INTERFACING WITH THE ARDUINO

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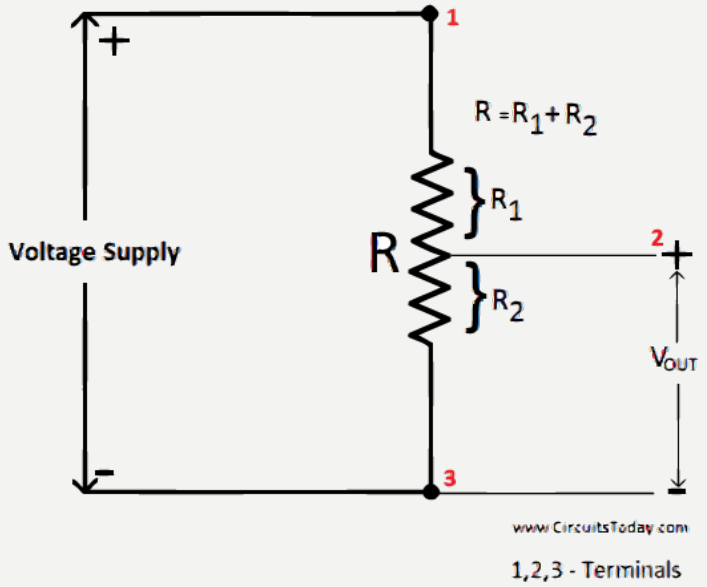
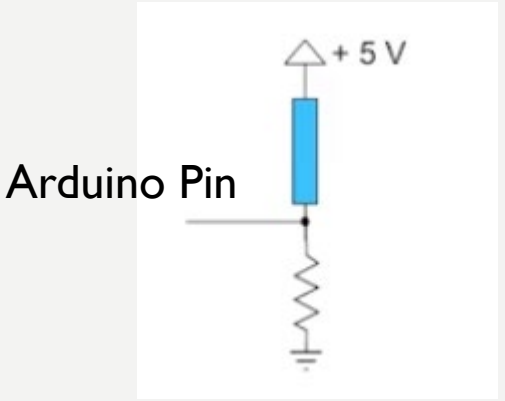
ELECTRIC CIRCUITS

- Terminal = Pôle / Soldering = Soudure / Short circuit = Court circuit
- Diode:
  - Forward Bias :
    - ≥ Threshold: PASS
    - ≤ Threshold: NO PASS
  - Revise Bias: NO PASS
- Potentiometer: R_1+R_2=cte (Top +, Middle Out, Bottom -)



SENSORS



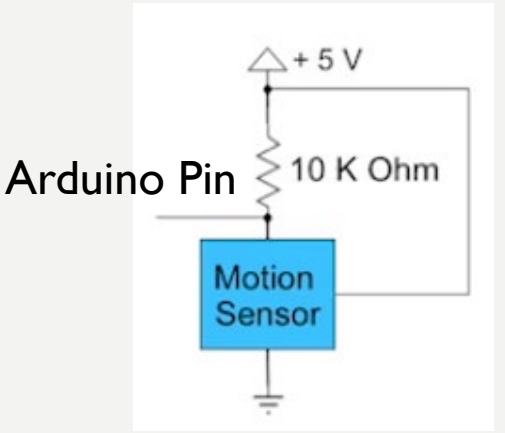
- Get information from environment
- Resistance ~ ➔ Voltage ~ ➔ Arduino pin receives a digital value

❑Resistive sensors (Resistance)

EXP: Photoresistor

❑Voltage controlling sensors (Pull Up Path)

EXP: Accelerometer (2D) ; Gyroscope (3D)



ACTUATORS

- Send information to environment

❑ On-off actuators (digital)

❑ Analog voltage control actuators

- ~~DAC~~ ⇔ Pulse Width Modulation PWM
- Duty cycle – AnalogWrite(Pin PWM ~, Value 0 to 255 [0% to 100%])
- Example: 50% – Duty cycle: Half the time 1, Half the time 0 ➔ Give 2,5V

✓ EXP: Buzzer – tone(pin, frequency in Hz, duration in ms) #Generate square wave; Fixed duty cycle 50% → notone()

EEPROM

- EEPROM: Electronically Erasable Programmable Read Only Memory
- Non volatile memory
- Writes a single byte at a time (Similar to flash memory)
- 1k bytes for Arduino
- Masking: Process to store data of 2 bytes (1's in the bits we interested in and 0's)
- PS: 0xFF is a mask for 255

❖ #include<EEPROM.h>

❖ EEPROM.read(address 1 byte 0->1023)

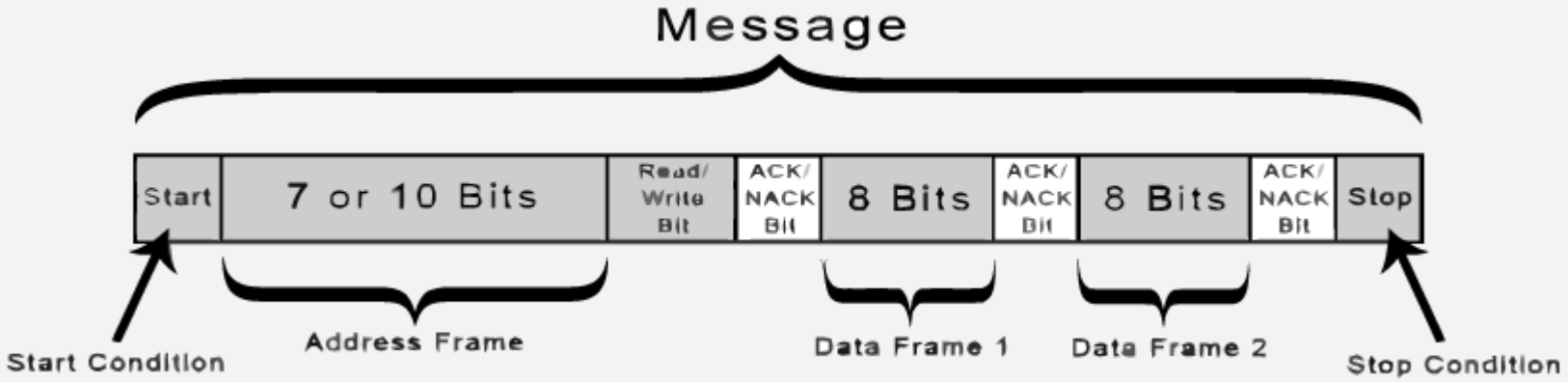
❖ EEPROM.write(address, data 1 byte)

I2C COMMUNICATION

- ❖ Serial protocol → 1 wire, 1 bit at a time → Saves pins
- ❖ Synchronous protocol → Shares same clock
- ➢ Master: Who starts the communication
- ➢ Slave: Who receives the communication
- Bit width fixed: 2 bits
  - 1 bit for data signal
  - 1 bit for clock signal
- 2 Wires:
  - SDA: Serial Data
  - SCL: Serial Clock
- ❑ Transmitter: Places data on the bus
- ❑ Receiver: Read data from the bus

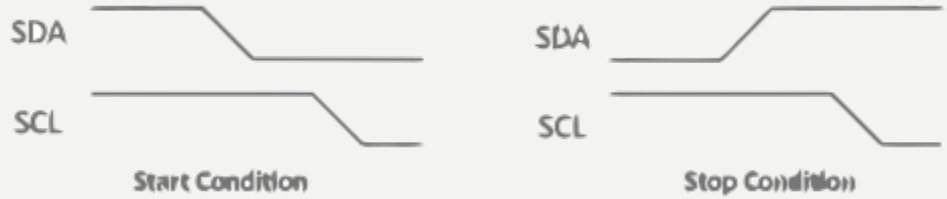
- ○ Transaction:
  - ○ Write
  - ○ Read

I2C COMMUNICATION



- SCL – Example of 1 clock pulse

- SDA – Can be both 0 and 1



  - Cross in SDA – SDA changes value
  - The sender has to apply a value of SDA before SCL goes HIGH and hold it while SCL is HIGH and that is the value that is going to be on the bus.
  - Acknowledge bit: After every byte the receiver sends an ack bit: SDA = 0 : Message received

```
#include<Wire.h>
```

Wire.begin() #No argument = Master ; #Addr(0->127) = Slave

I2C COMMUNICATION

Master communication (Write):

1. Wire.beginTransmission(@Slave) #Start the transmission
2. Wire.write(data)
3. Wire.endTransmission() #Returns 0 for success

PS: Whole data is put into a buffer before being sent.

Master communication (Read):

- Wire.requestFrom(@Slave,Nb of bytes to read, X) #X=Stop arg to release the bus after(optional) #Specify a read transaction
- Wire.read() #Returns a single byte from the receiver buffer
- Wire.available() #Returns number of bytes waiting

I2C COMMUNICATION

Slave operation:

PS: Slave cannot initiate for transmission : must wait.

- Problem → Busy wait: loops to check if there is transaction
- Solution → Call back functions: functions called when an event occurs "transmission is received"

❖ Wire.onRecieve(funcName) #Master: Write Transaction

❖ Wire.onRequest(funcName) #Master: Read Request

✓ Exp: void recieveFunction(int bytesRecieved) #1 argument

✓ Exp: void transmitFunction(void)

SHIELDS – ETHERNET SHIELD

Shield = Printed Circuit Board (PCB) → Adds functionality to Arduino

- Hardware: Circuit prewired (same size as Arduino)
- Software: Library associated to IDE

Exp: Ethernet shield ;

❑MAC address : Unique – 6 bytes long

❑IP address : Changeable – 4 bytes long

❑Port : Application protocol – 2 bytes long ; Exp: Port 80 (for Internet)

❑DNS: Domain Name Server → Match between IP@ and URL

❑DHCP: Dynamic Host Connection Protocol → Gives an IP@ dynamically | Static IP@

PS: Routers – DHCP / Servers – Static IP@

❖#include<Ethernet.h>

❖Ethernet.begin(@Mac*, @IP, DNS, Gateway, Subnet mask)

ETHERNET SHIELD

- EthernetClient client #Create a client object
- client.connect(@IP / DNS, port) #returns 1 if ✓
- client.stop()
- client.print(data)
- client.write(byte)
- client.read()
- client.available()

- EthernetServer server=EthernetServer(port) #Create a server object; before setup
- EthernetClient client=server.available()

Server Receives Data

```
EthernetServer server = EthernetServer(80);
void setup() {
  Ethernet.begin(mac, ip, gateway, subnet);
  server.begin();
}
void loop(){
   EthernetClient client = server.available();
  if (client) {
   Serial.print(client.read());
  }
}
```

Client Sends Data

```
byte mac[]={0xDE, 0xAD, 0xBE, 0xEF, 0x12, 0x34};
char server[]= "testdomain.edu";
EthernetClient client;
void setup() {
   Ethernet.begin(mac);
   if (client.connect(server, 80)) {
      client.println("GET index.html HTTP/1.1");
      client.stop();
   }
}
```

WIFI SHIELD

WiFi.begin(ssid,pass°,keyindex*,key*) #ssid=network ; pass type=WPA-2°,WEP*

- WiFiClient client#Create a client object
- client.connect(ip,port)
- client.stop()
  - WiFiServer server(port)#create a server object
  - server.begin()

❖WiFi.scanNetworks() #returns the number of available networks

❖WiFi.SSID(i) #returns ssid of the i'th network

❖WiFi.RSSI(i) #returns the strength of the i'th network (-80 → 0)

❖WiFi.encryptionType() #0 WEP ; 1 WPA-1 ; 2 WPA-2 ; 3 None