Soirée Pratique
Build your own robot

Session 4: Sensors

http://www.ieee-sb-leuven.be/soireepratiques

IEEE Student Branch Leuven

Roadmap SP 2013-2014 (sem1)

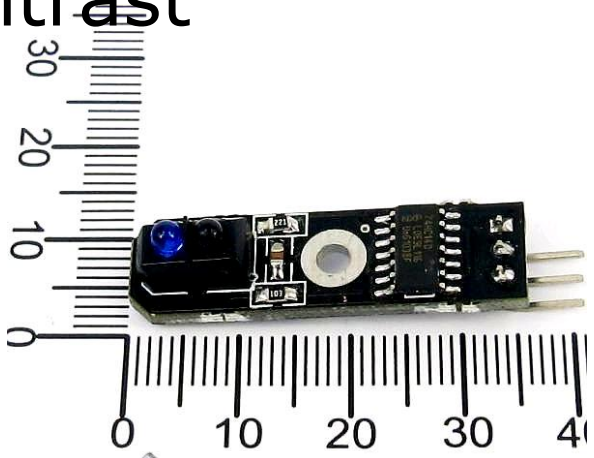
1. The brains: Arduino
2. The muscles: motor and power (today)
3. **The eyes: sensors (28/10)**
4. Brains: programming (4/11)
5. Training session (18/11)
6. *Ambilight(25/11)*
7. Sumo Competition (02/12)

Today's session

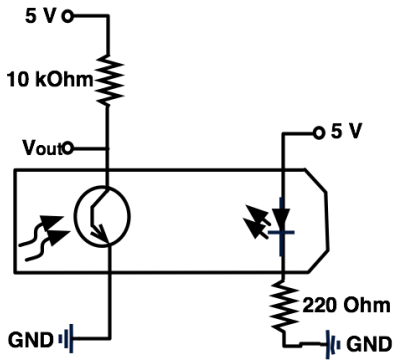
- Slides and info:
  http://www.esat.kuleuven.be/~hhoschle/sp/sensors.pdf

Short range distance sensors

- Reflection of emitted light detected by photoresistor=>range or contrast
- Vishay TCRT5000 IR
  - Range of 0.2 mm to 15 mm
  - Digital use



  - Analog use



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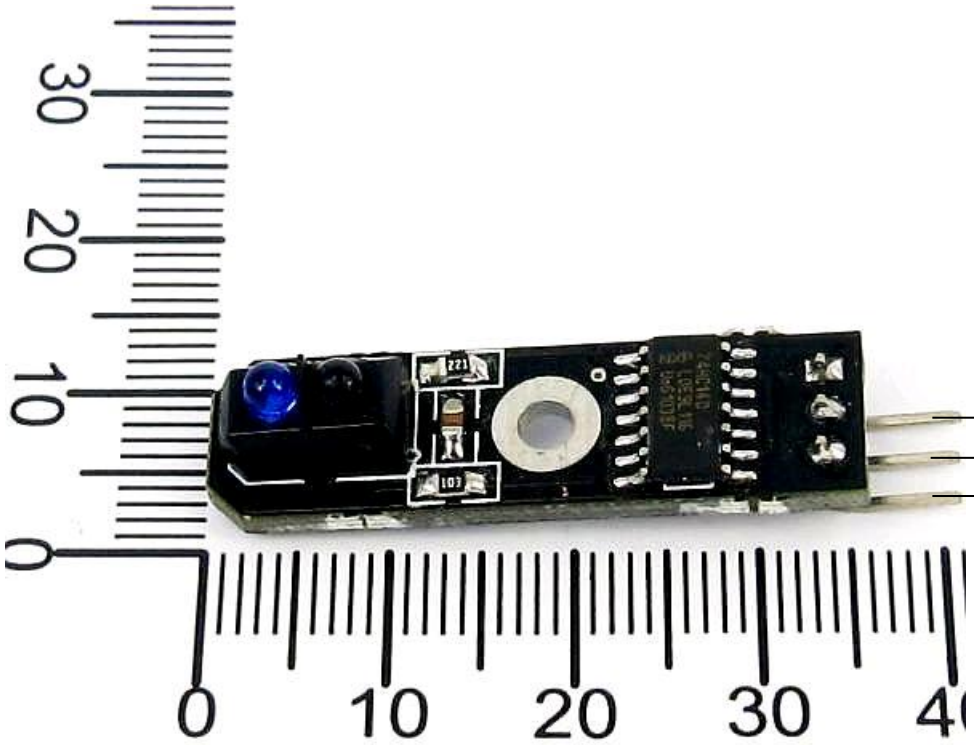
Short range distance sensors



OUT (digital read)

VCC (5V)

GND

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Short range distance sensors example (digital)

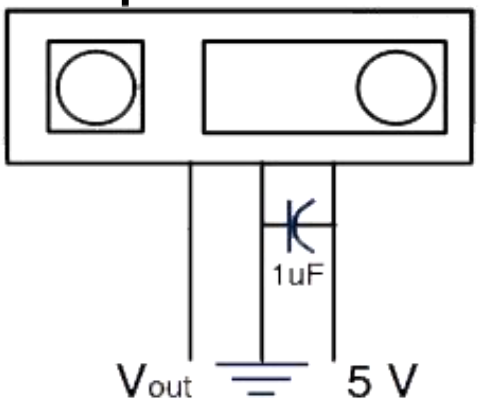
```
int ledPin = 13; // indicator LED
int inPin = 2; // sensor input (OUT)
int val = 0;

void setup() {
      pinMode(ledPin, OUTPUT);
      pinMode(inPin, INPUT);
 }

void loop(){
      val = digitalRead(inPin)
      if (val == HIGH){
            digitalWrite(ledPin, HIGH); // LED ON
      } else {
            digitalWrite(ledPin, LOW); // LED OFF
      }
}
```

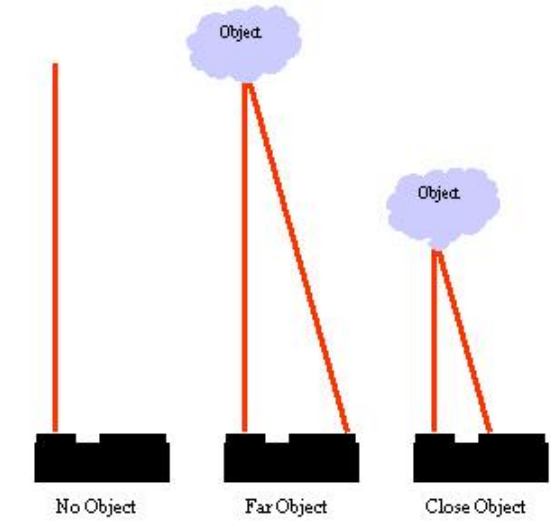
Other short range sensors

- Vishay CNY70
  - Range: 0-5mm
- APDS-9103/4 (or newer versions)
  - Range: 0-10mm

Long range distance sensors

- Sharp GP2D120 (4-30 cm)
- Sharp GP2Y0A4 (4-30 cm)
- Sharp GP2Y0A2 (10-80cm)
- Analog output~distance
- Use >10uF capacitor



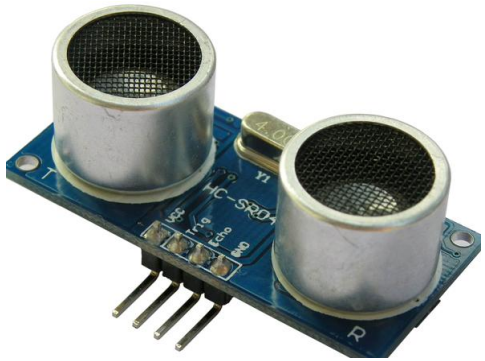


Long range distance sensors

- See AnalogReadSerial and ReadAnalogVoltage examples of Arduino
- Non-linear relation Voltage-Distance:
  - Look-up table (+ interpolation)
  - Approximate with function (eg. V=a/x+b)

Long range ultrasonic sensors

- "Ping"-style ultrasonic sensor
- Range (4cm – 0.004 km)
- Frequency 40Hz
- Measuring angle 15
- HC-SR04 Ultrasonic range finder
  - http://luckylarry.co.uk/arduino-projects/arduino-sonic-range-finder-with-srf05/
  - https://docs.google.com/document/d/1Y-yZnNhMYy7rwhAgyL_pfa39RsB-x2qR4vP8saG73rE/edit?pli=1
  - http://arduino.cc/en/Reference/pulseIn



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Long range ultrasonic sensors

```
// setup pins and variables for sonar device
int echoPin = 2;                    // SRF05 echo pin (digital 2)
int initPin = 3;                    // SRF05 trigger pin (digital 3)
unsigned long pulseTime = 0;        // stores the pulse in Micro Seconds
unsigned long distance = 0;         // variable for storing the distance (cm)

void setup() {

  pinMode(initPin, OUTPUT);         // set init pin 3 as output
  pinMode(echoPin, INPUT);          // set echo pin 2 as input

  Serial.begin(9600);
 }
```

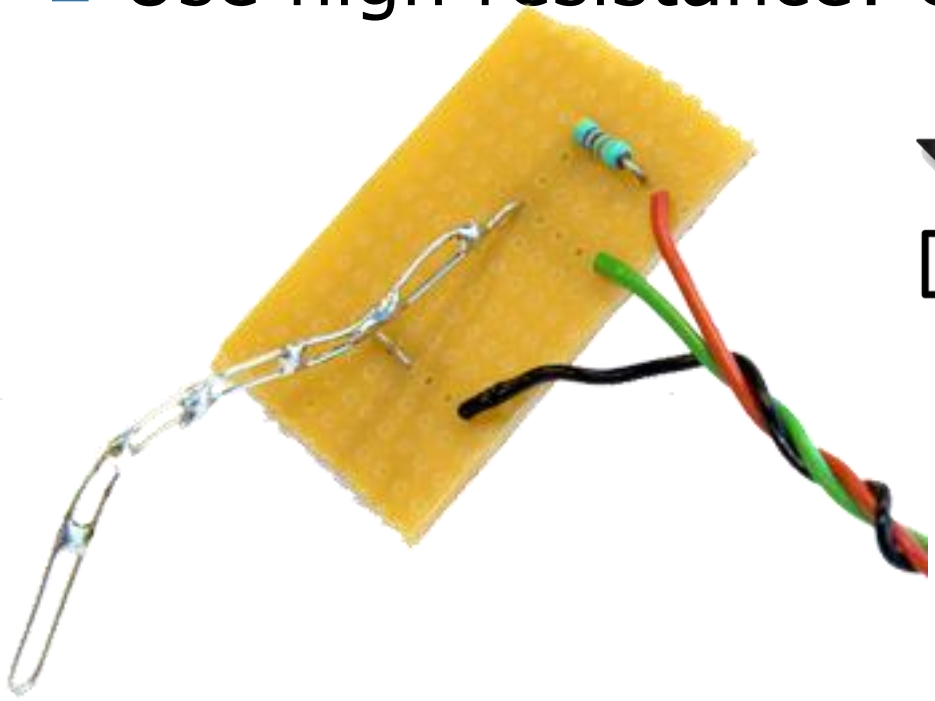
Long range ultrasonic sensors

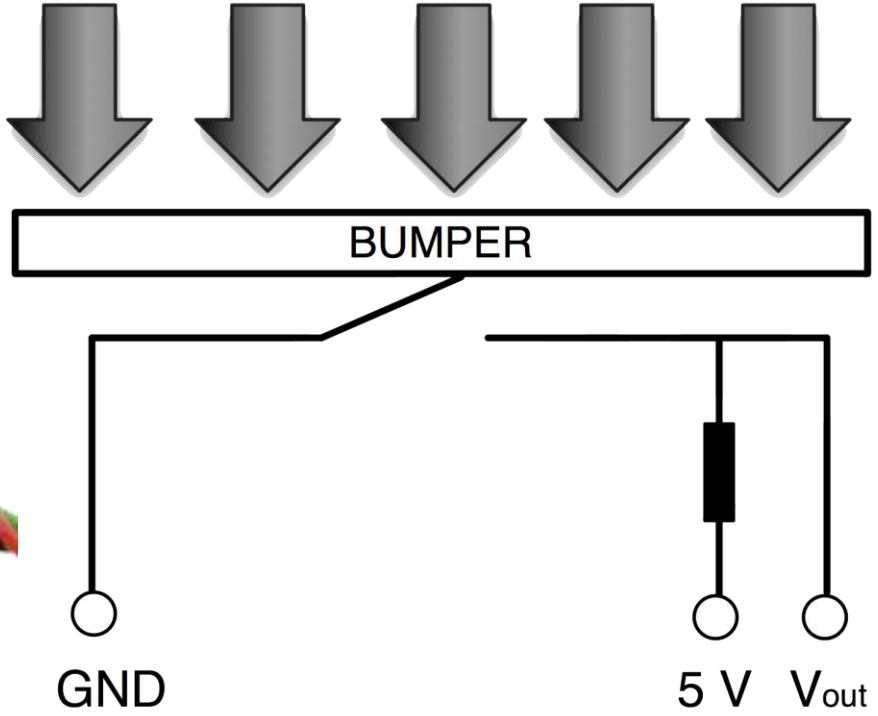
```
// execute
void loop() {
digitalWrite(initPin, HIGH);                // send 10 microsecond pulse
delayMicroseconds(10);                // wait 10 microseconds before turning off
digitalWrite(initPin, LOW);                // stop sending the pulse
timeout = 5800;            // microseconds (2ms)
pulseTime = pulseIn(echoPin, HIGH, timeout);          // Look for a return pulse, it should be high as the pulse goes low-high-low
distance = pulseTime/58;                // Distance = pulse time / 58 to convert to cm.
Serial.println(distance, DEC);        // print out the average distance to the debugger
  delay(100);                          // wait 100 milli seconds before looping again

}
```

Cheap touch sensor

- Make electrical contact=>digital(5V/0V)
- Use high resistance: eg. 10k Ohm





Tips & Tricks

- Have a look at the data sheets! (preferred orientation...)
- Low pass filtering/averaging of noisy sensor readings can be of interest
- Indicator leds when something is wrong/nothing is detected...

More…

- http://www.dwengo.org/nl/electronics/sensors
- http://arduino.cc/playground/Main/InterfacingWithHardware
- A lot of Arduino code out there!