Lab 9

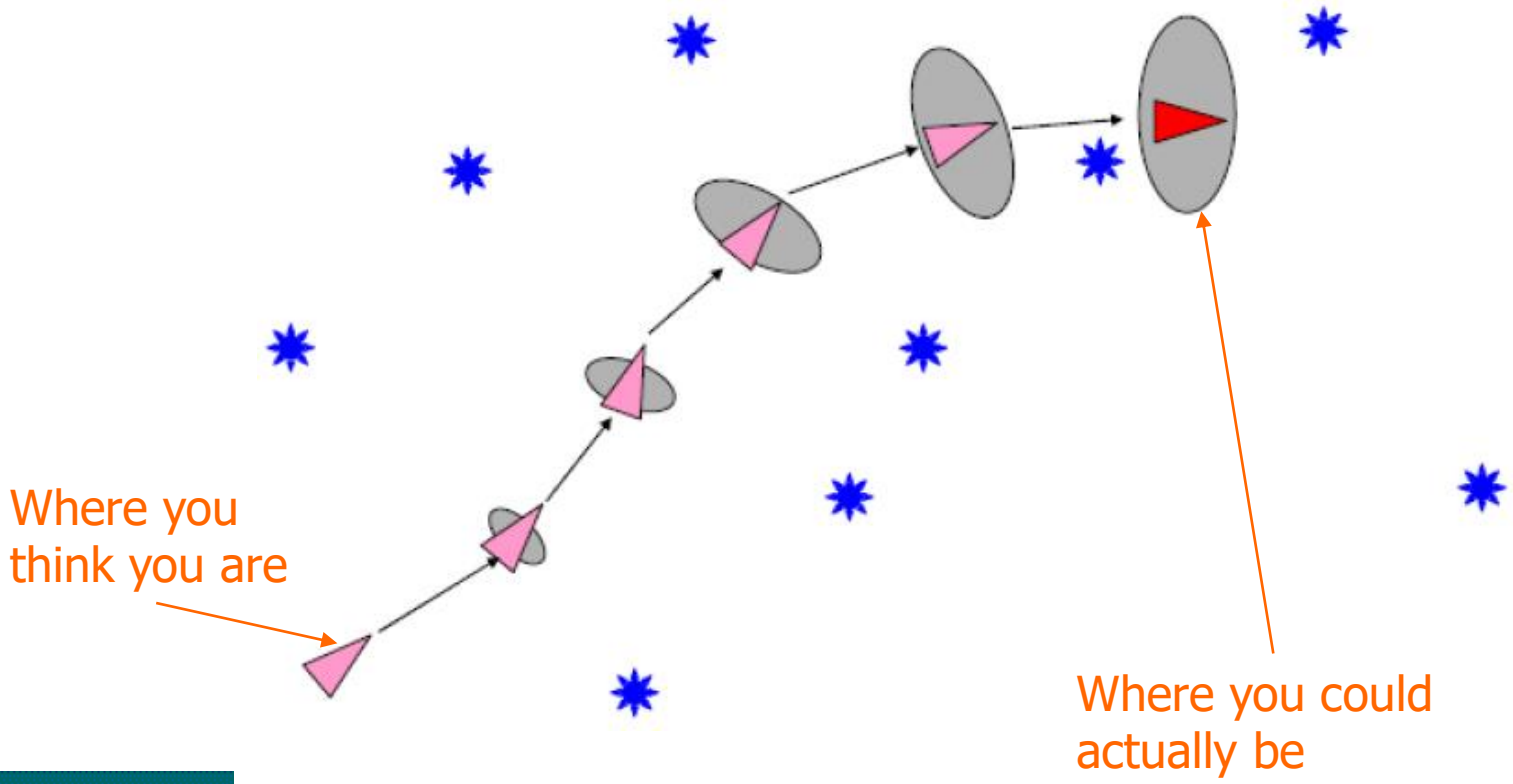
Robot Sensors

CMPE-110
Intro to Computer Engineering

R·I·T

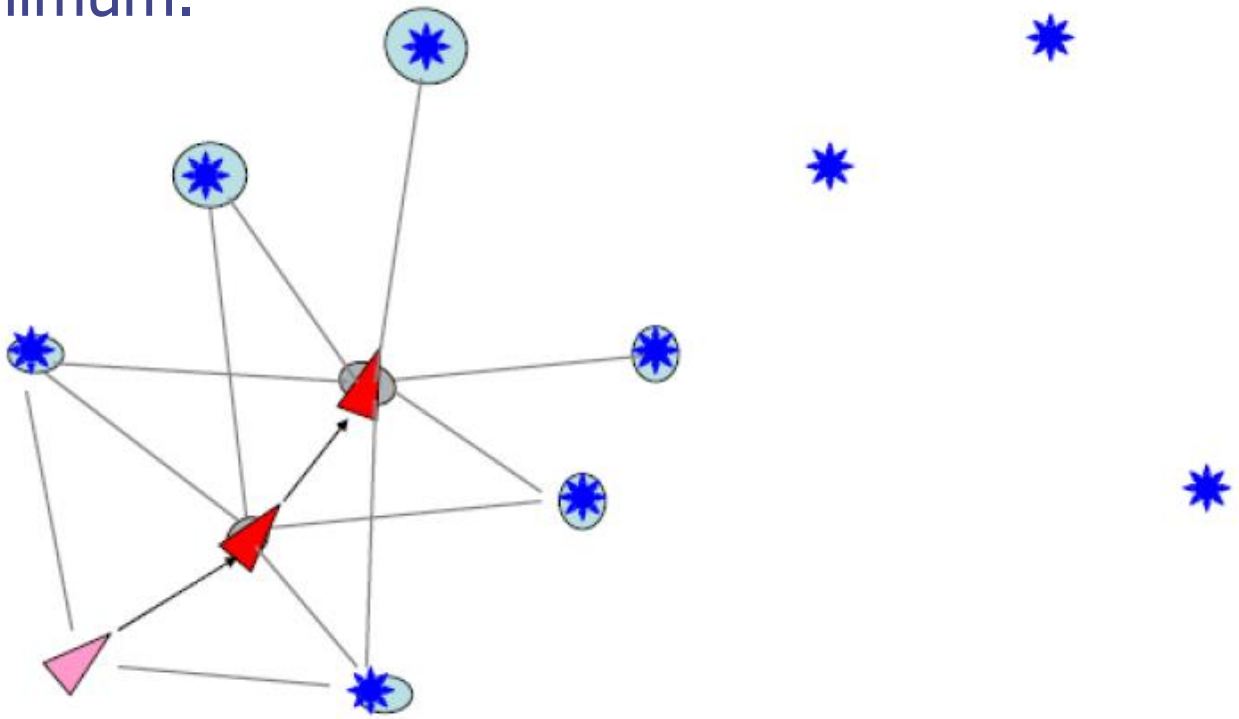
Dead Reckoning

- Without using landmarks to guide you, the variability of the actual location of where you increases.



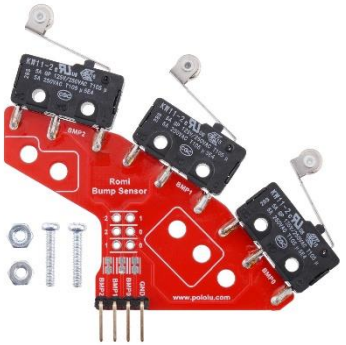
Dead Reckoning

- Using landmarks along the way (e.g. looking for walls or counting wheel revolutions), keeps the error to a minimum.

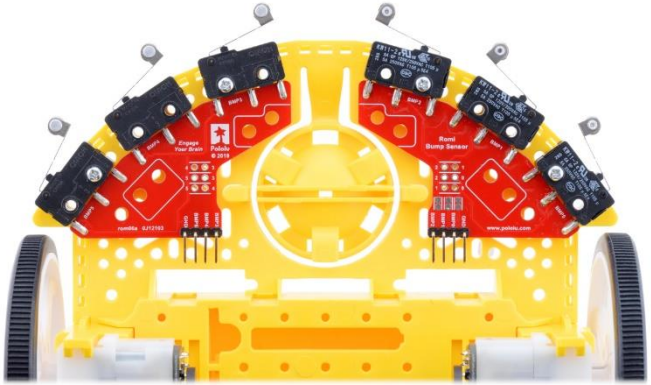


Bump Sensors

Our robot is equipped with six bump sensors



- Six bump sensors – three on each side
- Used to detect obstacles obstructing the robot's path
- Individually accessible
- State is low when pressed, high when released

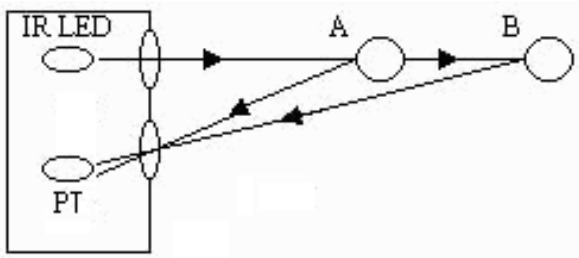


https://www.pololu.com/product/3674

Infrared (IR) Sensors

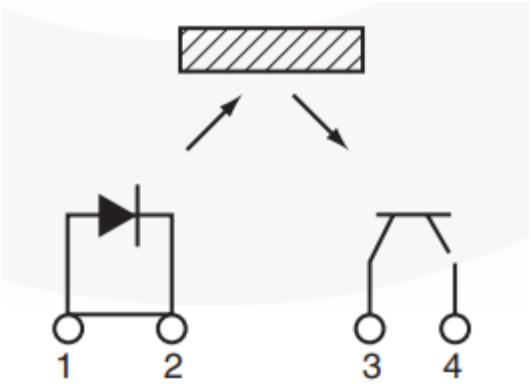
Use light wavelengths 780nm to 1300nm which is invisible to the human eye, but is detectable by some digital cameras/cell phones.

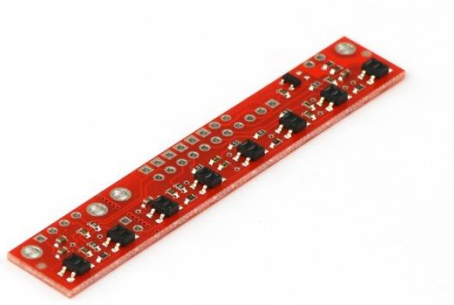
- Paired emitter/receiver.
- Can provide distance measurements from sensor to nearest object.
- Output is non-linear, but can easily be handled with a simple lookup table.
- They output an Analog voltage.
- In general, IR Sensors:
  - Are low cost, (<=$30)
  - Use little power,
  - Easy to integrate,
  - Work over short distances



Reflective Object Sensor

- Our robot uses Fairchild QRE1113.
- It has a infrared (IR) LED and an IR sensitive photo transistor.
- The LED emits a beam of IR light, and the transistor detects the amount of IR light reflected back.
- The more IR light that is sensed, the lower the analog output voltage.
- White surfaces reflect more IR light than black.





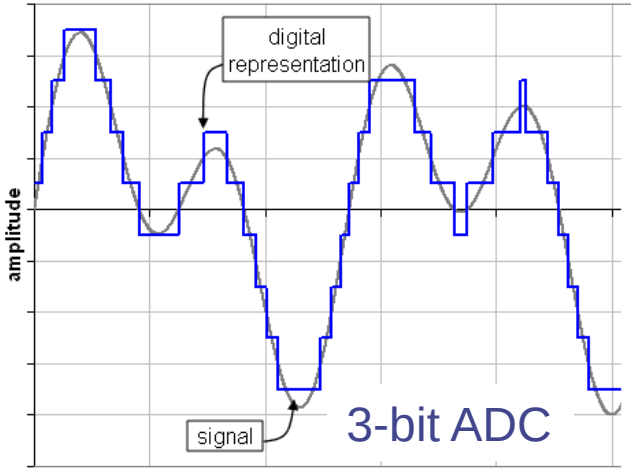
https://www.pololu.com/product/961

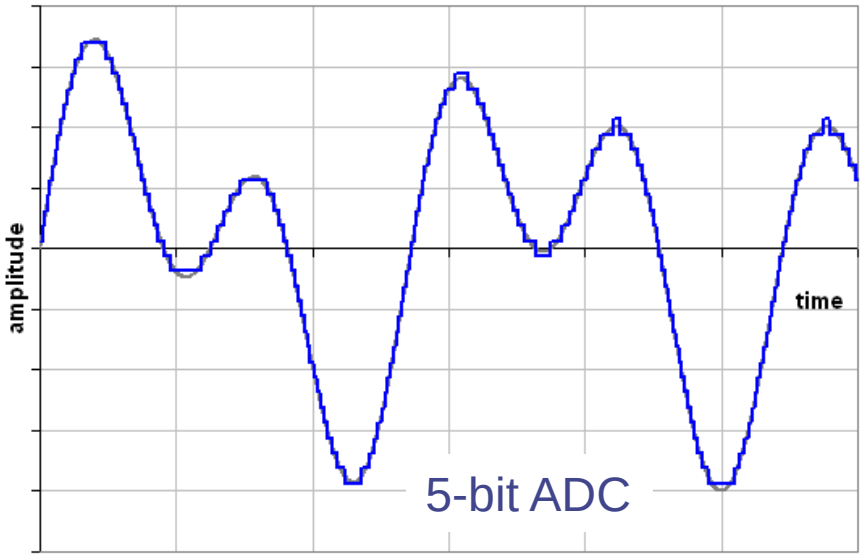
Analog to Digital Converters

- The MSP432 microcontroller only understands digital (i.e. 1’ and 0’s) which is discrete in nature, so need a way to convert the sensor’s voltage into something the Arduino will understand.
- An Analog to Digital converter (A2D) is a device that can do this for us.
- Although special purpose chips can do this for us, the MSP432 microcontroller has enough converters onboard for each light sensor

Analog to Digital Convertors

- The job of the A2D is to convert the analog input voltage, which in our case ranges from 0V to 5V, to some digital value from 0 to a *MaxCount*.
- The bit depth of the A2D determines the *MaxCount*.
  - For example a 2-bit A2D means the range is split into two values (0 and 1), so 0V to 2.5V would a 0 and a 2.51V to 5V would be a 1.
- The greater the bit depth, the more counts over the range, and the less quantization error from the A2D.





Our MSP432 has 16-bit A2D's

www.diracdelta.co.uk/.../source.html