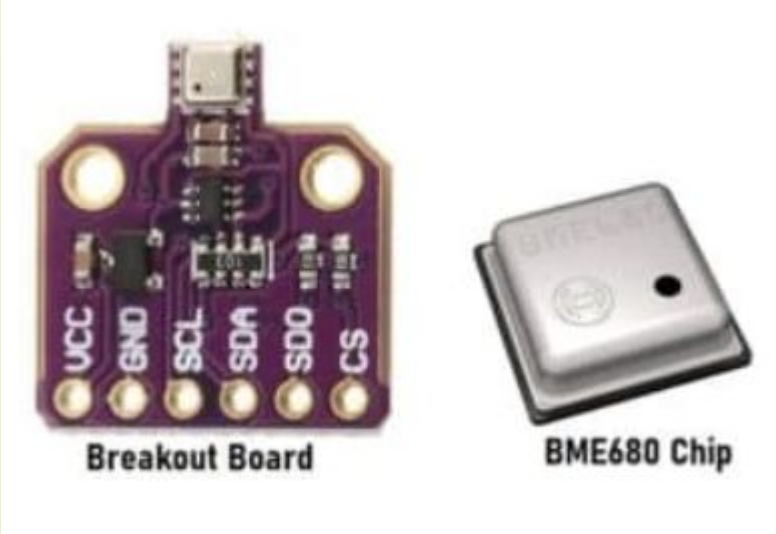
1. Context awareness, e.g. skin detection, room change detection
2. Health monitoring/well-being
3. Home automation control
4. Control heating, ventilation, air conditioning (HVAC)
5. Internet of things
6. GPS enhancement & Indoor/Outdoor navigation
7. Weather forecast
8. Vertical velocity indication (rise/sink speed)

Temperature ,Humidity Barometric Pressure and VOC Sensor-BME 680

BME680 Integrated Environmental Sensor

BME680 Specifications & Features

1. Working voltage: 1.7V to 3.6V
2. Operating Temperature range: -40~+85℃
3. Operating Humidity range: 0-100% r.H.
4. Operating Pressure range: 300-1100 hPa
5. IAQ Range: 0-500 PPM
6. Interface Type: I2C(up to 3.4MHZ)/ SPI(3 and 4 wire, up to 10MHz)
7. I2C address: 0x76(default)/ 0x77(optional)
8. Standby Current: 0.29 to 0.8 uA
9. Sleep Current: 0.15 to 1 uA
10. VOC Detection & Measurement (Ethane, Isoprene, Ethanol, Acetone, Carbon Monoxide)



Pressure Sensor MPX5010DP

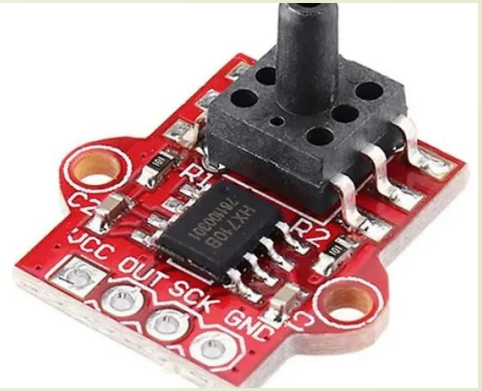
The MPX5010DP is a dual port, integrated silicon pressure sensor in 6 pin SIP package. This piezoresistive transducer is state of the art monolithic silicon pressure sensor designed for wide range of applications

- On-chip signal conditioned, temperature compensated and calibrated
- Differential configuration
- 5.0% maximum error over 0°C to 85°C
- Durable epoxy unibody
- Temperature compensated over -40°C to 125° C
- Patented silicon shear stress strain gauge
- Pressure range from 0KPa to 10KPa
- Supply voltage range from 4.75VDC to 5.25VDC
- Sensitivity of 450mV/mm
- Response time of 1ms

Pressure Sensor HX710B

This HX710B air pressure sensor module uses a high-precision AD sampling chip, adopts a 0-40KPa air pressure sensor, can connect a 2.5mm hose, can detect water level, and other air pressure
Features:

- Two Selectable Differential Input Channels.
- On-Chip Active Low Noise PGA.
- Selectable Gain of 32,64 and 128.
- On-Chip Power Supply Regulator For Load Cell and ADC Analog Power Supply.
- On-Chip Power-ON-Reset
- Simple Digital Control And Serial Interface.



Pressure Sensor MPX5050DP

The MPX5050DP is a dual port, differential integrated silicon pressure sensor in 6 pin SIP package. This piezoresistive transducer is a state of the art monolithic silicon pressure sensor designed for wide range of applications.

- On-chip signal conditioned, temperature compensated and calibrated
- 2.5% maximum error over 0°C to 85°C
- Ideally suited for microprocessor or microcontroller based systems
- Temperature compensated over -40°C to 125°C
- Pressure range from 0 KPa to 50 KPa
- Supply voltage range from 4.75VDC to 5.25VDC
- Sensitivity of 90mV/KPa
- Response time of 1ms

Distance Sensor HC-SR05

- **Ultrasonic Module HC-SR05 Distance Measuring Ranging Transducer Sensor DC 5V 2-450cm**

Sensing Distance	2.5 mm
Beam Angle	15 degrees
Brand	HY-SRF05
Sensor Type	Ultrasonic Module
Power supply:	5V dc,
Quiescent current:	<2 mA,
Range:	2 cm - 450 cm,
Resolution:	0.3 cm,
Blind spot:	2 cm.

Distance Sensor GY2Y0A21YK

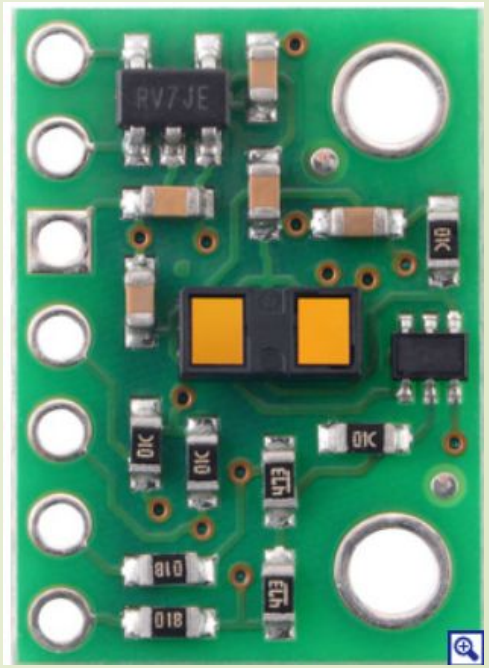
Feature summary

- Operating voltage: 4.5 V to 5.5 V
- Average current consumption: 30 mA
- Distance measuring range: 10 cm to 80 cm (4″ to 32″)
- Output type: analog voltage
- Output voltage differential over distance range: 1.9 V (typical)
- Update period: 38 ± 10 ms
- Size: 44.5 mm × 18.9 mm × 13.5 mm (1.75″ × 0.75″ × 0.53″)
- Weight: 3.5 g (0.12 oz)

Distance Sensor VL53L1X

Features and specifications

- Dimensions: 0.5″ × 0.7″ × 0.085″ (13 mm × 18 mm × 2 mm)
- Weight without header pins: 0.5 g (0.02 oz)
- Operating voltage: 2.6 V to 5.5 V
- Supply current: ~15 mA (typical average during active ranging at max sampling rate)
- Fast and accurate ranging with three distance mode options:
  - Short: up to ~130 cm, 50 Hz max sampling rate; this mode is the most immune to interference from ambient light
  - Medium: up to ~300 cm in the dark, 30 Hz max sampling rate
  - Long: up to 400 cm in the dark, 30 Hz max sampling rate
- Minimum range: 4 cm (objects under this range are detected, but measurements are not accurate)
- Emitter: 940 nm invisible Class 1 VCSEL (vertical cavity surface-emitting laser) – eye-safe



Ambient light and colour Sensor BH1750

BH1750FVI Is a Digital Light sensor , which is an digital Ambient Light Sensor IC for I2C bus interface.

- Illuminance to Digital Converter
- Wide range and High resolution. (1 - 65535 lx)
- Low Current by power down function
- 50Hz / 60Hz Light noise reject-function
- I2C bus Interface (f / s Mode Support)
- No need any external parts
- It is possible to select 2 type of I2C slave-address.
- It is possible to detect min. 0.11 lx, max. 100000 lx by using this function.

Ambient light and colour Sensor TCS3200

The TCS3200 programmable color light-to-frequency converter combines configurable silicon photodiodes and a current-to-frequency converter on a single monolithic CMOS integrated circuit. The output is a square wave (50% duty cycle) with frequency directly proportional to light intensity (irradiance). The TCS3200 reads an 8x8 array of photodiodes.

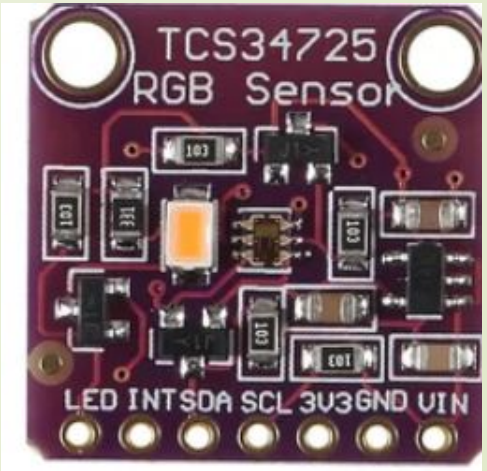
Features

- Programmable color light-to-frequency converter
- Output Enable (OE) pin
- Output frequency scaling
- Available in 5mm x 6.2mm SOIC (D) packagEnables high-resolution conversion of light intensity to frequency
- Disables the output into a Hi-Impedance state when OE input pin is Low
- Enables output range to be optimized for a variety of low-cost measurement techniques
- Reduces board space requirements while simplifying designs

Ambient light and colour Sensor TCS34725

Features

- The TCS34725 device provides digital return values for red, green, blue (RGB), and bright light sensing
-
- IR shading filters make the TCS3472 ideal for color-sensitive component solutions under varying light conditions and through attenuating materials.



Technical Details

- Model : TCS34725
- Operating Voltage (VDC): 3.3
- Supply Voltage(VDC) : 3.3 to 5
- Interface Max 5V Level I2C
- Color Sensor Channels RGBC
- Temperature Range [°C] -40 to 85

Applications

- Light color temperature measurement
- RGB LED consistency control

Accelerometer / Gyroscope ADXL345

The ADXL345 is a low-power, 3-axis MEMS accelerometer modules with both I2C and SPI interfaces. The Adafruit Breakout boards for these modules feature on-board 3.3v voltage regulation and level shifting which makes them simple to interface with 5v microcontrollers such as the Arduino.

The ADXL345 features 4 sensitivity ranges from +/- 2G to +/- 16G. And it supports output data rates ranging from 10Hz to 3200Hz.

- ADXL345 digital three-axis acceleration gravity tilt module code Ar iic / spi.
- Name: module ADXL345 (acceleration of gravity of three axes).
- Power supply: 3-5 v.
- Communication media: the iic / spi communication protocol.
- Measuring range: 2g 16g.
- 51, the avr, the test code of the microcontroller Ar.

Accelerometer / Gyroscope MPU-6050

Features:-

- Uses the popular MPU6050 IC
- MPU6050 contains a 3 axis Accelerometer and Gyroscope in a single package and simplifies design and usage. It also reduces cross axis alignment issues unlike other sensors with separate accelerometer and gyroscope ICs
- Digital I2C interface to read the output of the sensor
- Input Voltage: 2.3 - 3.4V
- Selectable Solder Jumpers on CLK, FSYNC and AD0
- Tri-Axis angular rate sensor (gyro) with a sensitivity up to 131 LSBs/dps and a full-scale range of ±250, ±500, ±1000, and ±2000dps
- Tri-Axis accelerometer with a programmable full scale range of ±2g, ±4g, ±8g and ±16g
- Embedded algorithms for run-time bias and compass calibration. No user intervention required
- Digital-output temperature sensor

Accelerometer / Gyroscope MPU-9250

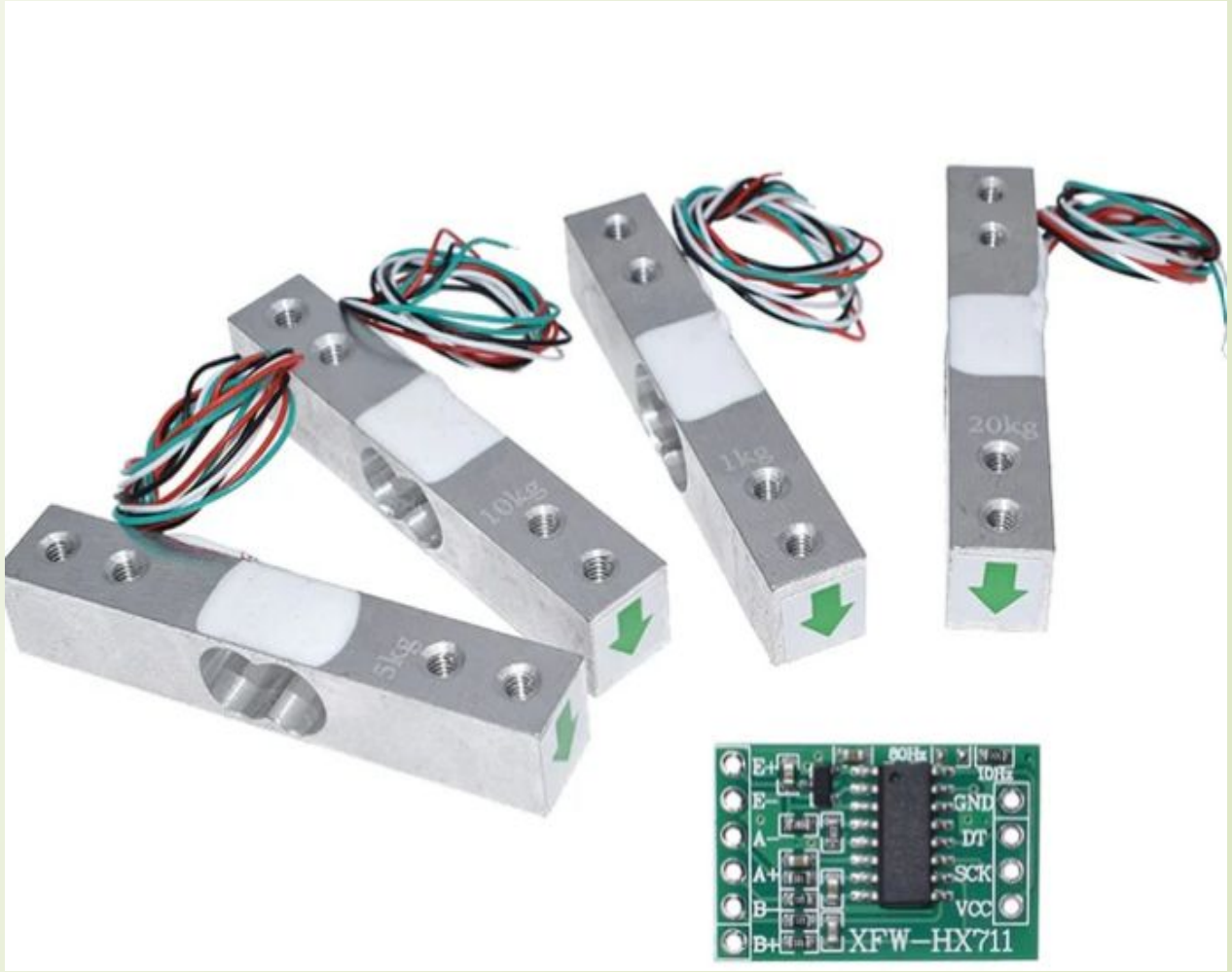
A digital 10 Degrees of Freedom Sensor. It comes with an onboard 3 axis accelerometer, 3 axis gyroscope, 3 axis magnetic field sensor and a barometric pressure sensor all in one single compact board.

Features

- Onboard 3 axis accelerometer - ADXL345
- Onboard 3 axis magnetometer - HMC5883L
- Onboard 3 axis gyro - L3G4200D
- Onboard barometric pressure sensor - BMP085
- Digital I2C interface to read the output of all the sensors
- Onboard voltage regulator and logic level converter allows the sensor module to be connected to microcontroller working between 3V3-5V
- Libraries and tutorials available for Arduino and other microcontrollers
- Can be used for tilt sensing, heading calculation, quadcopters, self balancing robots, etc

Load Cell

- The HX711 IC load cell module allows you to easily read load cells to measure weight. By connecting the amplifier to your microcontroller you will be able to read the changes in the resistance of the load cell, and with some calibration you'll be able to get very accurate weight measurements.



Flow Sensor

YF-S201 Water Flow Measurement Sensor with 1-30 Liter/min Flow Rate – Black. This sensor sits in line with your water line and contains a pinwheel sensor to measure how much liquid has moved through it. There's an integrated magnetic hall effect sensor that outputs an electrical pulse with every revolution. The hall effect sensor is sealed from the water pipe and allows the sensor to stay safe and dry.

By counting the pulses from the output of the sensor, you can easily calculate water flow. Each pulse is approximately 2.25 millilitres.

Features :

1. The simple and compact module.
2. Easy to Install.
3. High Sealing Performance.
4. High-Quality Hall Effect Sensor.

Proximity Sensor Inductive

To fit different industry verticals needs, we offer our patrons with precision engineered **Inductive Sensors.**Making use of superior grade raw material and advanced techniques, these sensors are precisely manufactured in strict adherence with industry standards by our associated vendors. Based on the principle of Damped Oscillator, these highly accurate sensors find application in detecting existence of any metal within its sensing range.

Features:

- High sensitivity
- Energy efficiency
- Durable finish standard

Digital Ambient Light and Proximity Sensor APD9930

- The APDS-9930 provides digital ambient light sensing (ALS), IR LED and a complete proximity detection system in a single 8 pin package.
- The proximity function offers plug and play detection to 100 mm (without front glass) thus eliminating the need for factory calibration of the end equipment or sub-assembly.
- The proximity detection feature operates well from bright sunlight to dark rooms. The wide dynamic range also allows for operation in short distance detection behind dark glass such as a cell phone.
- Features - Working voltage:2.8-3.8V. ALS, IR LED and Proximity Detector in an Optical Module; Ambient Light Sensing (ALS); Approximates Human Eye Response;
- Features - Programmable Interrupt Function with Upper and Lower Threshold; Up to 16-Bit Resolution; High Sensitivity Operates Behind Darkened Glass.

Magnetic Compass HMC5883L

- Harical GY-271 HMC5883L 3-axis Electronic Compass Module Magnetic Field Sensor
- 3-axis Gyro+Acceleration+Magnetic Fiel
- Air Pressure Module
- Power supply: 3-5V
- Build in ultra low noise linear LDO voltage regulator
- Built-in onboard filters, which reduce noise from motor and other high current electronics
- You can easily select two I2C address for MPU6050 by soldered jumper
- The digital compass thats usually based on a sensor called the magnetometer and provides mobile phones with a simple orientation in relation to the Earths magnetic field. As a result, your phone always knows which way is North so it can auto rotate your digital maps depending on your physical orientation

Capacitive Touch Sensor TTP223

- The TTP223 is a touch pad detector IC replicating a single tactile button. This touch detection IC is designed for replacing traditional direct button key with diverse pad size.
- **Features**
- 1. Input Voltage: 3.3V - 5.5V DC
- 2. Module size: 15mm x 11mm
- 3. Stable touching detection of human body for replacing traditional direct switch key.

Capacitive Touch Sensor TTP229 Keypad

The**TTP229 Touch switch digital sensor** is capacitive sensing design specifically for touch pad controls. The device built in regulator for touch sensor. Stable sensing method can cover diversity conditions.

Human interfaces control panel links through non-conductive dielectric material.The main application is focused at replacing of the mechanical switch or button. The ASSP can independently handle the 8 touch pads or up to 16 touch pads.

Description:

- 16-key board TTP229 capacitive touch sensor IC
- onboard power indicator
- working voltage: 2.4V-5.5V
- the module can be set to output mode, the key output mode, the longest time and fast output / low power options
- PCB board size: 49.3 (mm) x64.5 (mm)

Gas Sensor MQ- 2

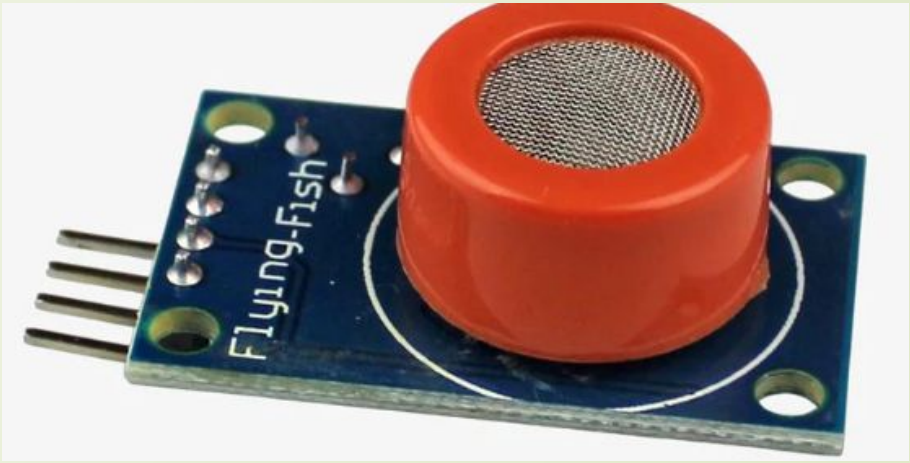
MQ2 Gas sensor module works on 5V DC and uses around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations in a range of 200 to 10000 ppm.

MQ2 Gas Sensor Features & Specifications

- Operating Voltage is +5V
- Analog output voltage: 0V to 5V
- Digital Output Voltage: 0V or 5V (TTL Logic)
- Preheat duration 20 seconds
- Can be used as a Digital or analog sensor
- The Sensitivity of Digital pin can be varied using the potentiometer

Gas Sensor MQ- 3

- **MQ3 Gas Sensor** is another one of MQ family of gas sensors which is used to detect the alcohol content from 0.05 mg/L to 10 mg/L.



Feature

- Operating Voltage 5V±0.1V
- Current Consumption 150mA
- Operating Temperature -10°C to 70°C
- Simple to use, Low Cost and Fast Response
- Onboard LEDs for output and power
- Output sensitivity adjustable for Digital Output
- Analog output 0V to 5V, Digital Output
- Stable and Long Life
- Good Sensitivity to Alcohol Gas

Gas Sensor MQ- 5

This **MQ5 gas sensor** is used in gas leakage detection, and suitable for home and industrial equipments for LPG, natural gas, coal gas detection and monitoring. The sensitive material used in the MQ5 gas sensor is SnO2, which has lower conductivity in clean air. When the target combustible gases exist in the atmosphere, sensor's conductivity increases with the gas concentration.

MQ5 Gas Sensor Specifications:

- Item Weight: 10.0 grams
- Heater Voltage: 5.0V
- Power Supply: 5 Volts
- Interface Type: Analog & Digital
- Working Current: 150mA
- DOUT: TTL output
- AOUT: Analog output

Gas Sensor MQ- 7

- **MQ7 Gas sensor** is one of Metal Oxide Semiconductor (MOS) type Gas Sensor of MQ Gas Sensors family involving MQ 2, MQ 4, MQ 3, MQ 8, MQ 135, etc. It is mainly used to detect **Carbon Monoxide**.

SPECIFICATIONS

- Operating Voltage is +5V
- Can be used to Measure or detect CO
- Analog output voltage: 0V to 5V
- Digital Output Voltage: 0V or 5V
- Stable, Long life and Low Cost
- Fast Response time
- Heater consumption about 350mW
- The Sensitivity of Digital Output pin can be varied using the potentiometer

Gesture Sensor APDS9960

- Display Backlight Control, Correlated Color Temperature Sensing, Cell Phone Touch-screen Disable
- Digital Camera Touch-screen Disable, Mechanical Switch Replacement,Gesture Detection

Features:

- RGBC Light Sensor, Proximity and Gesture Detector with IR LED in an Optical Module
- I2C Interface Compatible with Dedicated Interrupt Pin
- High Sensitivity Enabling Operation Behind Darkened Glass
- RGBC Light Sensing with Integrated UV-IR Block Filter
- Geometrically Arranged RGBC Photodiodes Providing Uniform Angular Response
- Calibrated to 100mm Detection Distance Eliminating Customer End Product Calibration
- Four Separate Photodiodes Sensitive to Different Directions
- Low Power Consumption: 1.0 µA typical in Sleep Mode

Motion Sensor

PIR

HW-MS03 (2.4GHz to 5.8GHz)

HB100

Actuator
Relay

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

Specifications

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A

Actuator
Solenoid Lock

12V 1 Amp Solenoid Actuator Door Lock

Specifications:

- Iron Body Material
- High quality ultra-compact electric lock.
- Rustproof, durable, safe, convenient to use.
- Suction which tightly sucks the iron, thus locking the door.
- Designed with the open frame type and mount board, high power.
- Easy to install for the electric door lock or other automatic door lock systems with the mounting board
- Applicable for being installed in the escape door or fire door electronic controlled system.
- Adopts the principle of electric magnetism, when the current through the silicon, the electromagnetic lock will achieve a strong

Actuator
Tower Pro MG945 Servo Motor

Product Specification

- Voltage 4.8 ~ 6.6V
- Brand TowerPro
- Model Name/Number MG945
- Gear Type Metal Gear
- Temperature Range 0 to 55 DegreeC
- Operating Speed @4.8V 0.23sec/60 Degree
- Operating Speed @6.6V 0.2sec/60 Degree
- Degree of Rotation 180 Degree
- Servo Wire Length 32 cm
- Power Supply Type Through External Adapter
- Dead Band Width 1us
- Stall Torque 10 kg.cm (4.8V); 12 kg.cm (6V)
- Current Draw At Idle 10 MA
- No Load Operating Current draw 170 MA

Display

- Alphanumeric LCD
  20 x 4

Graphical LCD
128 x 64

OLED(1.3”)

TFT (2.4”)

e-Ink Paper
(1.54”)

Wi-Fi Module

HM-10 BLE Bluetooth 4.0 CC2541

Wi-Fi Module ESP-01S

RF Module nRF24L01

LoRa

SOC

- Wemos D1 mini (ESP8266-ESP12F)

- Wemos D1 mini pro (ESP8266-ESP12F)

- LOLIN 32 (ESP32)

- LOLIN 32 PRO (ESP32)