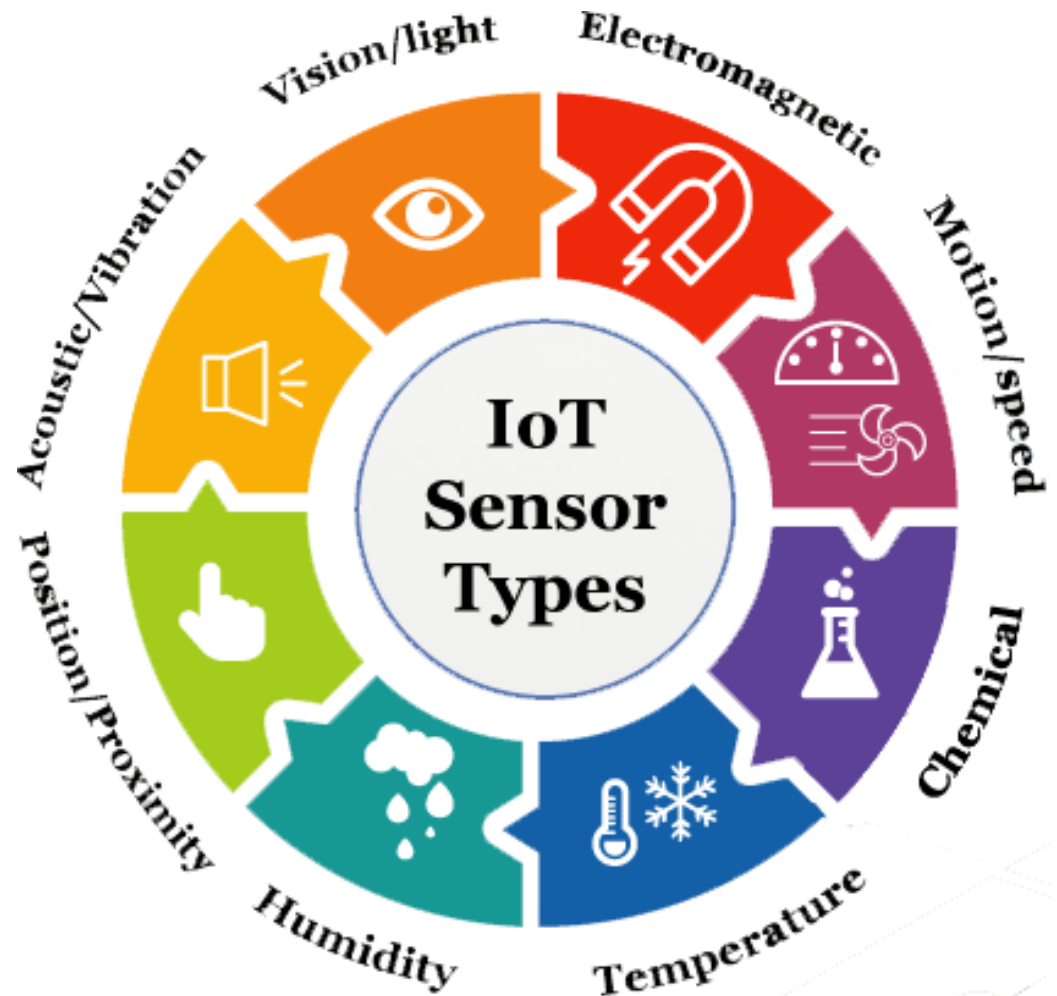## Module 3 (IoT & Applications)
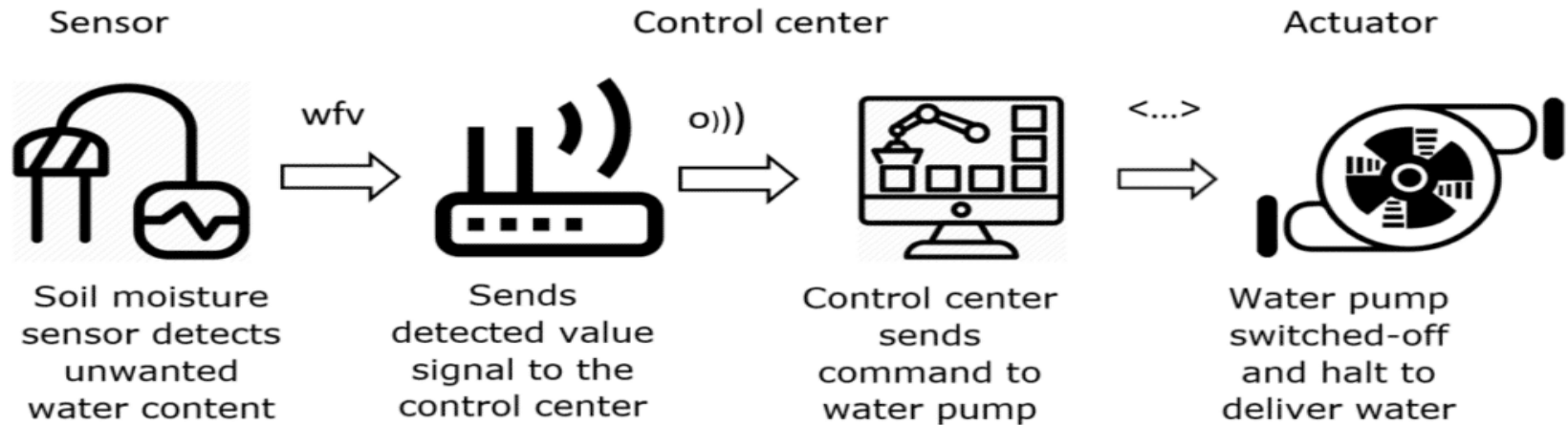
Introductory Class on Sensors and Actuators

Role of Sensors in IoT

Sensor and Actuator

▸ A sensor is a device which detects or measure a physical property and records, indicate or otherwise responds to it.

▸ Actuator is a device that causes a machine or other device to operate.

Example:

Sensor		Control center		Actuator

Soil moisture sensor detects unwanted water content → wfv → Sends detected value signal to the control center → o))) → Control center sends command to water pump → <...> → Water pump switched-off and halt to deliver water

Definitions

▸ A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine.

▸ A transducer is a device that converts energy from one form to another. Usually a transducer converts a signal in one form of energy to a signal in another.

▸ An actuator is a device that produces a motion by converting energy and signals going into the system.

Examples of Sensors

Sensors exist in various forms and shapes. Here are some of the common ones:

▸ Biosensors – are typically used in electronical technology. Medical devices use them to analyze proteins, cells, and more.

▸ IR sensor – helps measure distance by estimating the depth of IR reflection.

▸ Temperature sensor – converts temperature changes into electrical signals with the help of the thermodynamic principle.

▸ Image sensor – leverages CMOS (Complementary Metal Oxide Sensor) technology to identify and transfer the details used to create images. You'll find these sensors in surveillance and consumer electronics devices.

▸ Motion detectors – are based on radar, microwave, and ultrasonic technologies. They generate waves and use echo to determine nearby motion and obstacles in their pathways.

Difference b/w sensor and actuator

Basis for comparison	Sensor	Actuator
Basic	Used to measure the continuous and discrete process variable.	Impel continuous and discrete process parameter.
Placed at	Input port	Output port
Outcome	Electrical signal	Heat or motion
Example	Magnetometer, camera, accelerometer, microphone.	Led, laser, loudspeaker, solenoid, motor control

Key Differences Between Actuators and Sensors

Here are the main differences between the two components:

1. Sensors identify events or alternations in the environment and transmit this information to other devices, while actuators are machine components that control the moving mechanism.

2. Sensors are placed at the input port, while actuators are fixed at the output port.

3. Sensors measure both continuous process and discrete variables. In contrast, actuators help impel the parameters of these two processes.

4. A sensor will convert any physical attribute to a control signal, while an actuator does the opposite, changing the control signal to physical action.

5. Actuators' industrial applications include valves, couplings, and operating dampers. On the other hand, sensors are used to analyze asset vibration, fluid level, or pressure.

6. Some non-industrial devices that utilize sensors include cameras, microphones, and home security systems. Other devices like motor controllers, LED, and lasers use actuators.

7. Actuators and sensors often depend on each other to perform certain tasks. Where both are present, the actuator relies on the sensor to power its function. If one or the other fails to work correctly, the system will malfunction. In most instances, either the actuator triggers the action, and the sensor transmits the signal, or actuator movements help the sensor send out alerts.

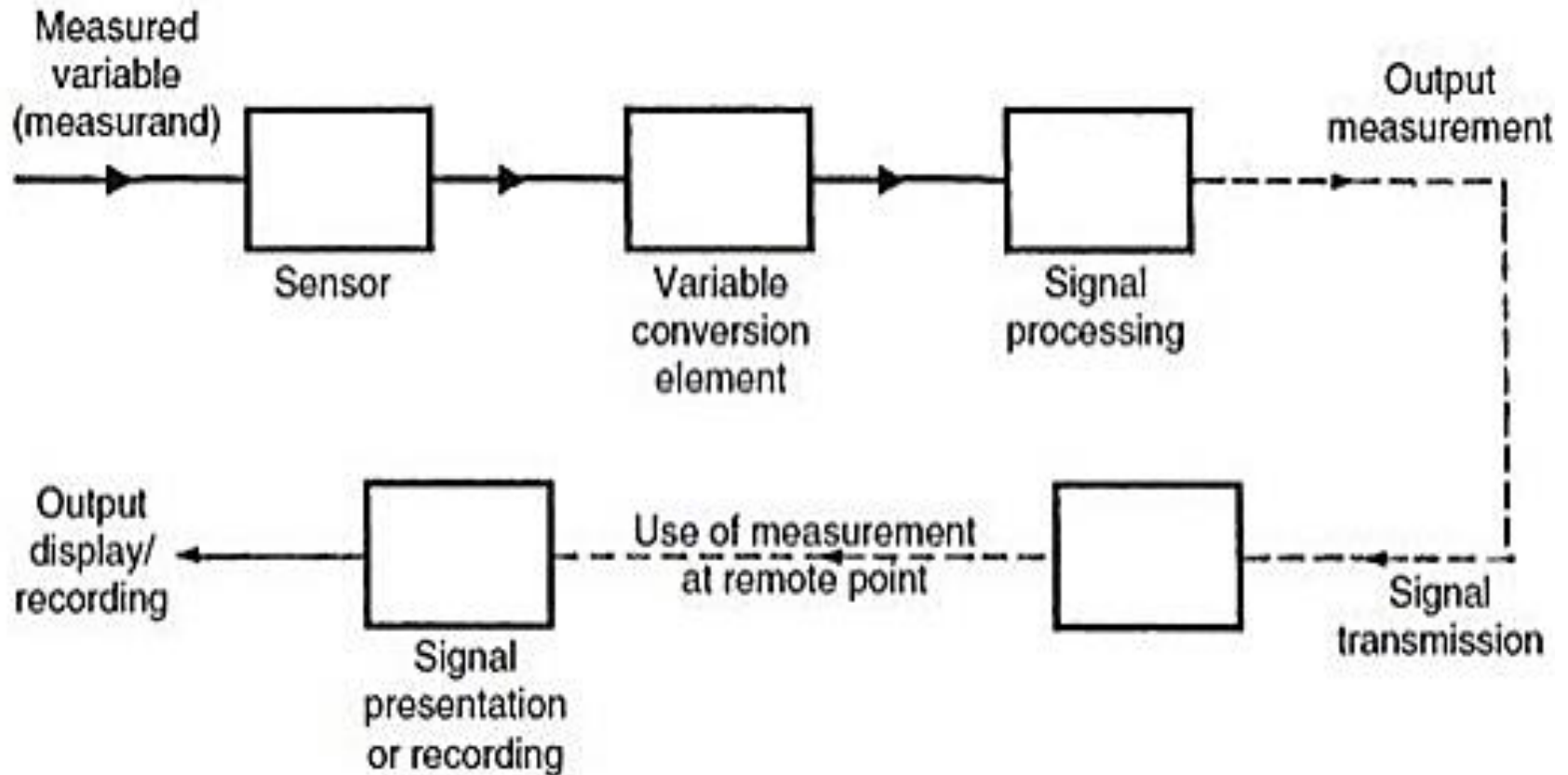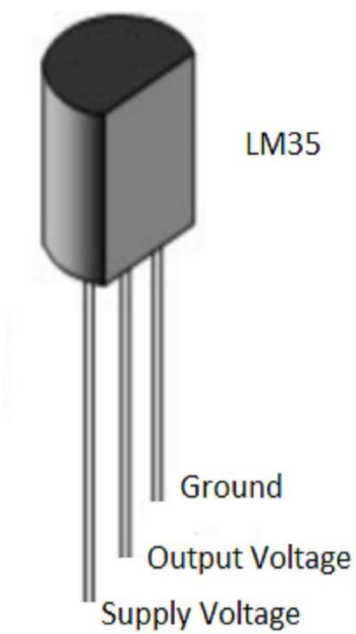# Generalized block diagram of a measurement system
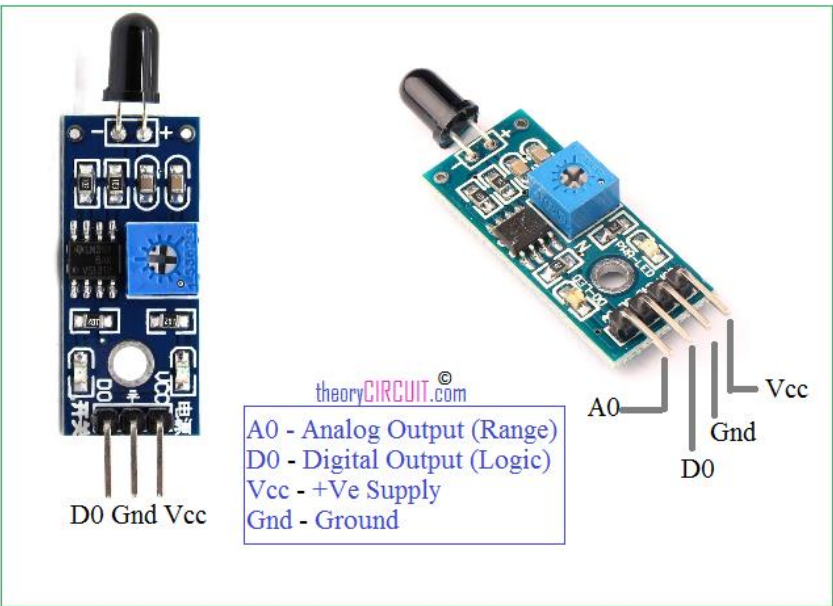

Fig 1.1 Generalised Measurement system
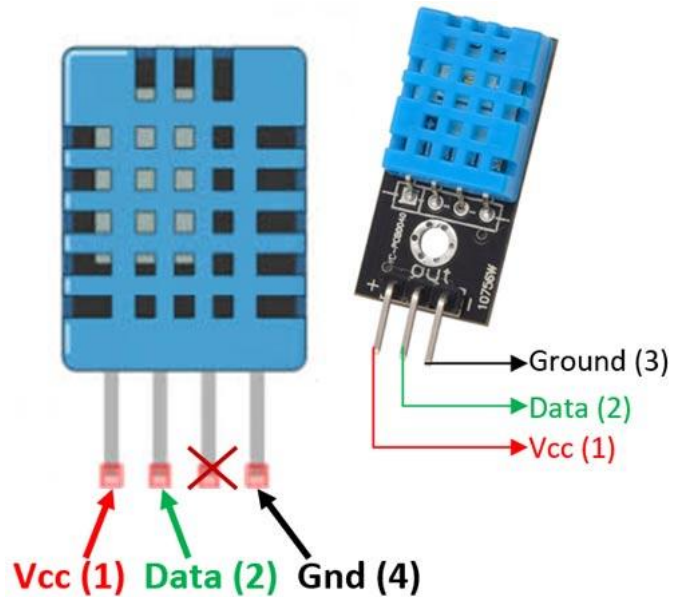
Sensors
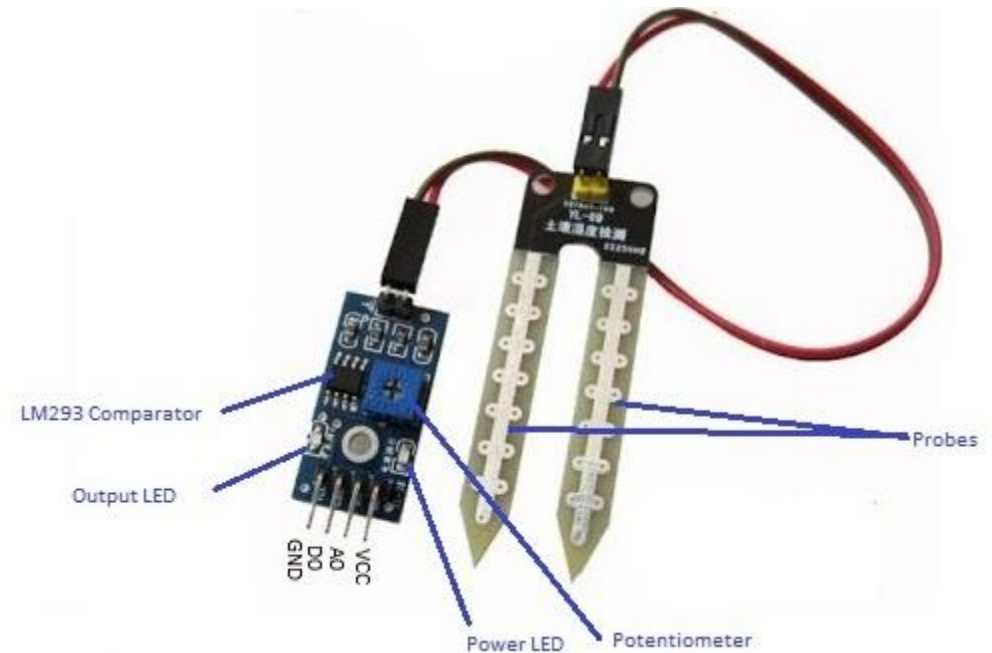

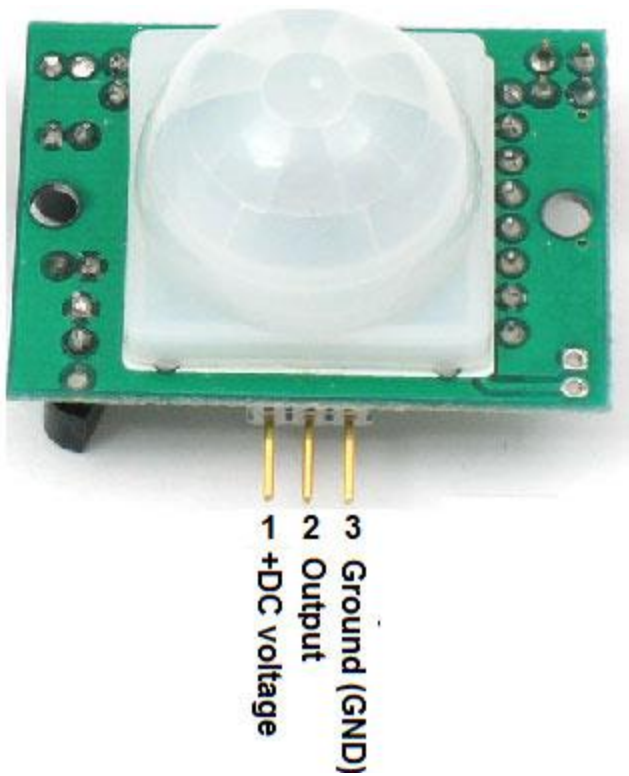**Temp sensor(LM317)   Temp (DS18B20)   Flame Sensor**
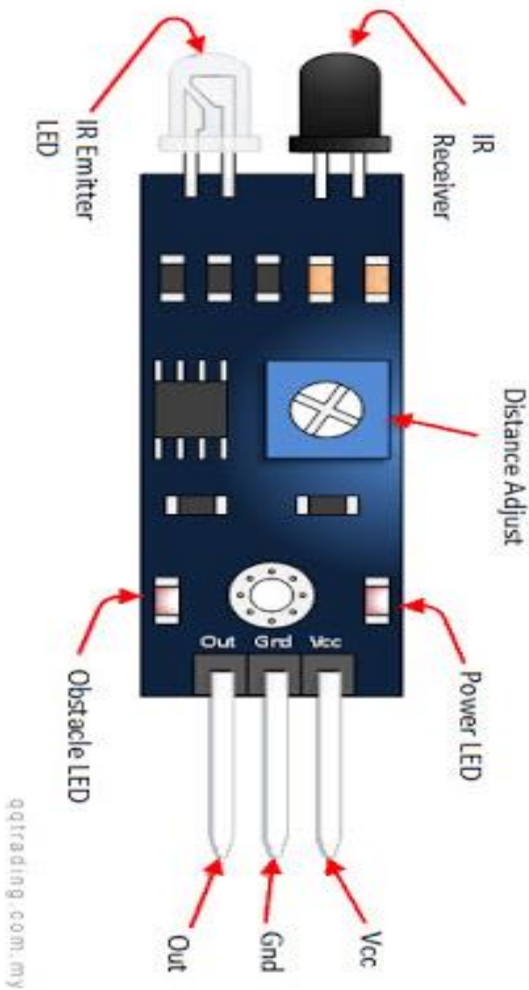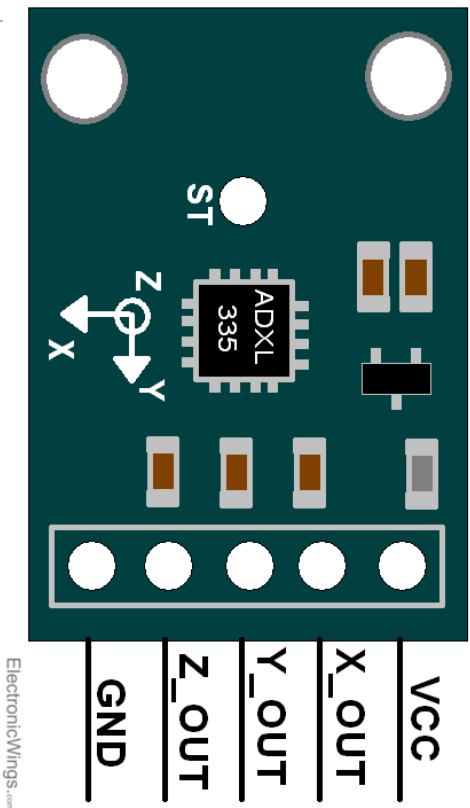
Sensors

Temp sensor (DHT11)

Soil Moisture probe
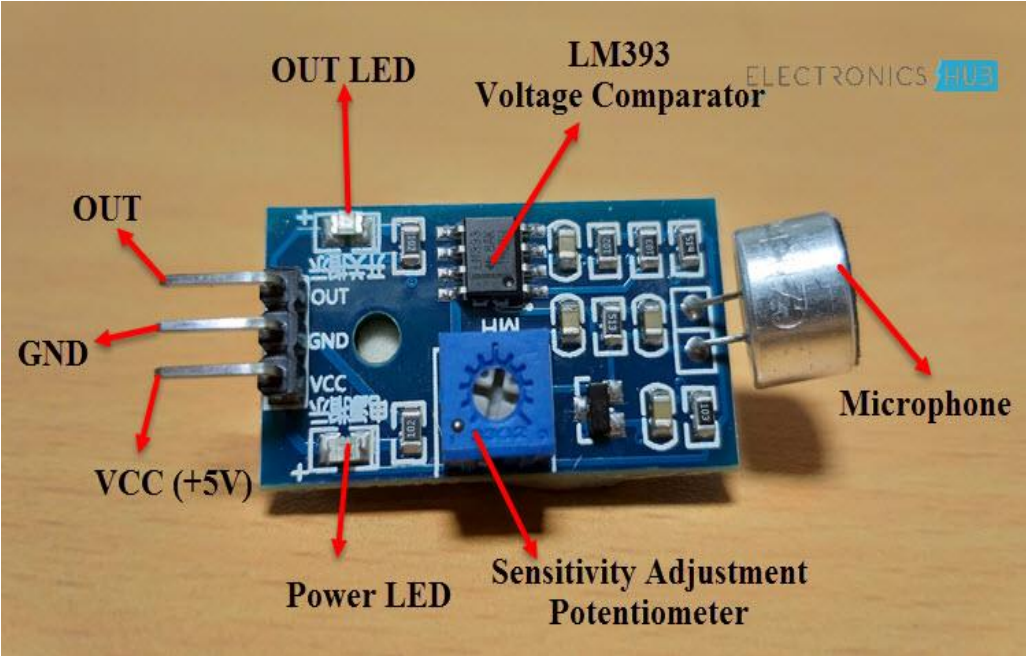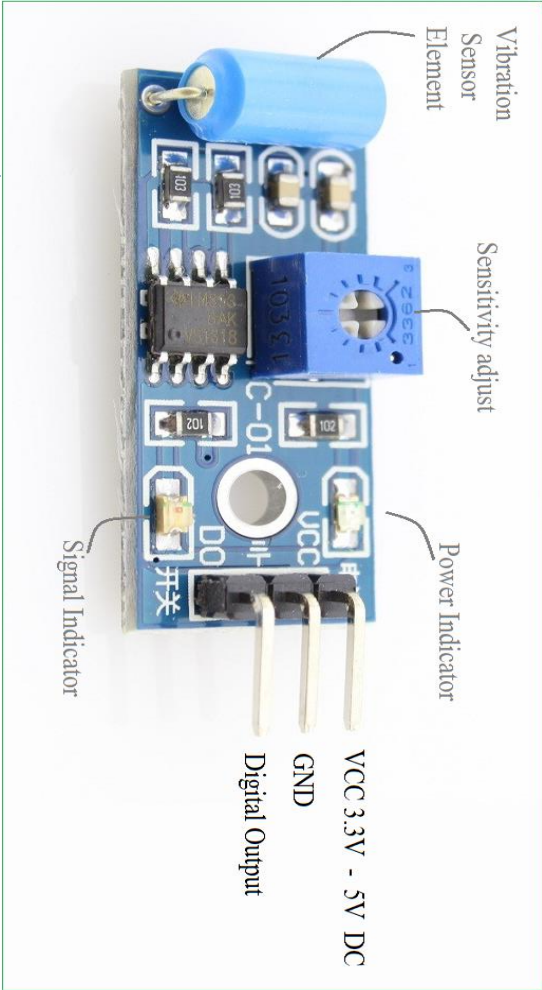
Sensors

Motion sensor (HC-SR 501)   **IR module**   **ADXL335**

1 2 3
+DC voltage
Output
Ground (GND)

IR Emitter LED
IR Receiver
Distance Adjust
Obstacle LED
Power LED
Out   Gnd   Vcc
Out   Gnd   Vcc

ST
Z
X
Y
ADXL 335
GND
Z_OUT
Y_OUT
X_OUT
VCC

Sensors

Sound sensor module

Vibration Sensor Module

Sensors

BMP180
PRESSURE
SENSOR
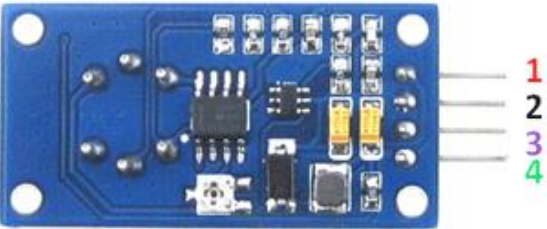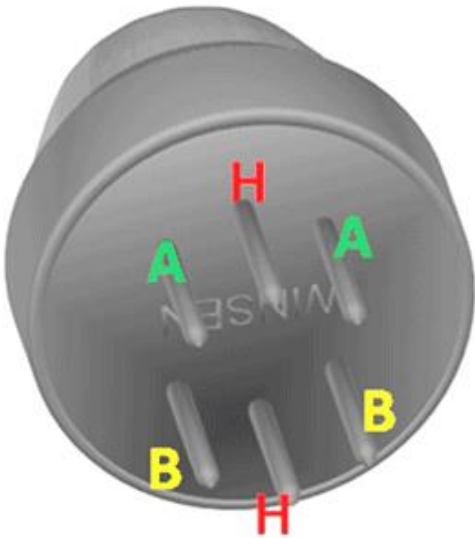
Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

VIN — Not Used
3Vo — 3.3V to 5V
GND — Ground
SCL — SCL
SDA — SDA

Gas sensor module (MQ135)
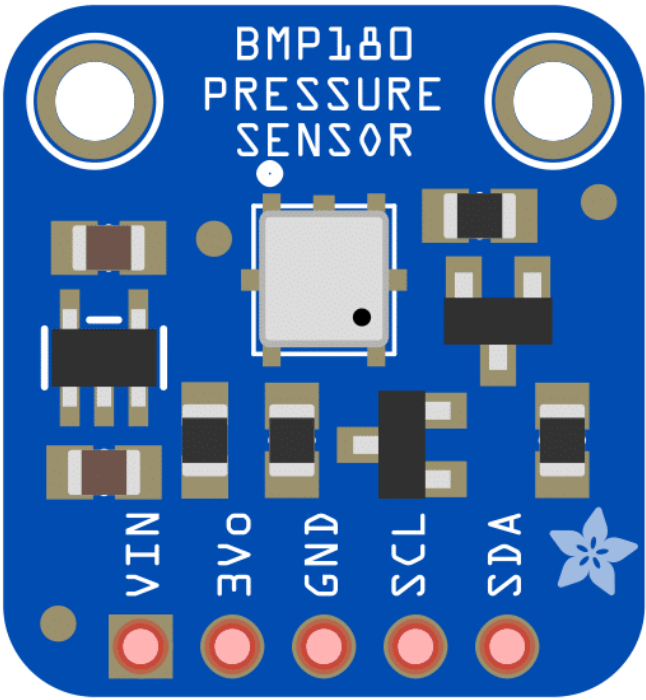
Pressure Sensor Module

Silicon ...beyond teaching | Silicon Institute of Technology
Bhubaneswar

Sensor Module Circuits
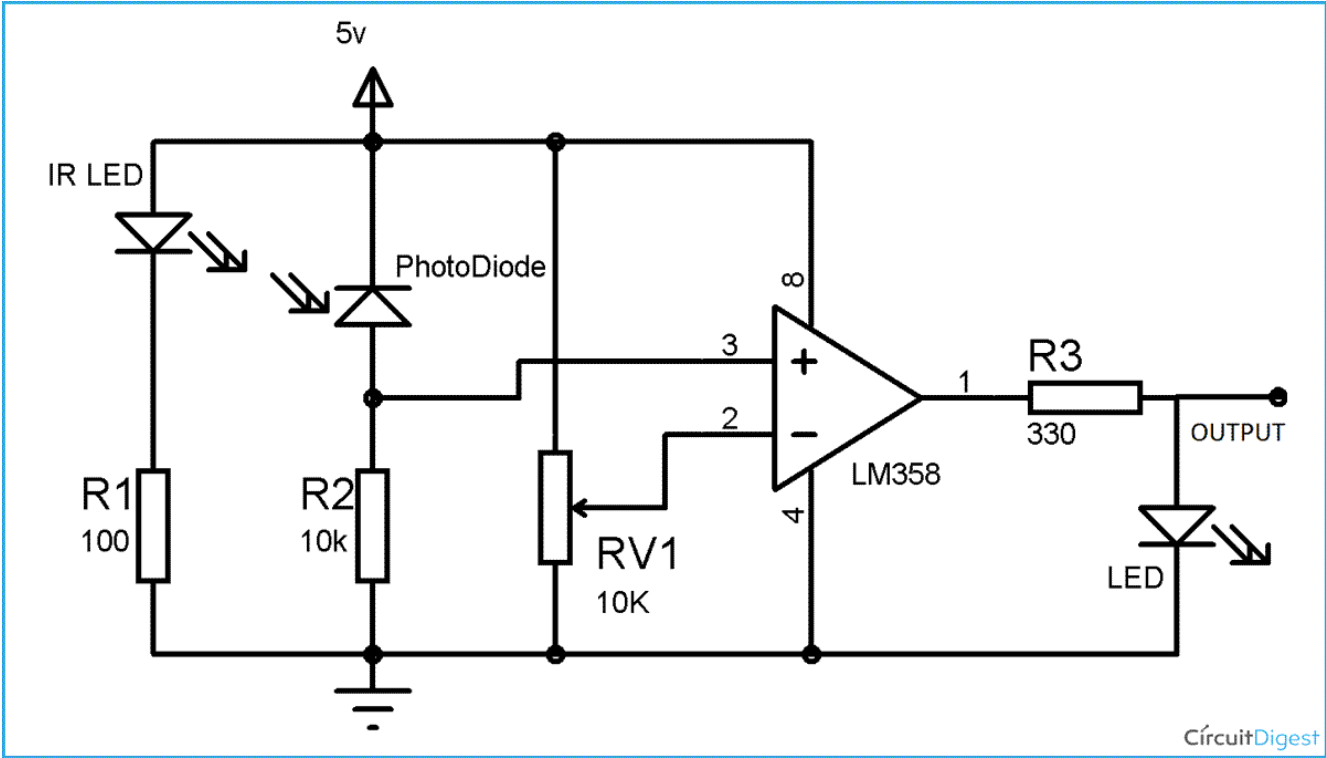
IR Module Circuit Diagram   **IR Module**
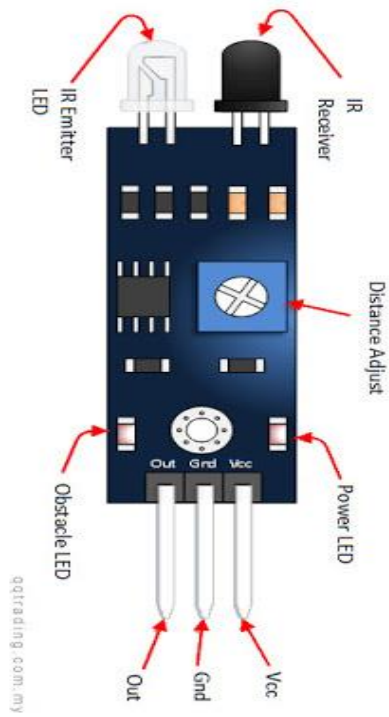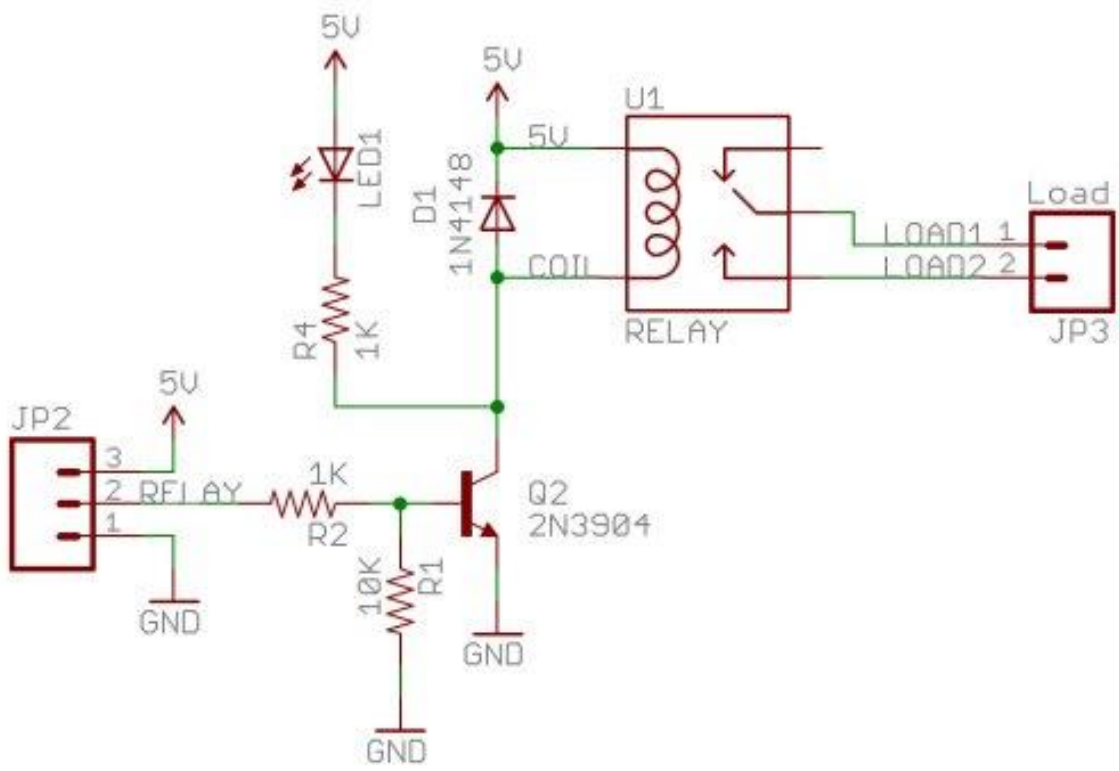
Actuators

Servo motor
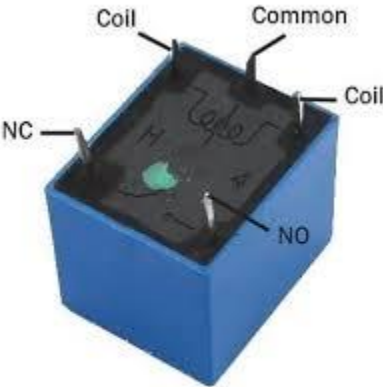
SPDT relay

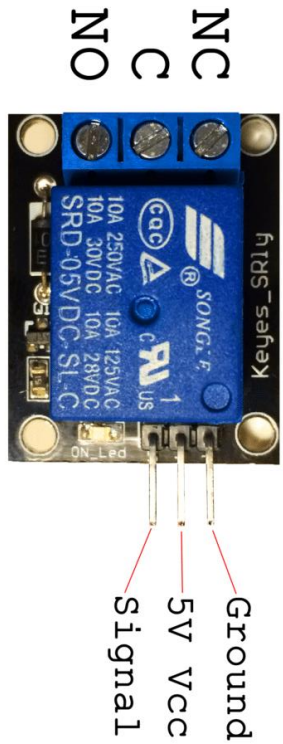**Relay Module (2 channel)**

Actuator Module Circuits

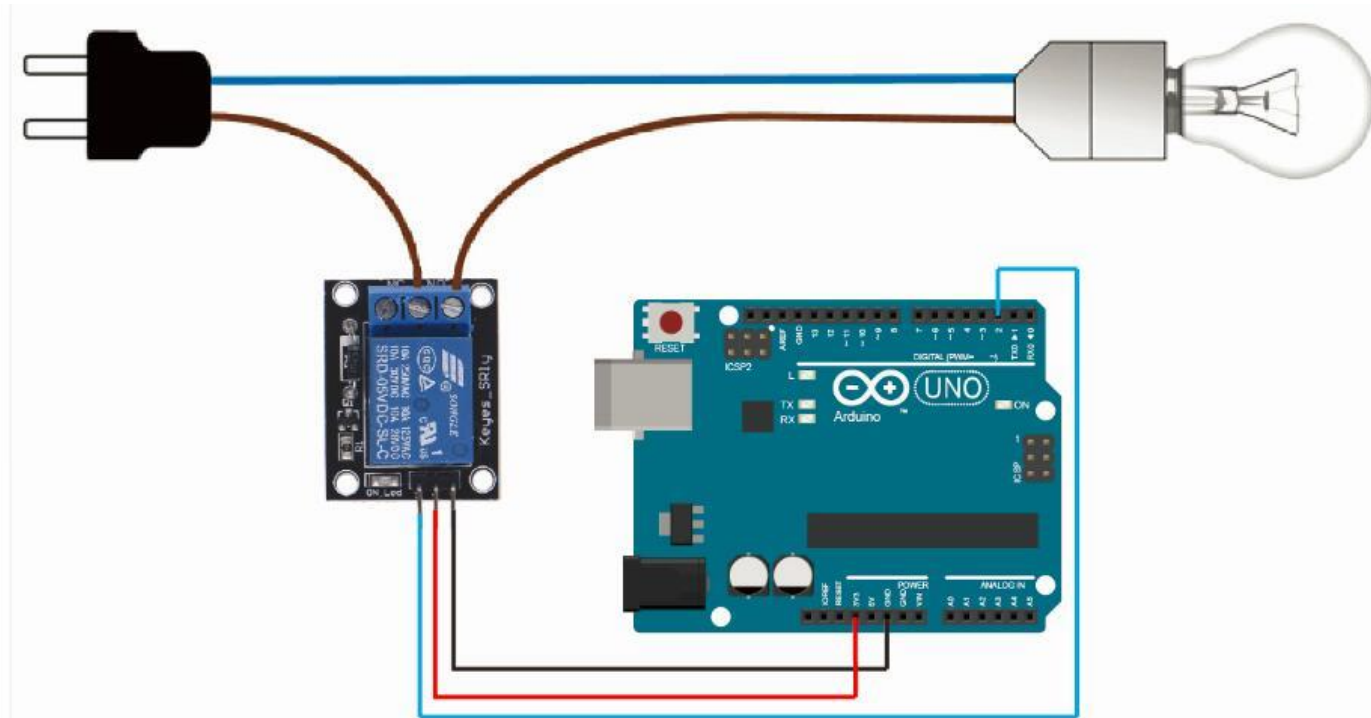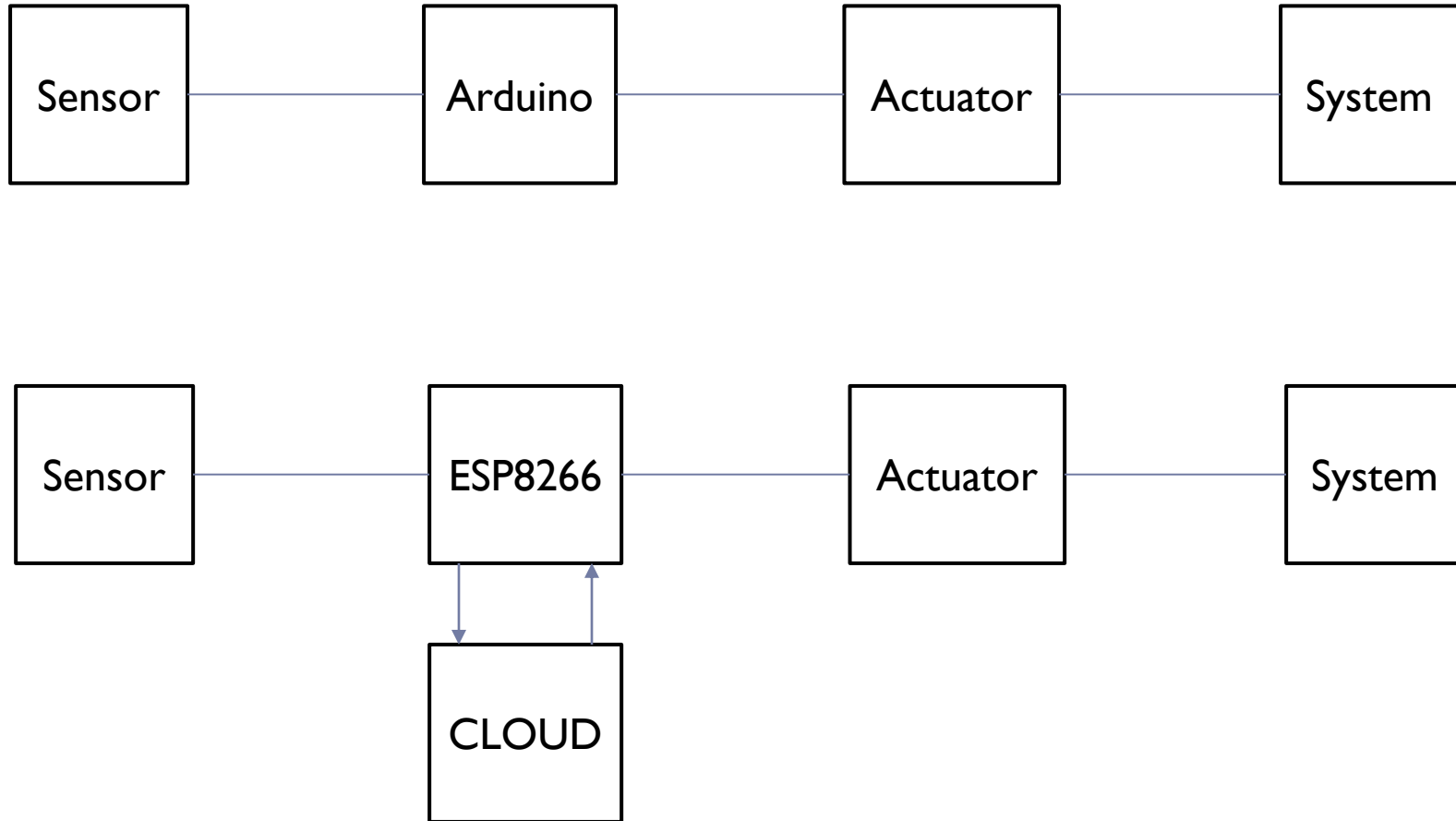**Relay Module Circuit Diagram**

Relay Module

Arduino with relay

Input type – DC voltage level
Relays acts as electromechanical
switch.

System design (Case study discussion)

```
┌─────────┐      ┌─────────┐      ┌─────────┐      ┌─────────┐
│ Sensor  │──────│ Arduino │──────│ Actuator│──────│ System  │
└─────────┘      └─────────┘      └─────────┘      └─────────┘


┌─────────┐      ┌─────────┐      ┌─────────┐      ┌─────────┐
│ Sensor  │──────│ ESP8266 │──────│ Actuator│──────│ System  │
└─────────┘      └────┬────┘      └─────────┘      └─────────┘
                      │  ↑
                      ↓  │
                 ┌─────────┐
                 │  CLOUD  │
                 └─────────┘
```

THANK YOU