What Is a Sensor?

Light-dependent resistor

GPS unit

Wireless card

Toilet float mechanism

We know it when we see it, but will not try to formally classify.
Where Might We Want to Use Sensors?

- Shopping mall
- Control room
- Assisted living
- Coral reef
Where Might We Want to Use Sensors?

Roomba

CMU Boss

UAV

Protein
What Physical Quantities Are Sensable?

**Spatial:** displacement, velocity, acceleration, distance to something, proximity, position, attitude, area, volume, level/tilt, motion detection

**Temporal:** clock, chronometer (elapsed time), frequency.

**Electromagnetic:** voltage, current, power, charge, capacitance, inductance, magnetic field, light intensity, color. These may operate within a circuit or within open space.

**Mechanical:** solid (mass, weight, density, force, strain, torque), fluid (acoustic, pressure, flow, viscosity), thermal (temperature), calories.

**Other:** chemical (composition, pH, humidity, pollution, ozone), radiation (nuclear), biomedical (blood flow, pressure).

See *CRC Measurement, Instrumentation, and Sensors Handbook*
What Sensors Are Available?

- Contact sensor
- Sonar
- Compass
- Microphone
What Sensors Are Available?

- Wheel encoder
- Stopwatch/timer
- Occupancy detector
- Safety beam
What Sensors Are Available?

- Camera
- Wii remote
- Pressure mat
- SICK laser scanner
Common Sensor Characteristics

- **Transfer function** converts physical phenomenon to sensor reading:
  \[ g : \mathbb{R} \rightarrow \mathbb{R}. \]

- Domain of \( g \) may be *absolute* vs. *relative*.

- \( g \) itself may be *linear* or *nonlinear*.

- *Resolution* is given by set of possible \( g(x) \).

- *Sensitivity* is set of stimuli that produce same reading.

- *Repeatability* is producing same readings under same phenomena.

- *Calibration* eliminates systematic errors.

You will find these notions in sensor handbooks.