

# **CG1111: Engineering Principles and Practice I**

Sensors

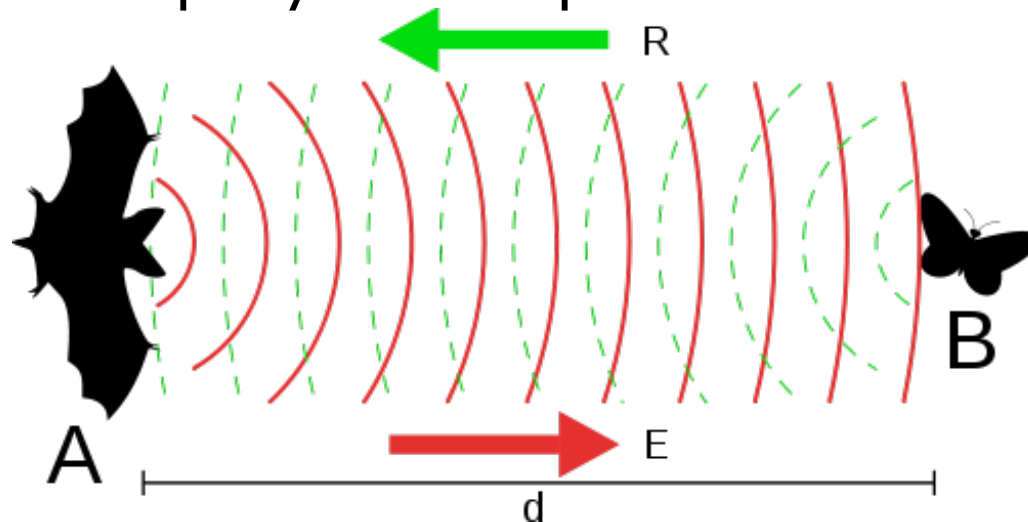
Ultrasonic Sensor

Microphone



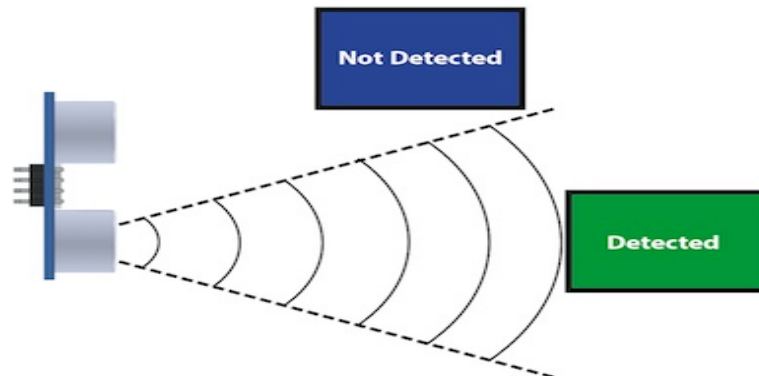
# Bats and Echolocation

- Bat echolocation is a perceptual system where ultrasonic sounds are emitted specifically to produce echoes
- By comparing the outgoing pulse with the returning echoes, the brain and auditory nervous system can produce detailed images of the bat's surroundings
- This allows bats to detect, localize, and even classify their prey in complete darkness



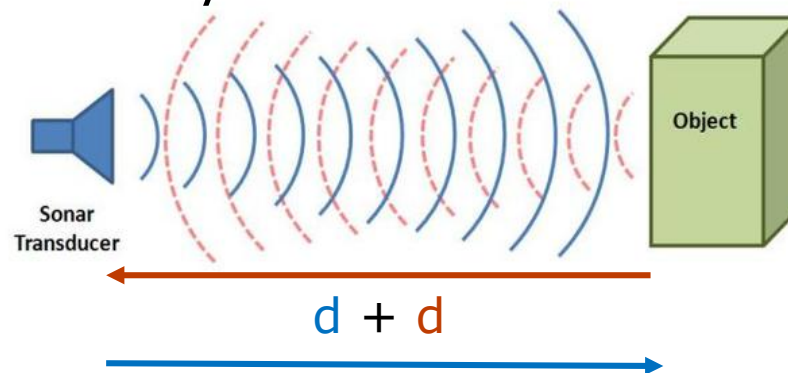
# Ultrasonic Sensor

- Ultrasonic sensors measure distance by using ultrasonic waves
- The sensor head emits an ultrasonic wave and receives the wave reflected back from the target
- Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception



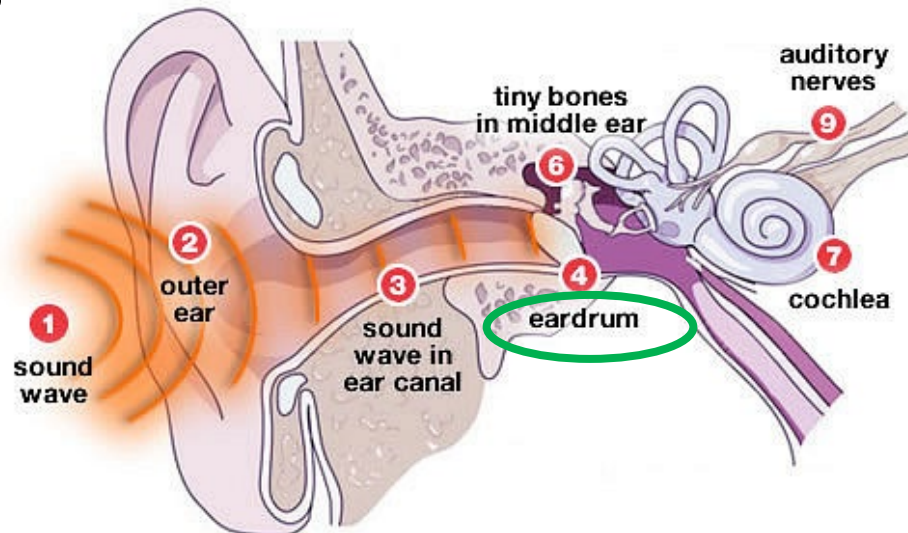
# Ultrasonic Sensor

- The sensor head emits an ultrasonic wave and receives the wave reflected from the target
- The speed of sound = 340m/s
- Total distance travelled = Speed of sound \* total time for the wave to be reflected from target
- Also, Total distance travelled = 2 \* distance between the target and sensor
- Distance between the target and sensor = Total distance travelled / 2



# The Human Ear

- Sounds are produced when vibrating objects, produce pressure pulses of vibrating air molecules, better known as sound waves
- Hearing is the process by which the ear transforms **sound** vibrations in the external environment into nerve impulses (**electrical signal**) that are conveyed to the brain, where they are interpreted as sounds



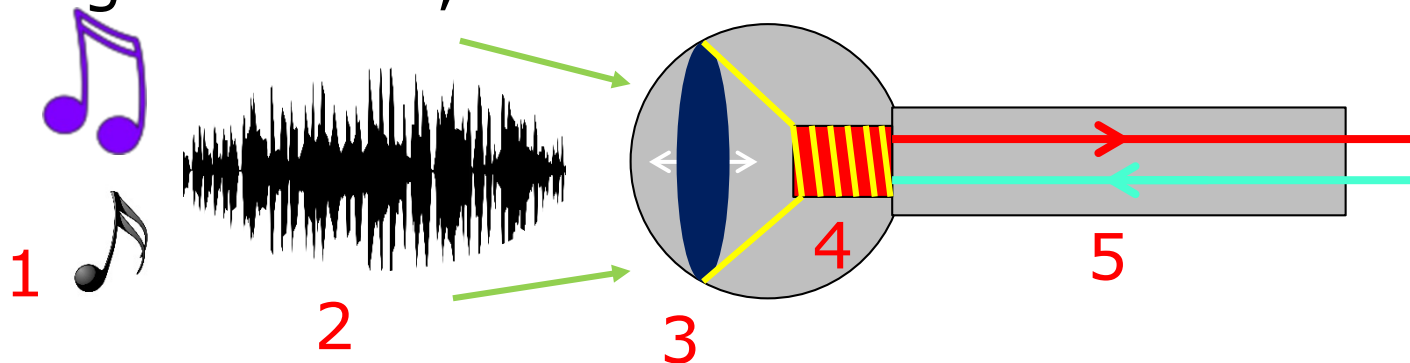
# Microphone

- Microphones are similar to our human ear
- It has a diaphragm similar to the eardrum that converts sound into an electrical signal



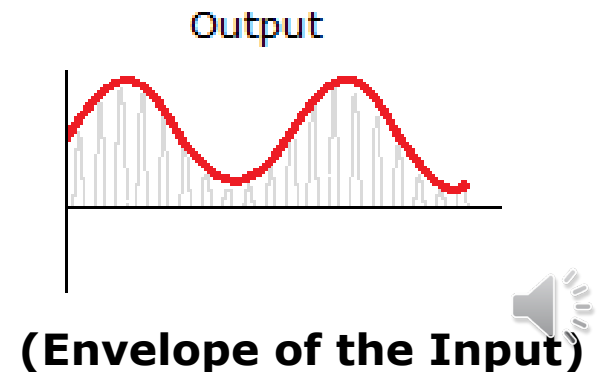
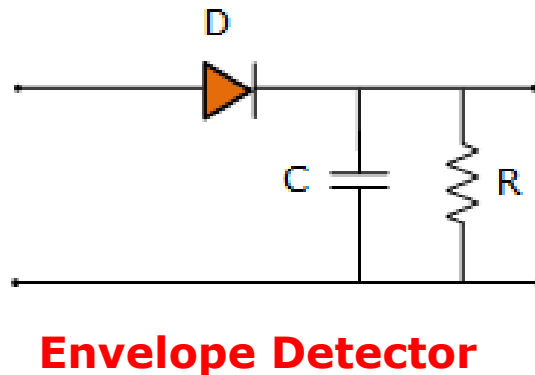
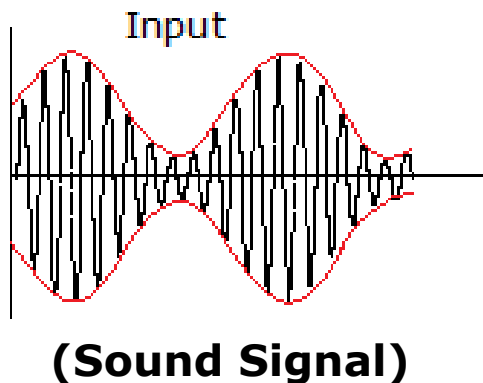
# How does a Microphone Work?

1. When you speak, **sound waves** created by your voice carry energy toward the microphone
2. Remember that sound we can hear is energy carried by vibrations in the air
3. The **coil**, attached to the diaphragm, moves back and forth as well
4. The permanent magnet produces a magnetic field that cuts through the coil
5. As the coil moves back and forth through the magnetic field, an electric current flows through it



# Envelope Detector

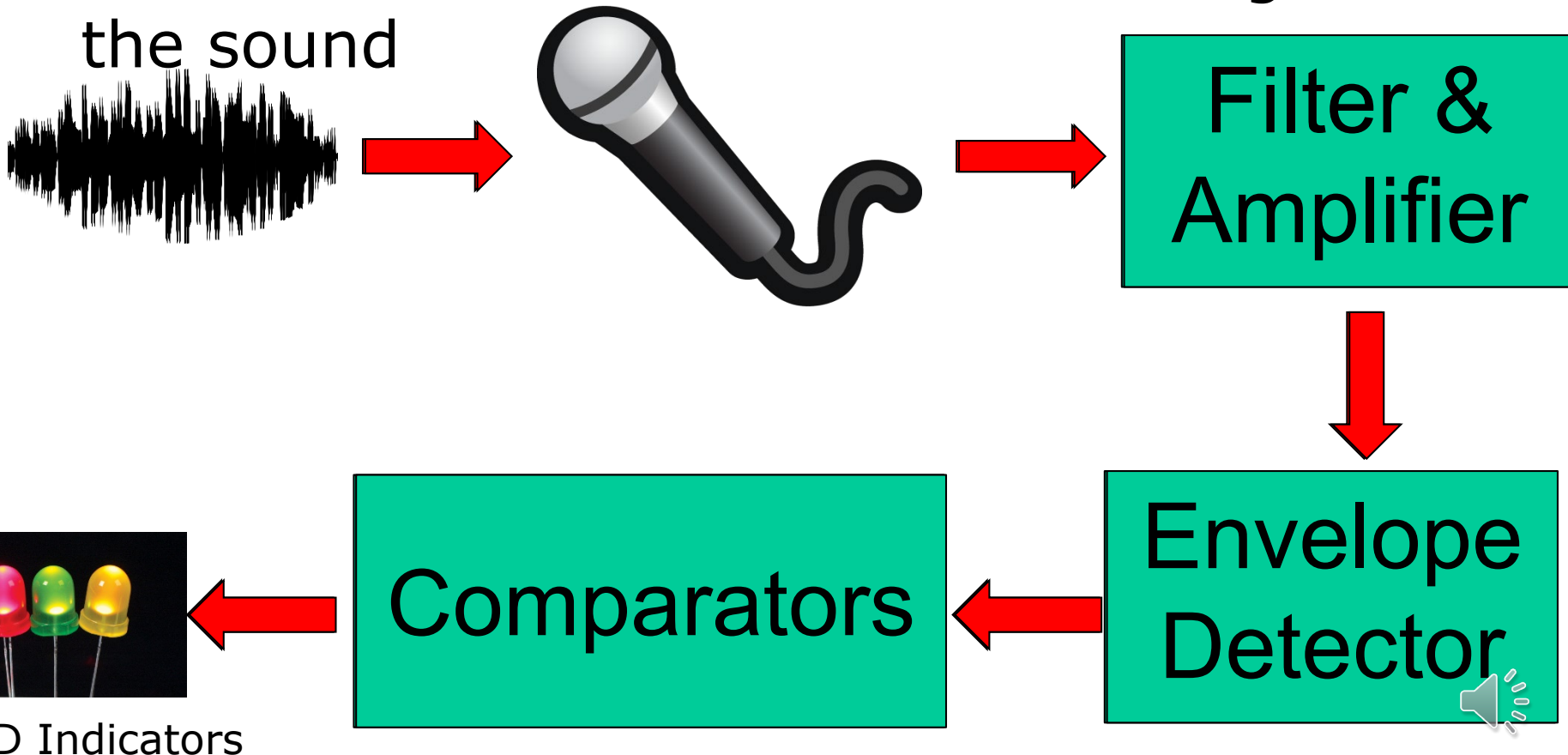
- An envelope detector is an electronic circuit that takes a high-frequency signal as input (**sound**) and provides an output which is the envelope of the original signal
- The capacitor in the circuit stores up charge on the rising edge, and releases it slowly through the resistor when the signal falls





# Designing a Noise Detector

- The amplitude of a sound signal is directly proportional to the loudness of the sound
- A filter is used to filter out the DC signal in the sound



**THANK YOU**