Robotic Sensors

Different Types

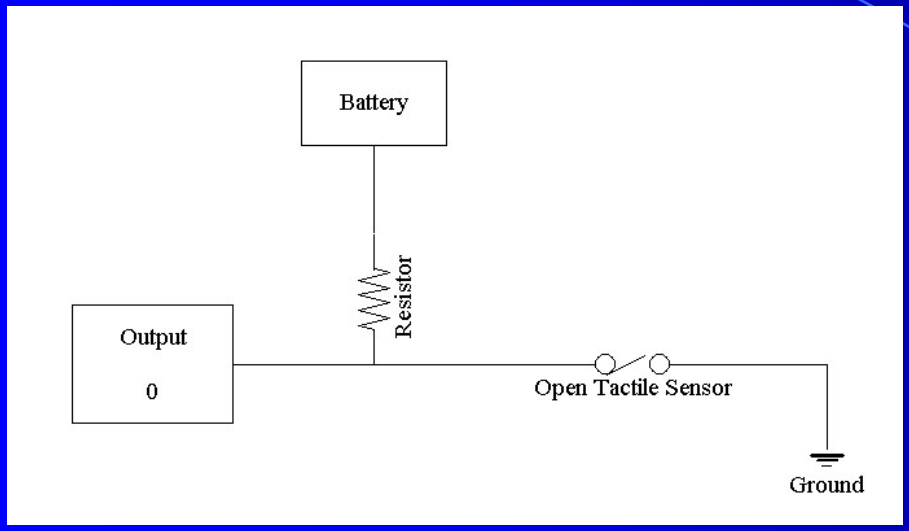
- **Tactile Sensors** — **Used to tell us if we hit something**
  - Magnetic
  - Ultrasonic
  - Microwave
  - Optical
- **Time of Flight Sensors** — **Used to tell us how far objects are from us**
  - Ultrasonic
  - Laser-Based
- **Compasses** — **Used to tell us our heading (angle from North)**
  - Mechanical
  - Fluxgate
  - Hall-Effect
- **Miscellaneous** — **Used to tell us things about our environment**
  - Gyroscopes
  - Motion Detection
  - Smoke
  - Pressure
  - Temperature

Tactile Sensors

- Mainly used for collision detection

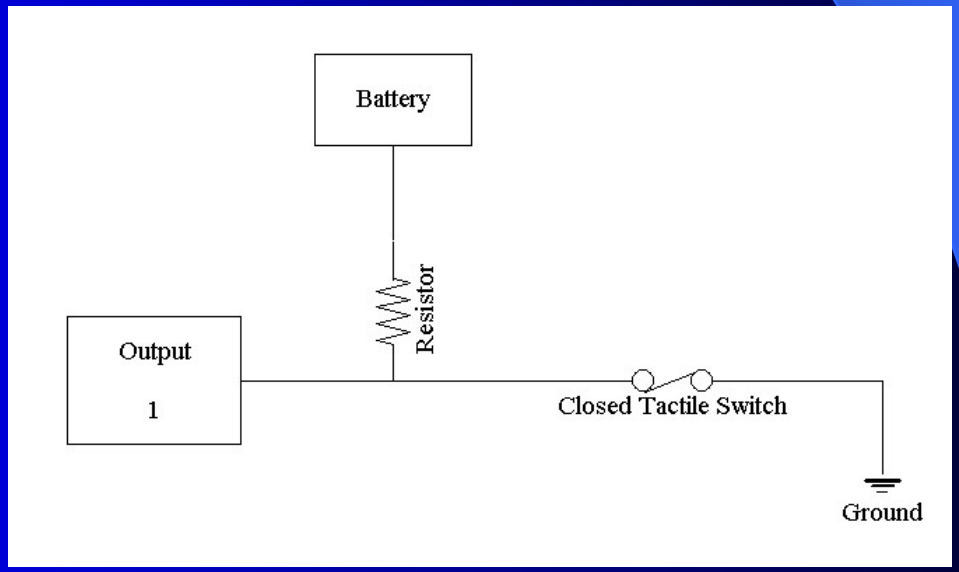
- If the switch connects, electricity passes and we can detect a “hit”
- Different from *Proximity (Non-contact) Sensors*
  - These are used to detect near-collisions
  - More complex internals

Tactile Sensors (2)

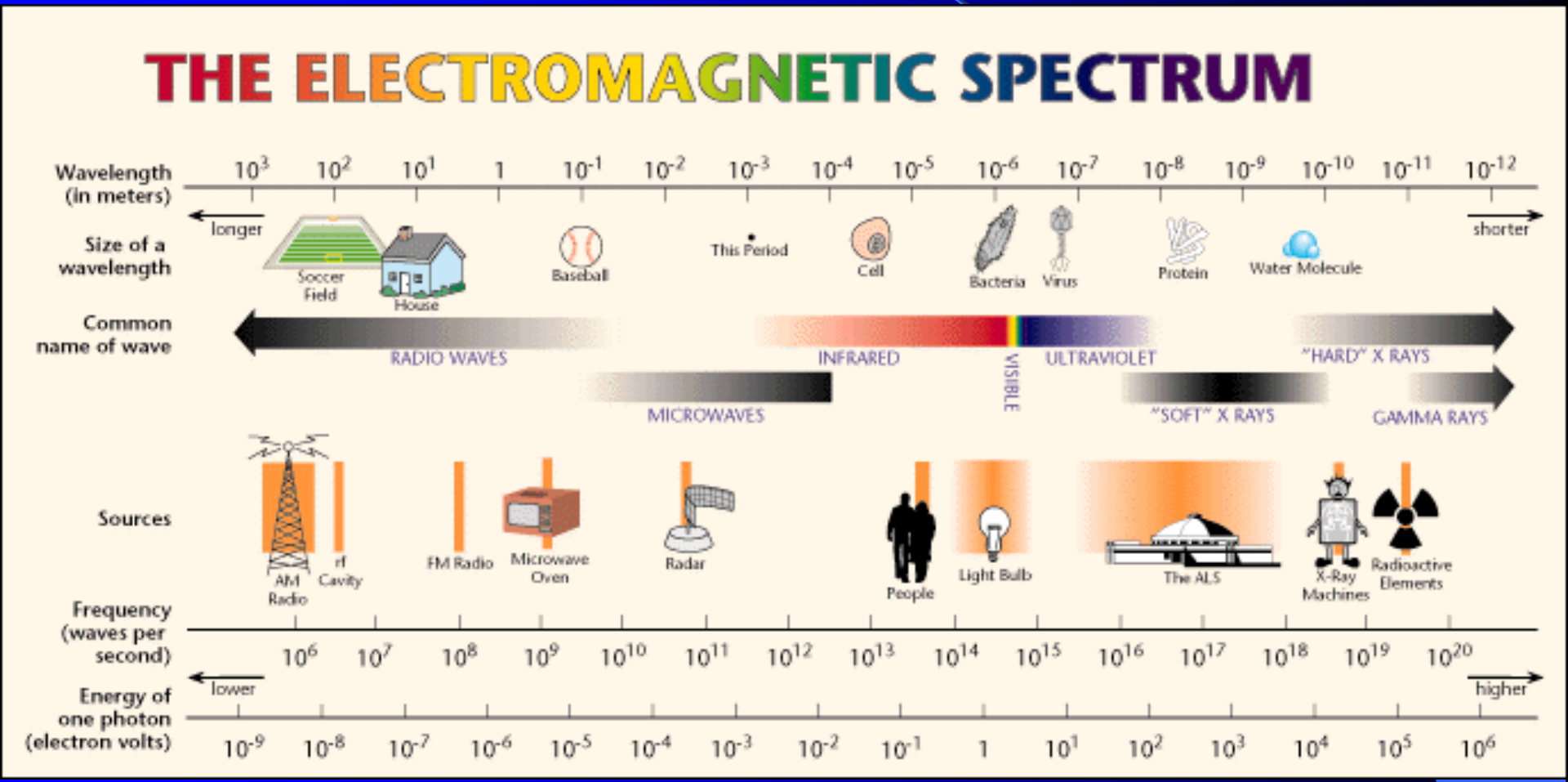


Switch Open

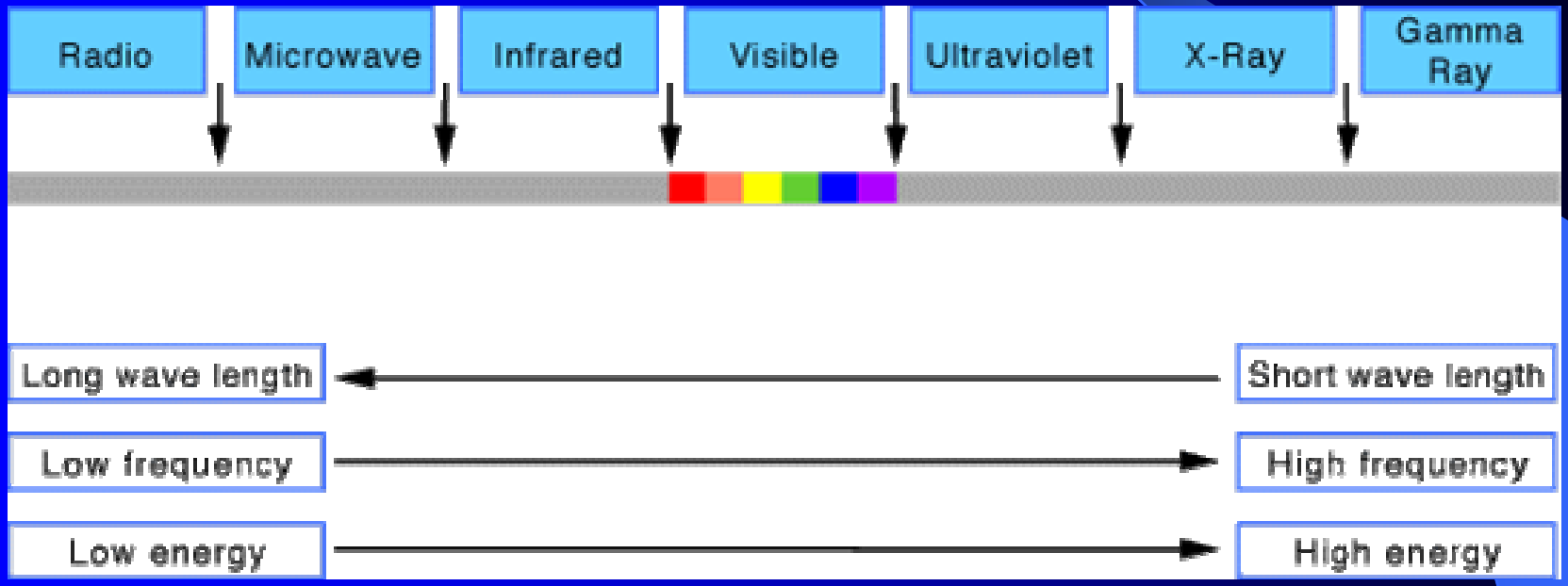
Switch Closed



The EM Spectrum



The Light Spectrum

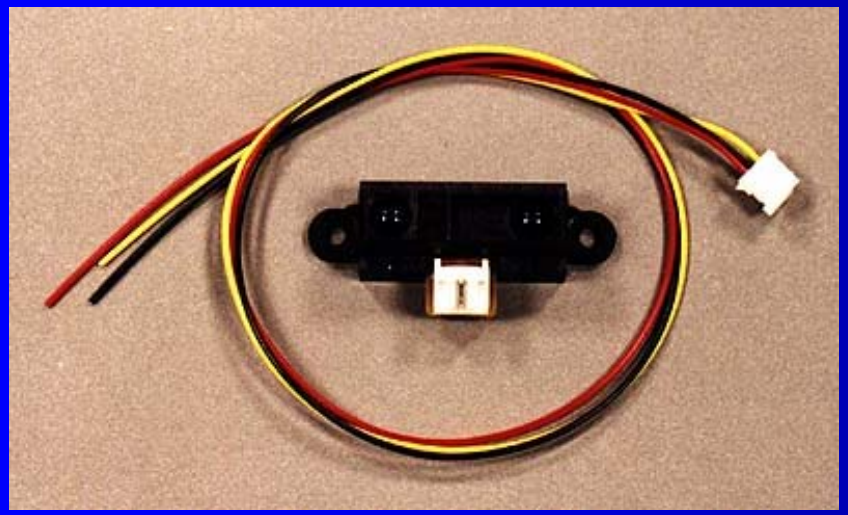


Time of Flight Sensors

- 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)

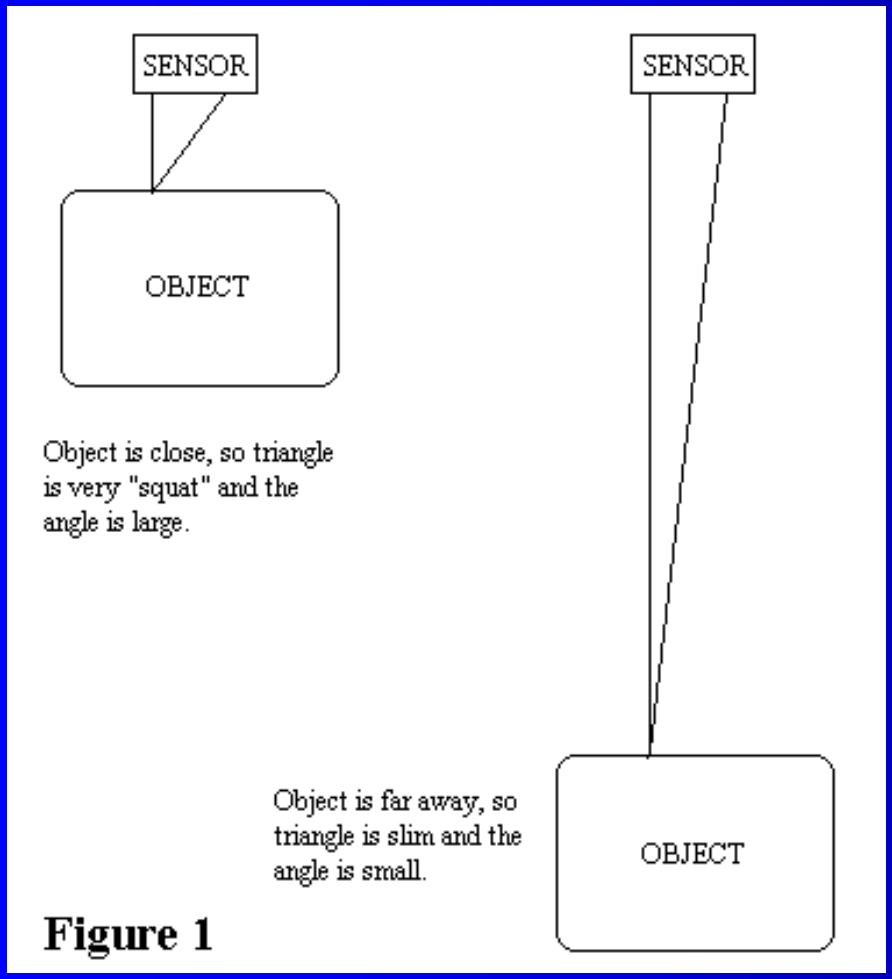


Figure 1

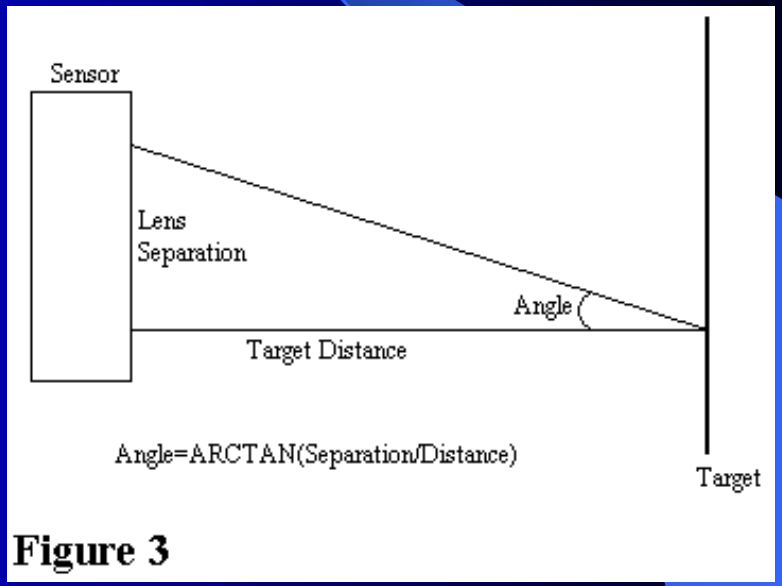
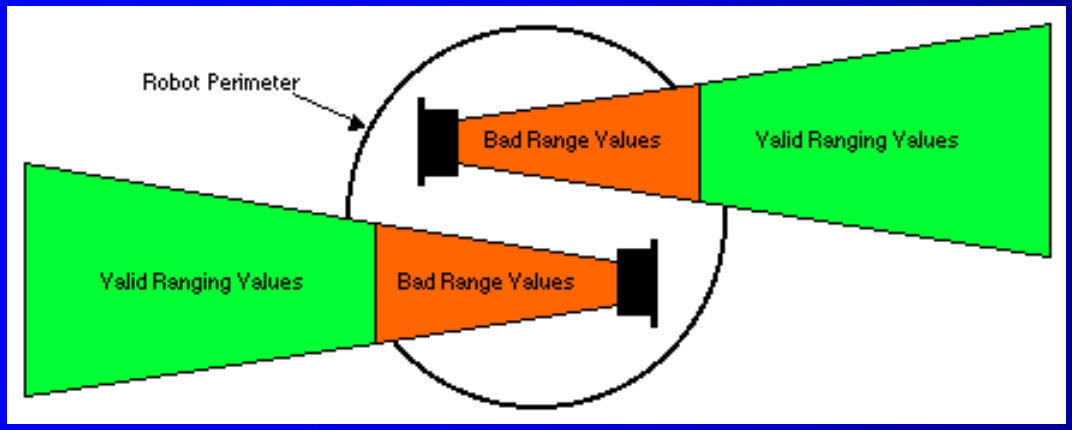
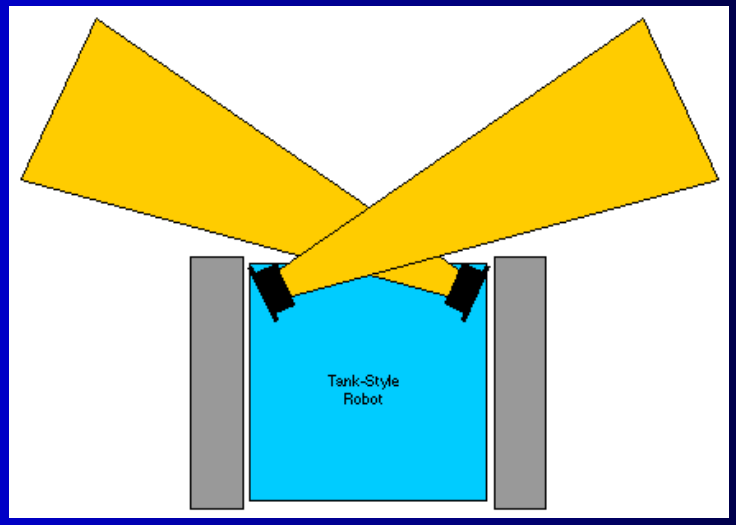


Figure 3

IR Sensors (3)



Simple Configuration



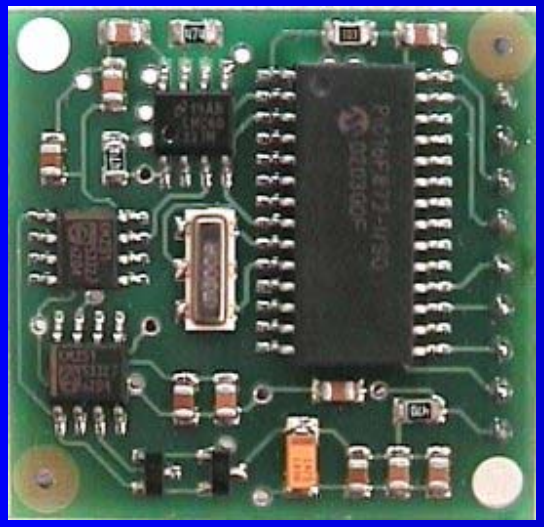
Tank-Style Configuration

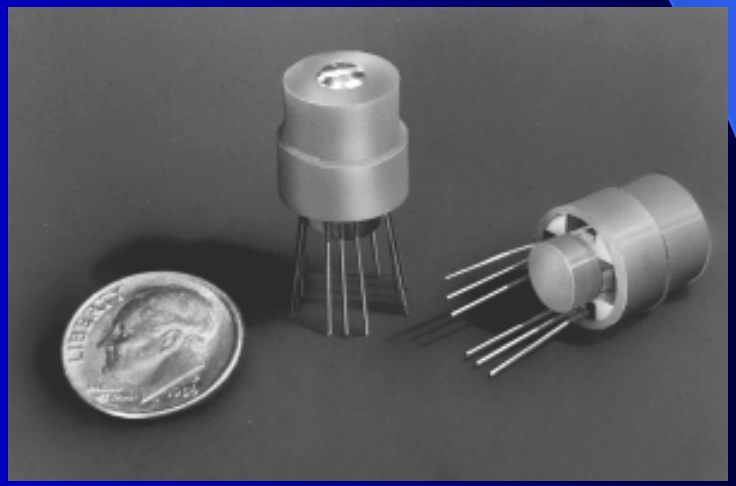
Sound (Ultrasonic) Sensors

- 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°

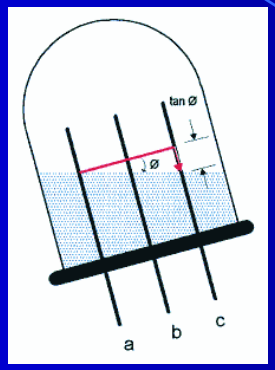




Compasses (2)

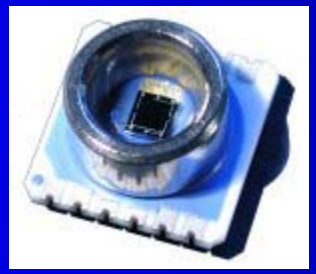
Other Sensors

- Gyroscope



- Motion Detection
- Smoke

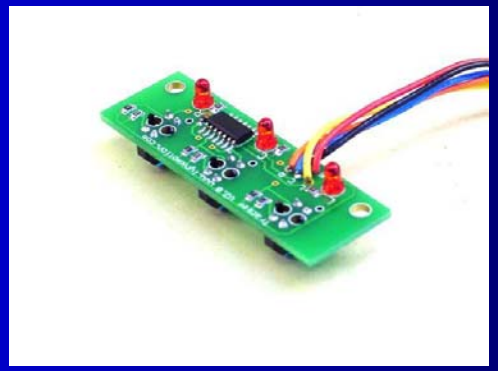
- Pressure



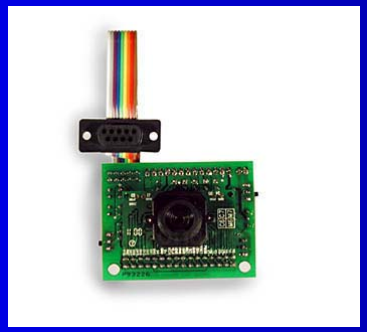
Other Sensors (2)

- Temperature

- Line Tracking



- Video



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