



Introduction to Robotics

CSE 461

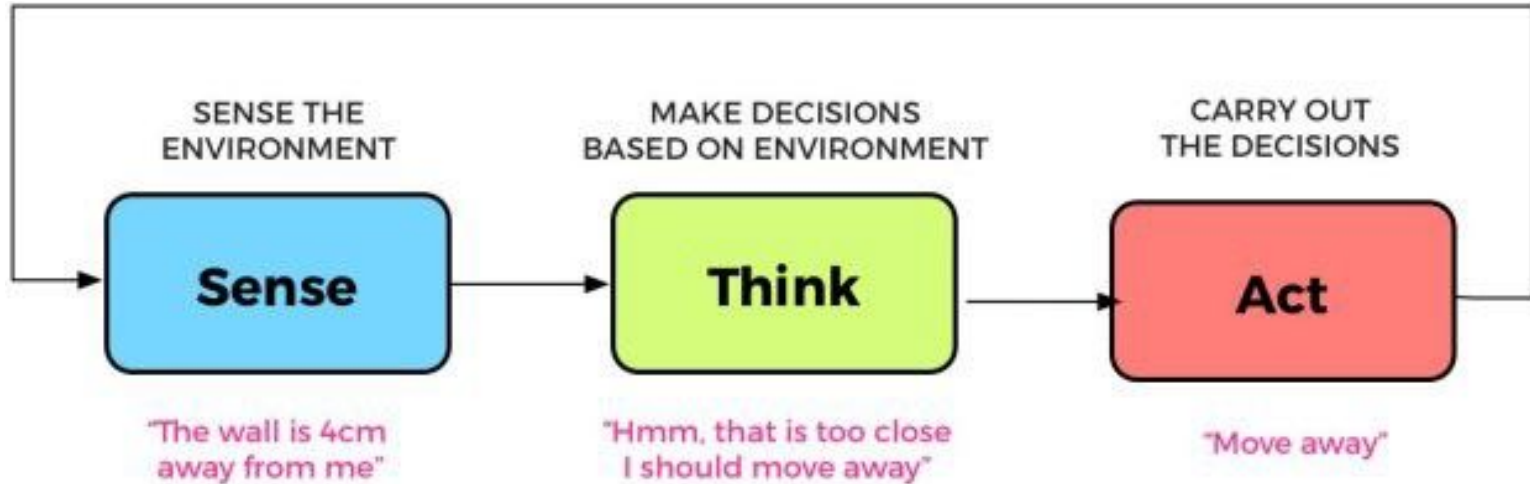
Lecture 3 : Chapter 1(Introduction to robotics: basics)

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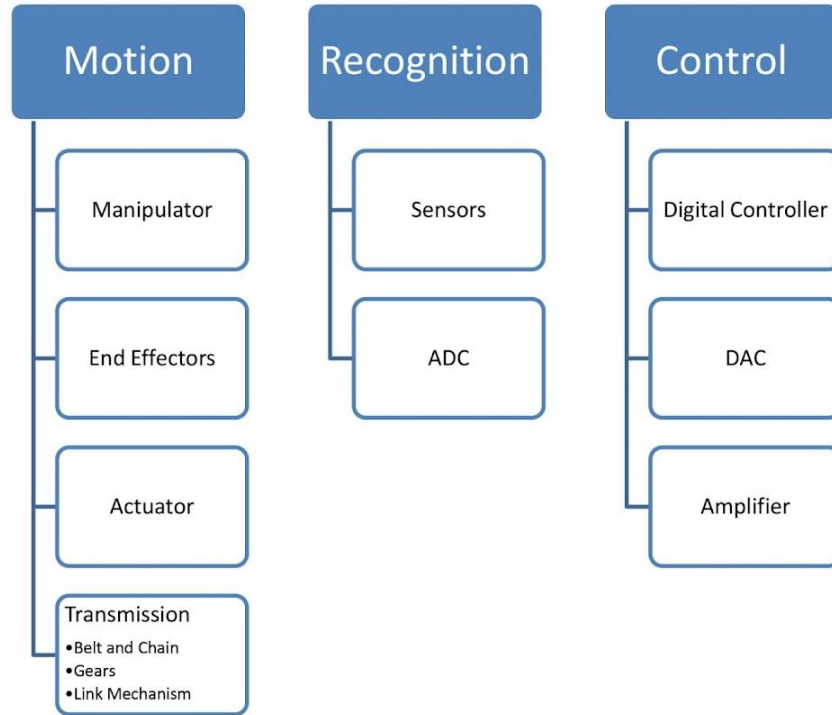
Previous Class

1. Primitives
2. Paradigms

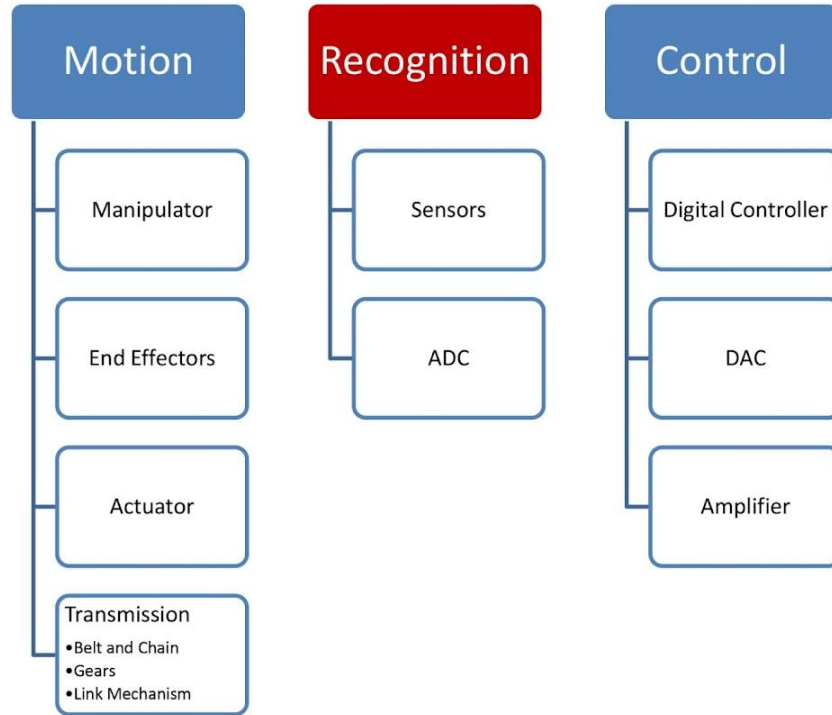
Recall



Subsystems

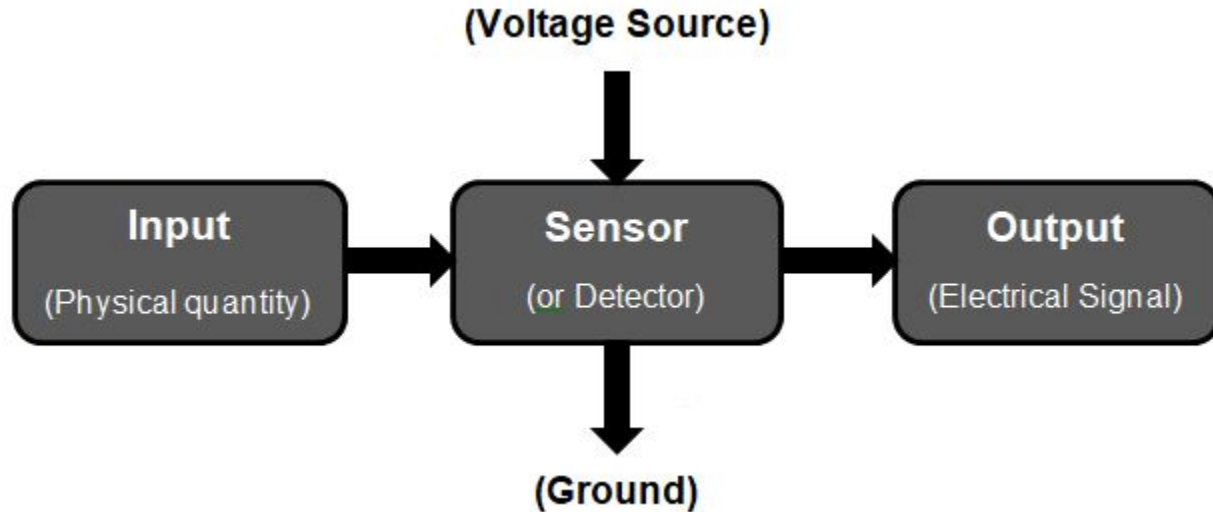


Subsystems



Sensor

A sensor is a device that detects or measures physical, chemical, or biological properties of the environment or a system and converts them into a signal that can be processed or analyzed.



Sensor Examples

Recognition

Physical Property

Sensor

contact

switch

distance

ultrasound, radar, infrared

light level

photocells, cameras

sound level

microphone

rotation

encoders and potentiometers

acceleration

accelerometers gyroscopes

More Sensor Examples

Recognition

Physical Property

Sensor

magnetism

compass

smell

chemical

temperature

thermal, infra red

inclination

inclinometers, gyroscopes

pressure

pressure gauges

altitude

altimeters

strain

strain gauges

Active sensors



Passive sensors



Ultrasonic Sensor

Converts electrical energy into acoustic wave, which is an ultrasonic wave travelling at above 18kHz frequency.

- HC-SR04 operates at 40kHz

a microcontroller is used for communication with an ultrasonic sensor.

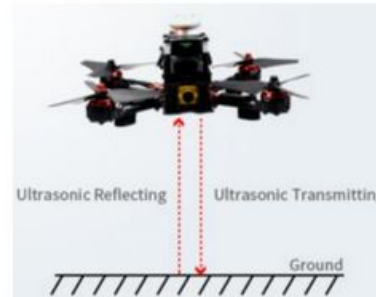
Applications

- Measure wind speed and direction
- Navigation of UAV
- Measure tank depth



HC-SR04 Ultrasonic Sensor

(Source: Digikey)

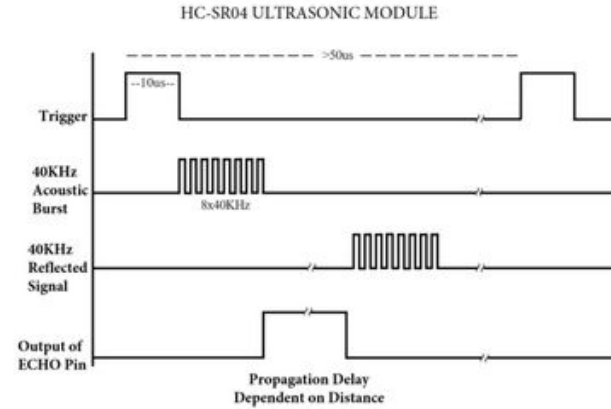


Ultrasonic sensor measuring height during drone's flight.

(Source: RadioLink)

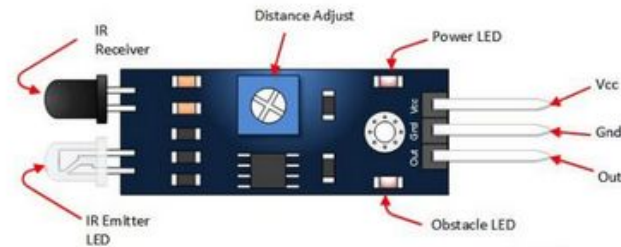
Ultrasonic Sensor: How It Works??

1. a microcontroller is used for communication with an ultrasonic sensor.
2. To begin measuring the distance, the microcontroller sends a trigger signal to the ultrasonic sensor. The duty cycle of this trigger signal is $10\mu\text{S}$ for the HC-SR04 ultrasonic sensor.
3. When triggered, the ultrasonic sensor generates eight acoustic (ultrasonic) wave bursts and initiates a time counter.
4. As soon as the reflected (echo) signal is received, the timer stops. The output of the ultrasonic sensor is a high pulse with the same duration as the time difference between transmitted ultrasonic bursts and the received echo signal.

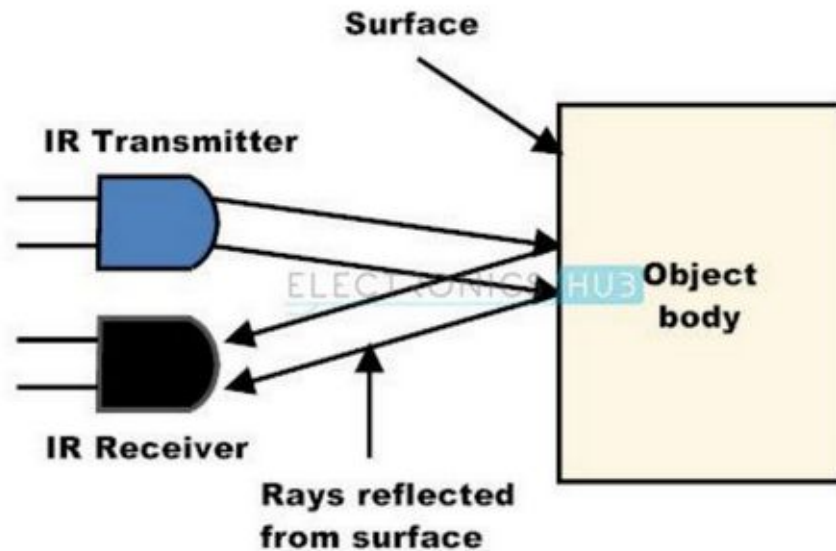


Infrared Sensors

- An electronic device that can detect and measure infrared (IR) radiation in the environment
- Anything that emits heat (everything that has a temperature above around five degrees Kelvin) gives off infrared radiation
- Applications
 - TV Remote
 - Motion Sensing
 - Proximity Sensing



Infrared Sensors: How Active Sensing Works

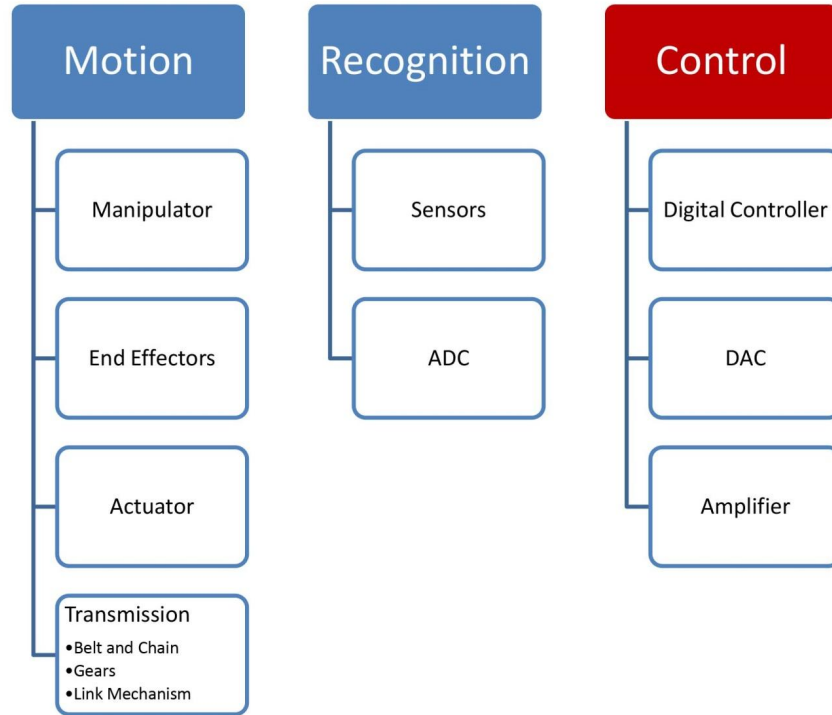


Lidar



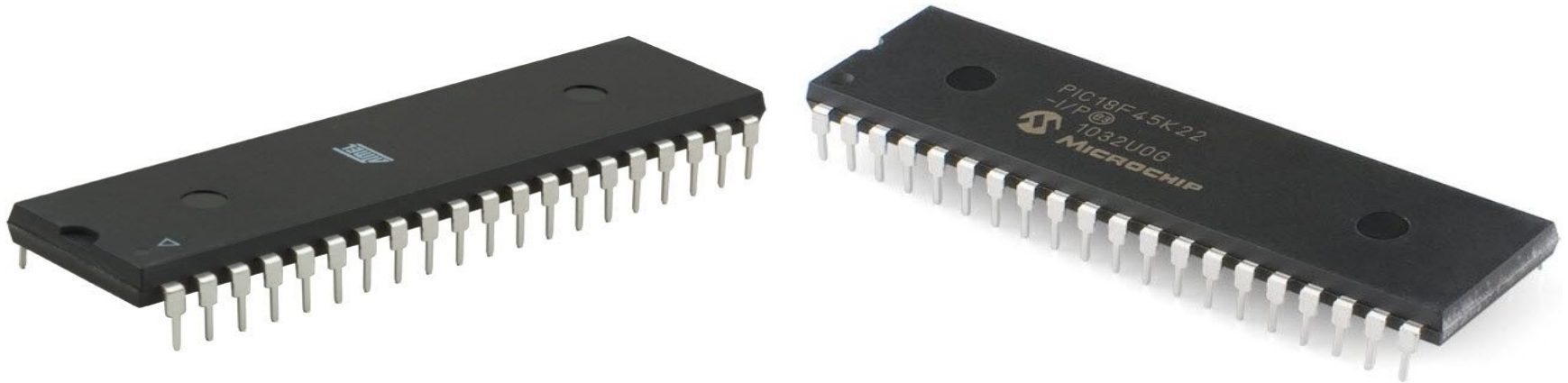
- Laser generates an optical pulse(*Up to 200,000+ pulses/second*)
- After reflecting off an object, the pulse returns to the receiver sensor
- High-speed counter measures the time of flight from the start pulse to the return pulse
- Time measurement is converted to a distance
- An onboard computer records each laser's reflection point, translating this rapidly updating "point cloud" into an animated 3D representation of its surroundings.

Subsystems



Microcontrollers

A microcontroller is a small, integrated circuit that contains a processor, memory, and input/output peripherals.



Arduino



Arduino



Arduino Uno



Arduino Leonardo



Arduino Mega 2560



Arduino LilyPad



Arduino Mega ADK



Arduino Fio



Arduino Ethernet



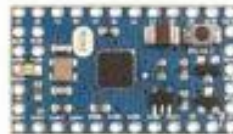
Arduino Pro



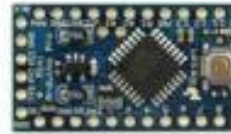
Arduino BT



Arduino Nano

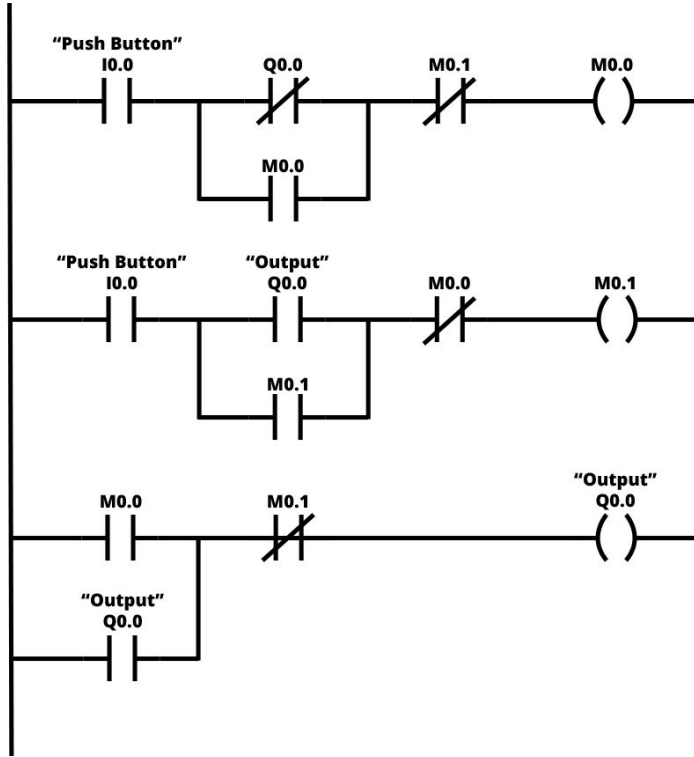


Arduino Mini

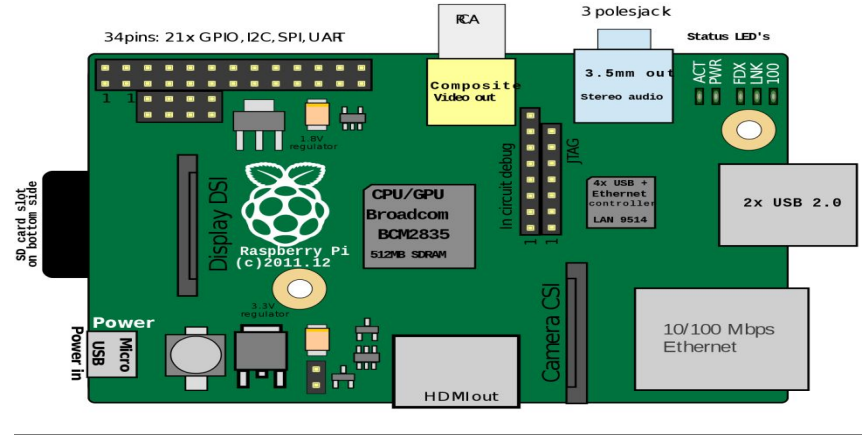


Arduino Pro Mini

Programmable Logic Controller (PLC)



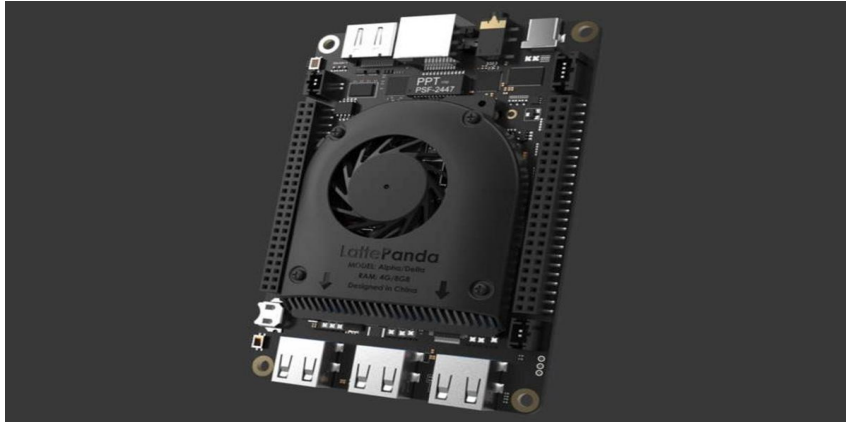
Single board Computer



Raspberry Pi 4, Tinkerboard



Little Panda and Jetson nano



Next Class

- Subsystem (Motion)

Thank You