

# Robotic Sensors

Mini-Enrichment Course

*Robotics: Intelligent Connection of  
the Perception to Action*

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# Different Types

- **Tactile Sensors**

- Magnetic
- Ultrasonic
- Microwave
- Optical

**Used to tell us if we hit something**

- **Time of Flight Sensors**

- Ultrasonic
- Laser-Based

**Used to tell us how far objects are from us**

- **Compasses**

- Mechanical
- Fluxgate
- Hall-Effect

**Used to tell us our heading (angle from North)**

- **Miscellaneous**

- Gyroscopes
- Motion Detection
- Smoke
- Pressure
- Temperature

**Used to tell us things about our environment**

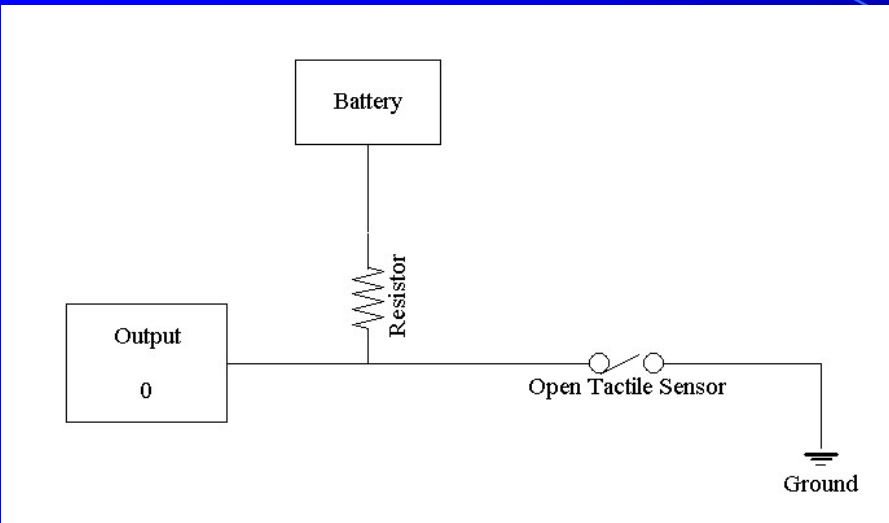
# Tactile Sensors

- Mainly used for collision detection



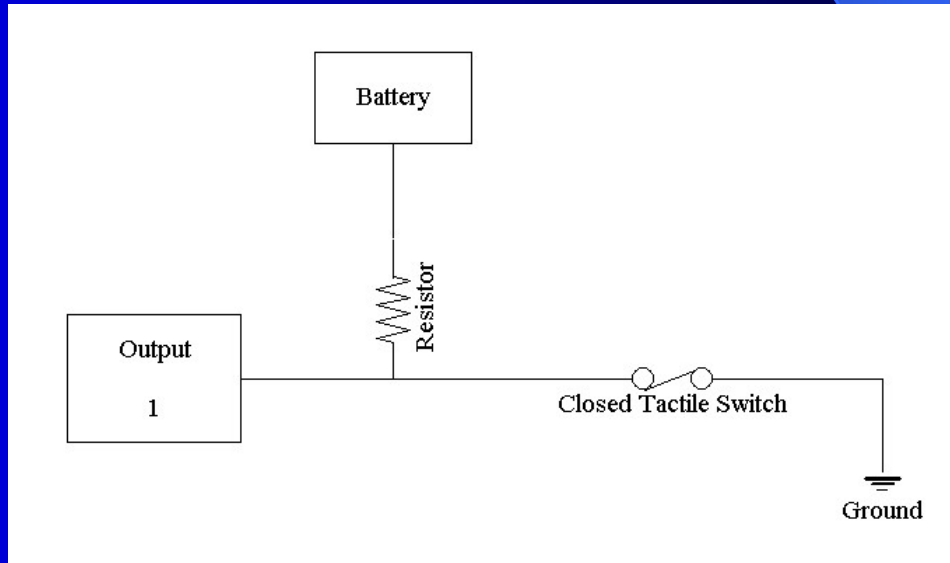
- If the switch connects, electricity passes and we can detect a “hit”
- Different from *Proximity (Non-contact) Sensors*
  - These are used to detect near-collisions
  - More complex internals

# Tactile Sensors (2)



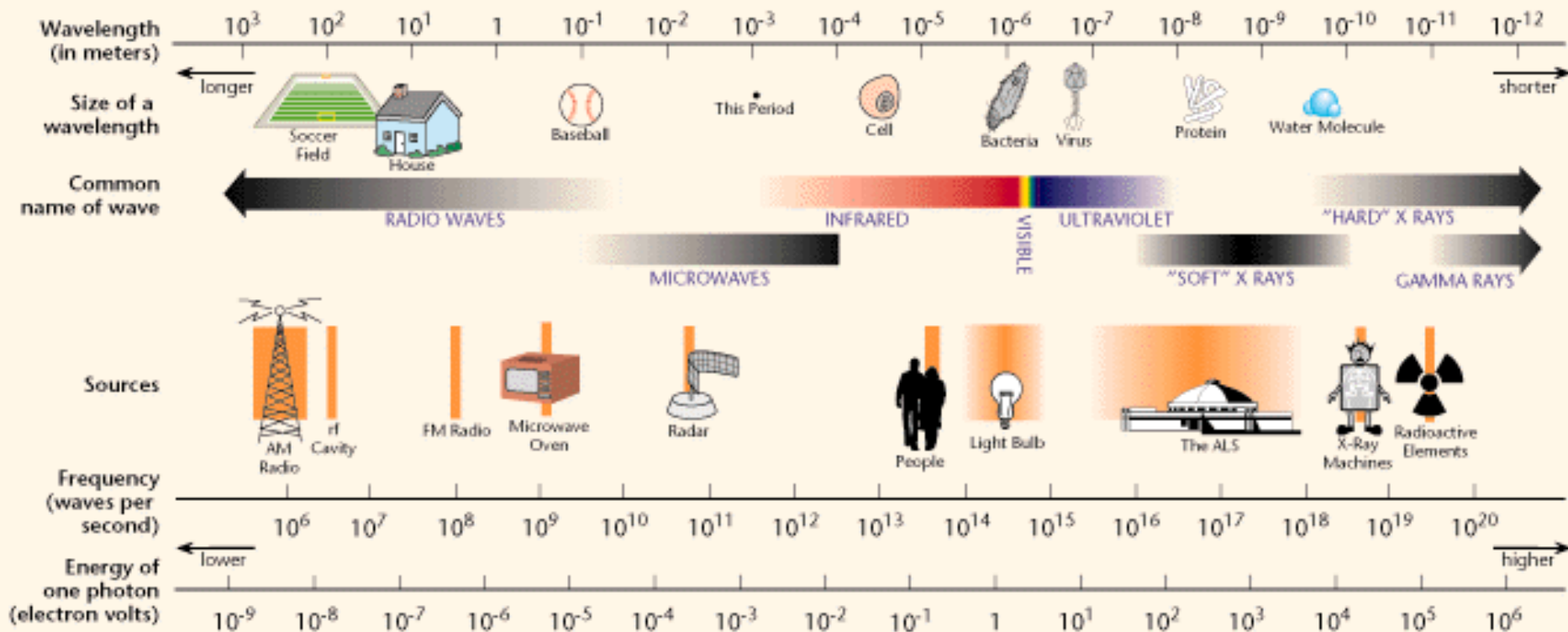
Switch Open

Switch Closed

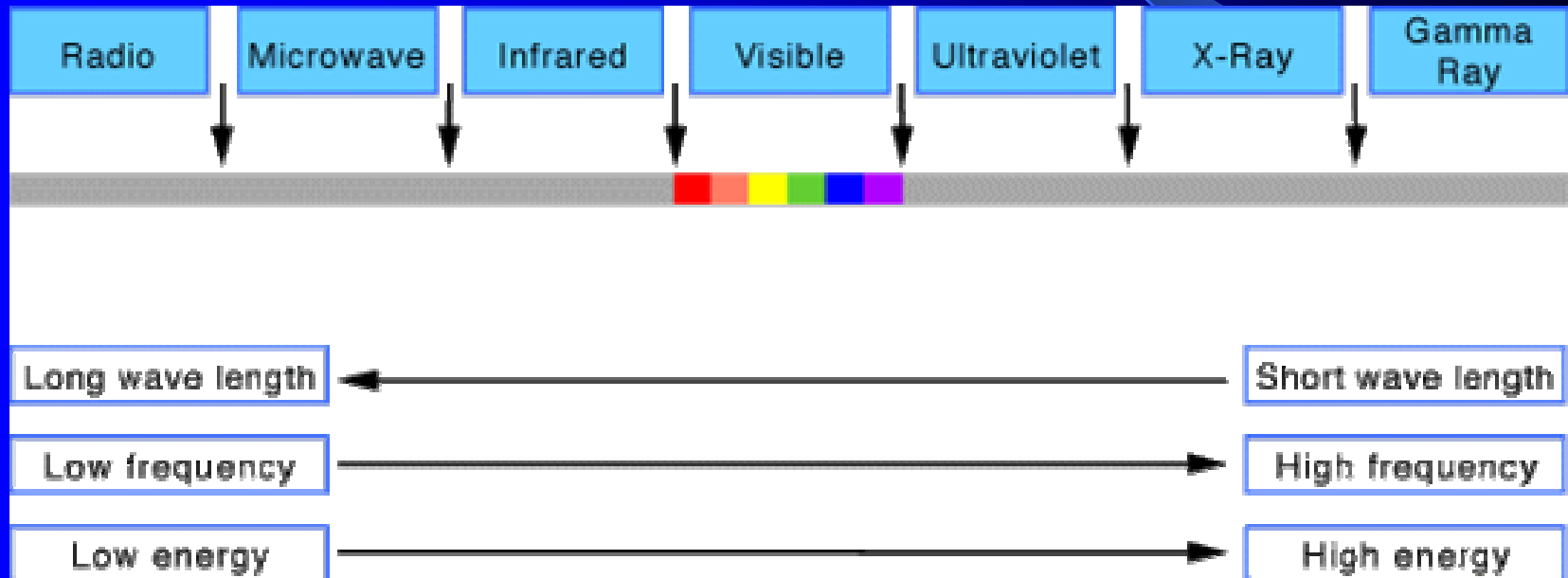


# The EM Spectrum

## THE ELECTROMAGNETIC SPECTRUM



# The Light Spectrum

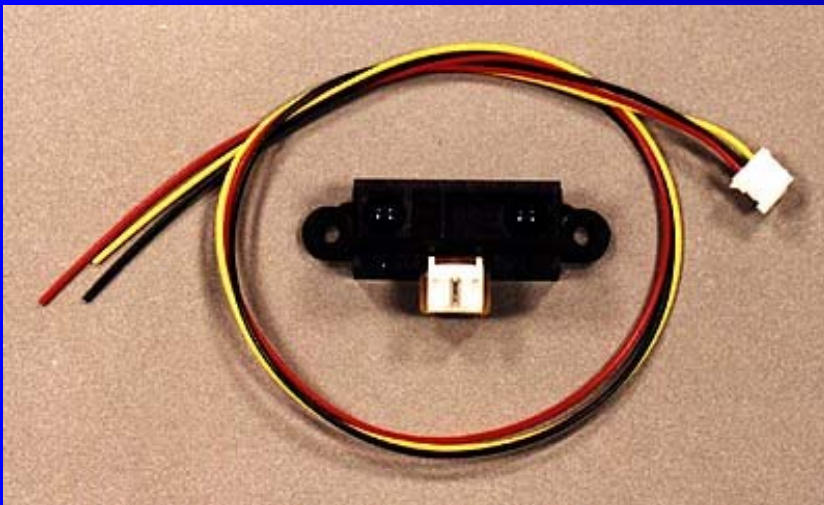


# Time of Flight Sensors

- Procedure is quite simple
  1. Send a signal and start a timer ( $t_1 = 0$  sec)
  2. Wait for echo signal, and stop timer ( $t_2 = 12$  sec)
  3. Calculate difference ( $t_1 - t_2 = 12$  sec)
  4. Use time difference to calculate distance (distance = speed \* time)
- Different signals have different speeds
  - Sound travels at 1 ft/ms
  - Light travels at 1 ft/ns (Faster than light)

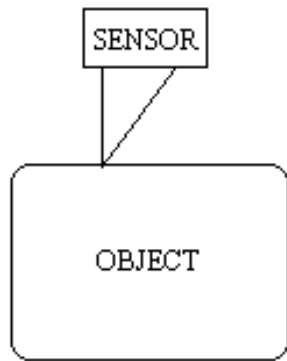
# IR Sensors

- Works on Infra-Red light (invisible to humans)
- Measures the time it takes for light to go and come back
- Works at about 15 degrees away from the robot

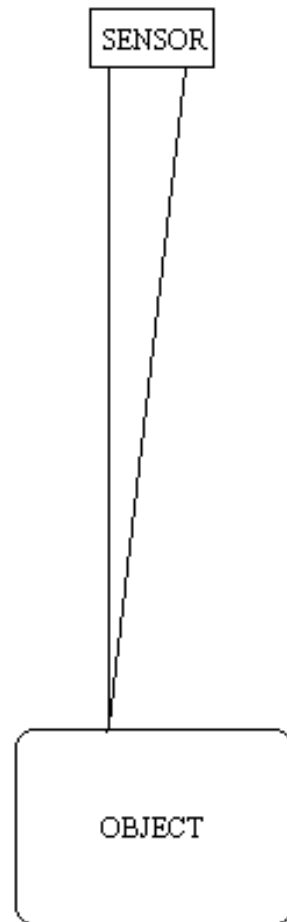




# IR Sensors (2)

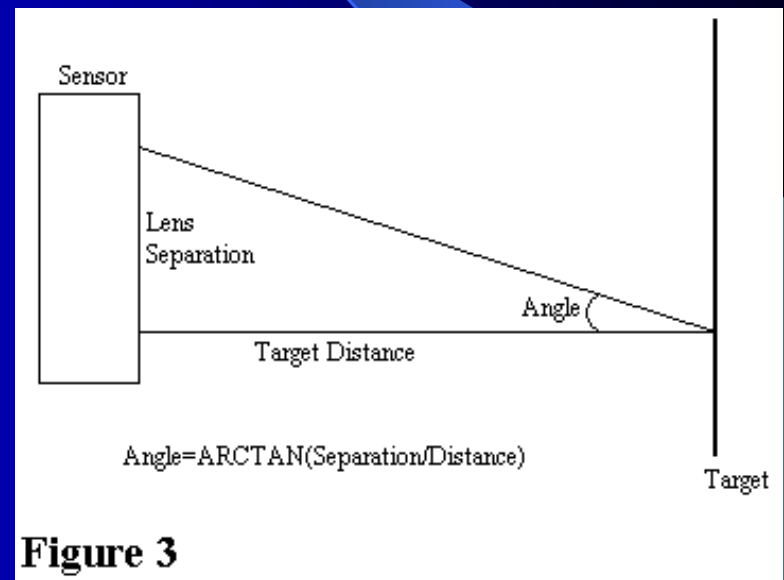


Object is close, so triangle is very "squat" and the angle is large.



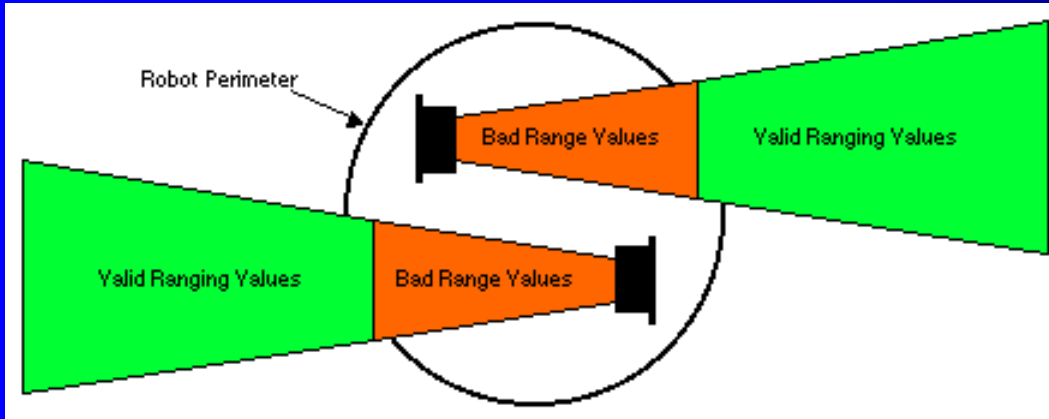
Object is far away, so triangle is slim and the angle is small.

**Figure 1**



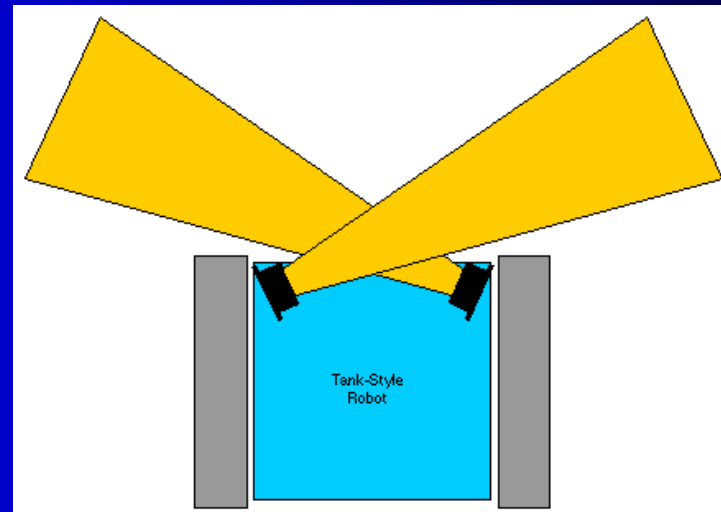
**Figure 3**

# IR Sensors (3)



Simple Configuration

Tank-Style Configuration



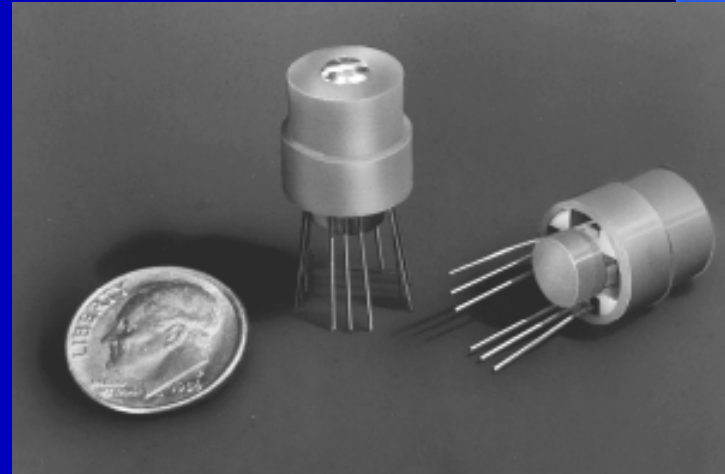
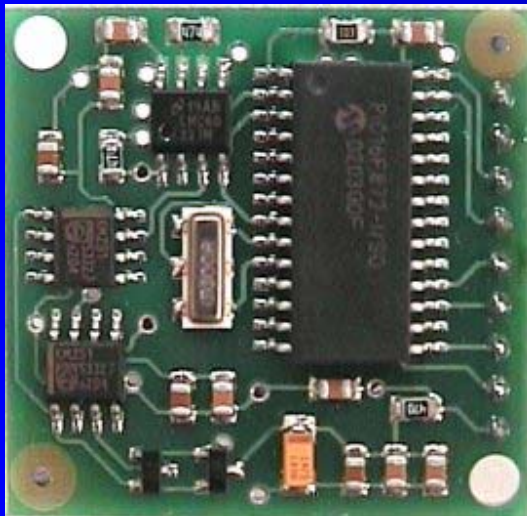
# Sound (Ultrasonic) Sensors

- Very similar to the light sensor, but works by sending sound waves instead!
- We can't hear the sound waves, but they bounce off the target and come back to the sensor
- We measure the distance in the same manner as we do it for light



# Compasses

- Compass sensors can tell us our *heading*
  - Either by N, E, W and S
  - Or by the angle from  $0^\circ$

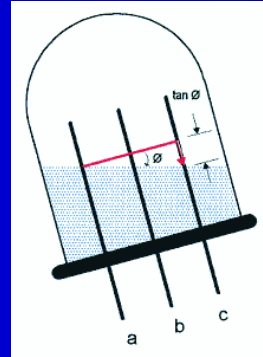


# Compasses (2)



# Other Sensors

- Gyroscope



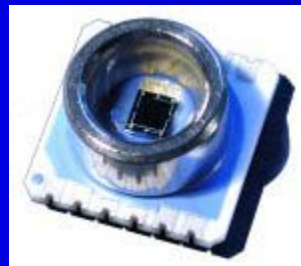
- Motion Detection



- Smoke



- Pressure

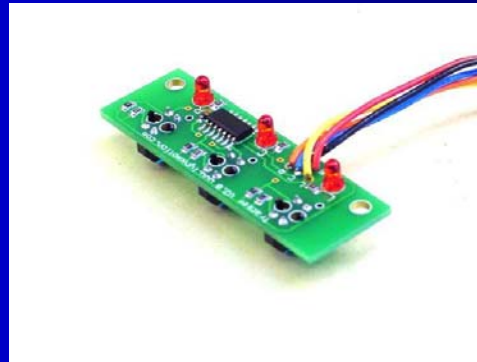


# Other Sensors (2)

- Temperature



- Line Tracking



- Video



# References

- <http://www.intersema.com/site/technical/ms5534.php>
- <http://www.acroname.com>
- <http://www.robotstorehk.com/sensor.html>
- <http://www.hvwtech.com>
- <http://www.site.uottawa.ca/~rabielfmo/elg4392b>
- <http://www.lynxmotion.com>
- <http://www-2.cs.cmu.edu/~cmucam/>