

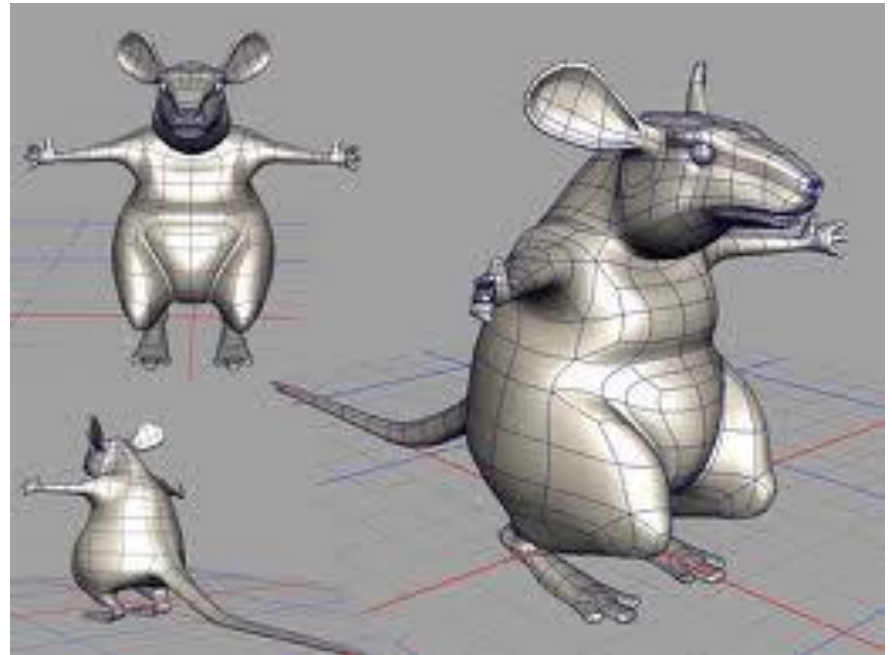
Linking Analog Sensors to Microcontroller Inputs

Team 7



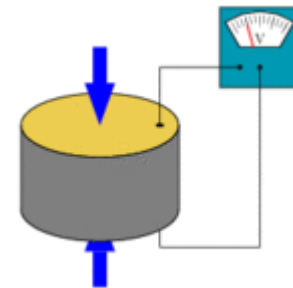
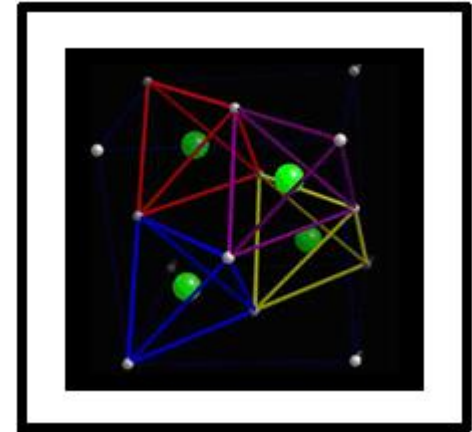
Passive Sensors

- Do not require external power
- Generate their own signals based on sensing parameter



Passive Sensor Example

- Piezoelectric material
 - Contains many dipoles that at rest are at charge equilibrium
 - When under strain dipole moments, μ , are formed
 - Thus a polarization, P , is created
 - $P = \frac{\Sigma\mu}{Volume} \rightarrow Voltage$



Passive Sensor Example

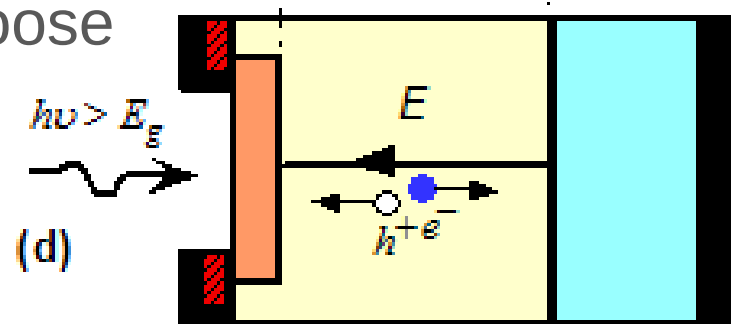
- Photodiodes

- Create current in response to received photon energy

- Incoming photon carries enough energy to knock electrons loose

- Thus a current is created

- ECE 303 example



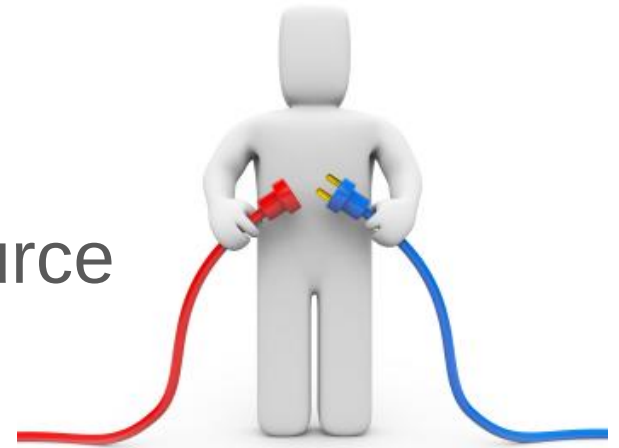
Passive Sensors

- Advantages:
 - Lack of external supply cuts costs, both electrically and financially
 - This also makes for simpler circuits and smaller footprints
- Disadvantages:
 - Tend to be less accurate than active sensors
 - Slight differences in material batches may cause discrepancies from sensor to sensor



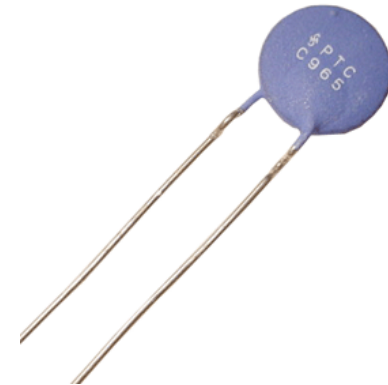
Active Sensors

- Requires external excitation source
 - AC or DC Excitation
 - Voltage Excitation
 - Current Excitation
- Capable of on-board amplification
 - Higher Cost
 - Eliminates External Circuitry

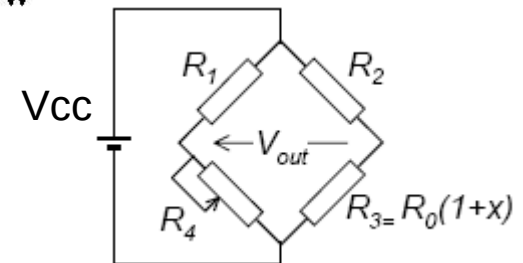
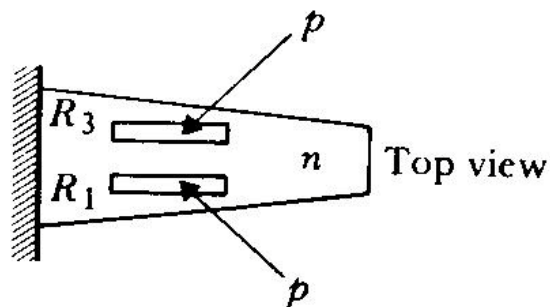
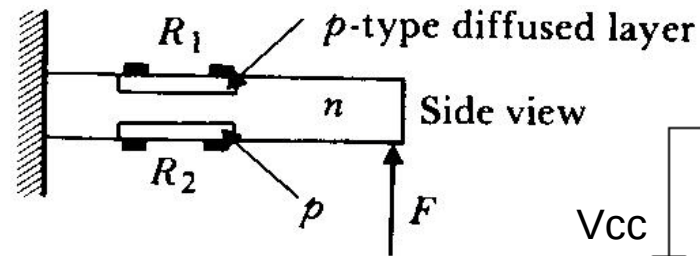


Active Sensor Examples

- Thermistor
 - Resistor based sensor



- Strain gauge
 - Bridge circuitry



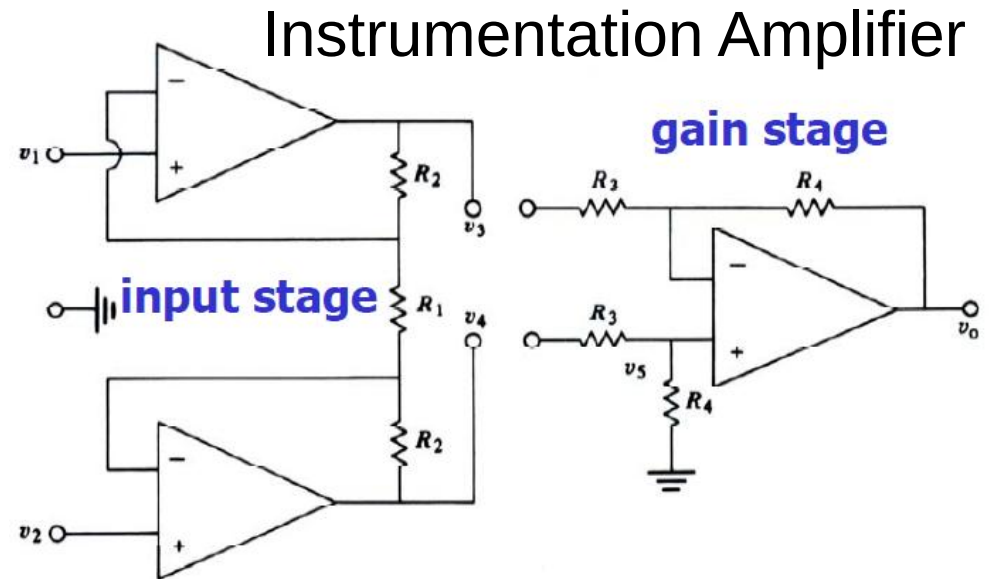
Active Sensors

- Advantages:
 - Voltage and temperature compensation
 - Sensor outputs can be scaled internally
- Disadvantages:
 - Higher cost
 - Increases size of the design



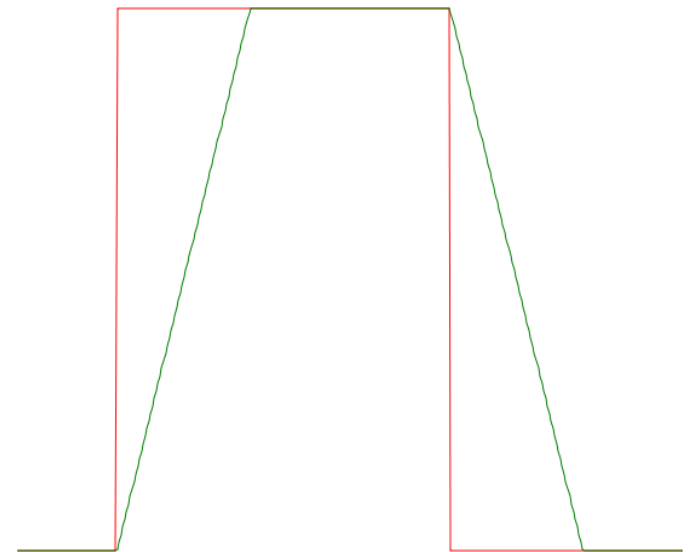
Connecting to Microcontroller

- Use of external amplifier
- External filtering
- External resistance
- Slew rate



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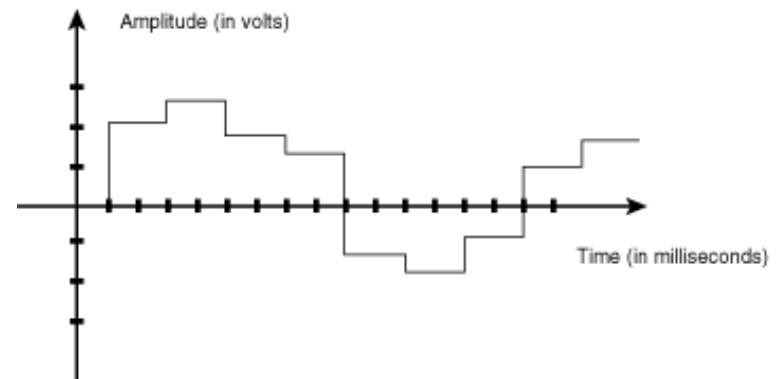
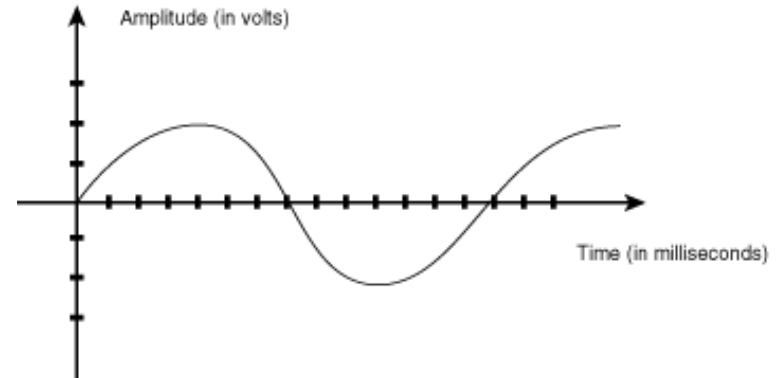


Slew Rate $\left(\frac{V}{s \text{ or } ms} \right)$



Connecting to Microcontroller

- A/D conversion
- Clock speed

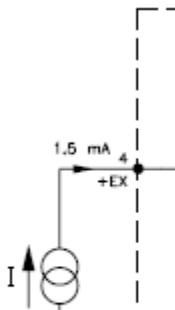


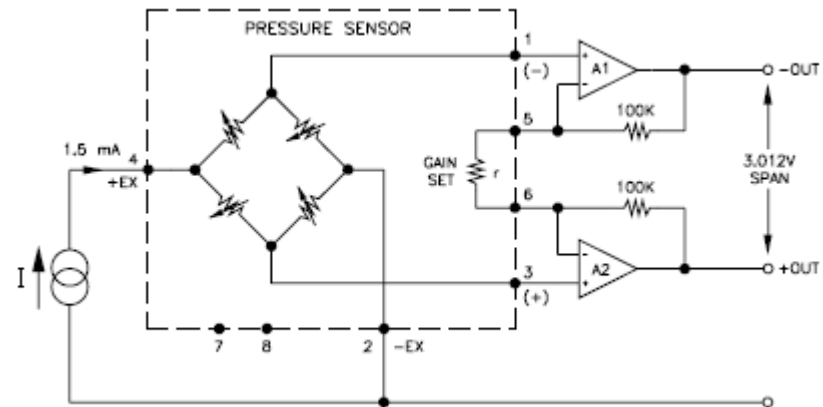
Advanced Microcontroller Considerations

- ADC resolution
- Clock speed vs. sample rate
- Conversion time
- Step recovery
- Filtering for noise immunity
- Drift



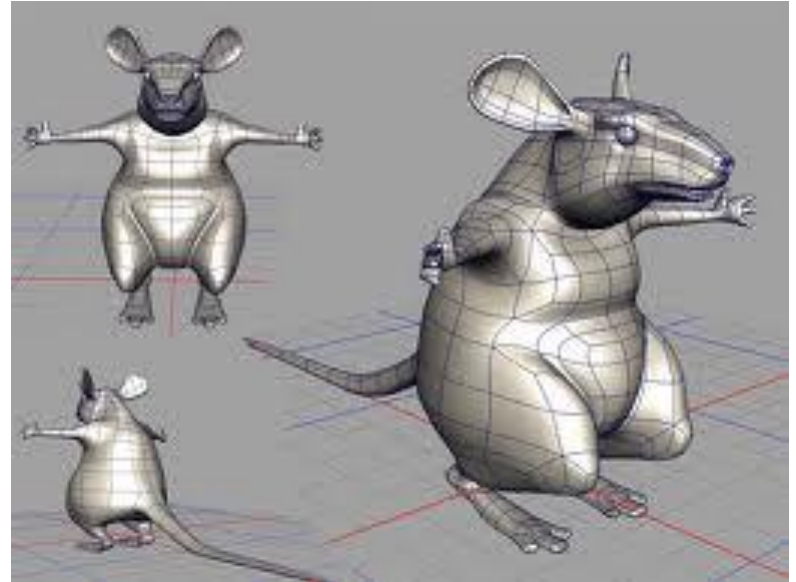
Integration of Our Pressure Sensor

- Piezoresistive
 - Amplified
 - Temperature compensated
 - Uses current excitation
 - Fast response
 - Noise immunity
 - Interchangeability
- 
- The diagram shows a piezoresistive sensor circuit. A current source, represented by a circle with an upward arrow and labeled 'I', is connected to a piezoresistive element, represented by a rectangle with a diagonal line. The current source is labeled '1.5 mA'. The piezoresistive element is labeled '+EX'. The output of the sensor is connected to a dashed line, indicating a signal output.



Summary

- Passive sensors
- Active sensors
- Choice for microcontroller
- Sensor interface to microcontroller
- Hardware/software integration



Result: working system



Questions?

