Data Driven Design

Topic 2
Input and Output Devices

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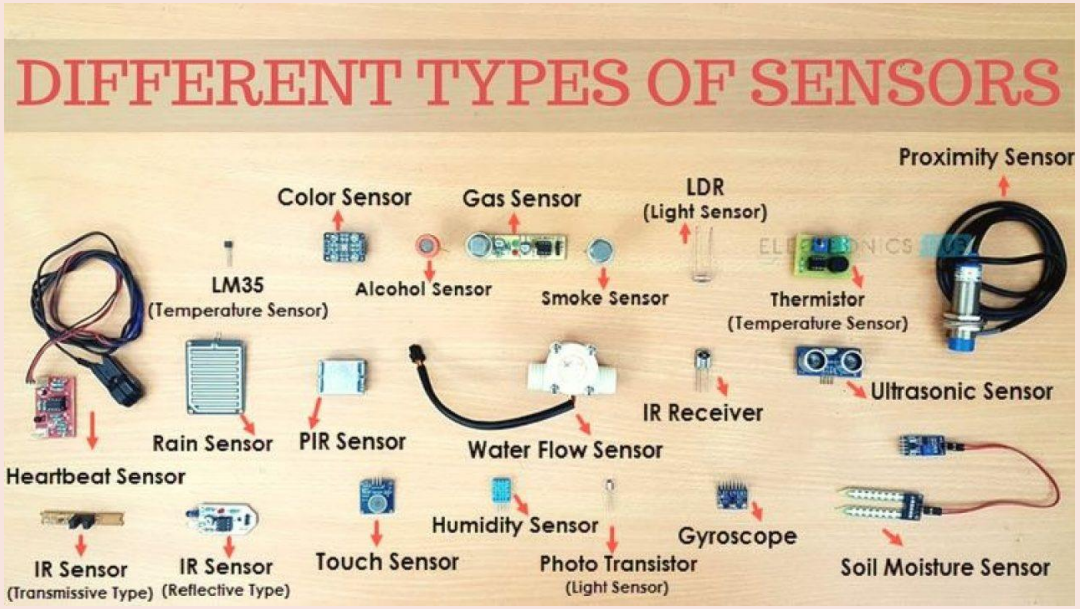
30th January 2024

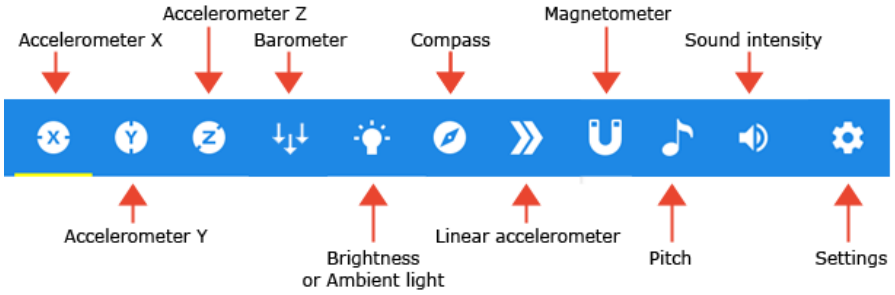
Input Devices

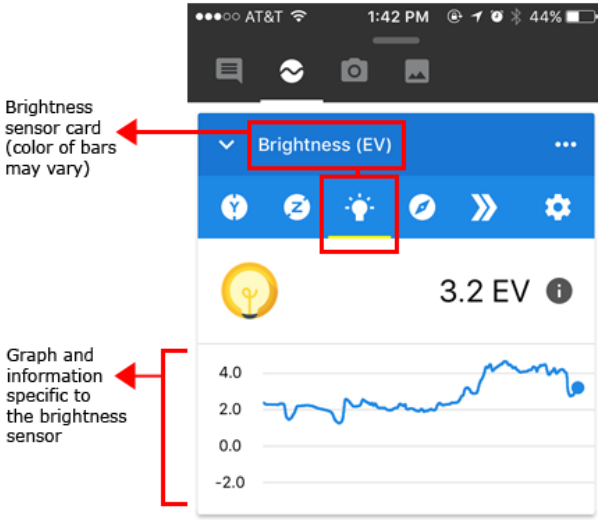


- Sensors
- Different types of sensors to measure temperature (thermistor), distance (ultrasonic sensor), force (strain gauge), light, sound
- Do you know of any sensors that you use in your everyday life?
- What makes your smart phone so smart? Link

Arduino Science Journal App

Sensors in your phone





Innovating for billions

NETRA

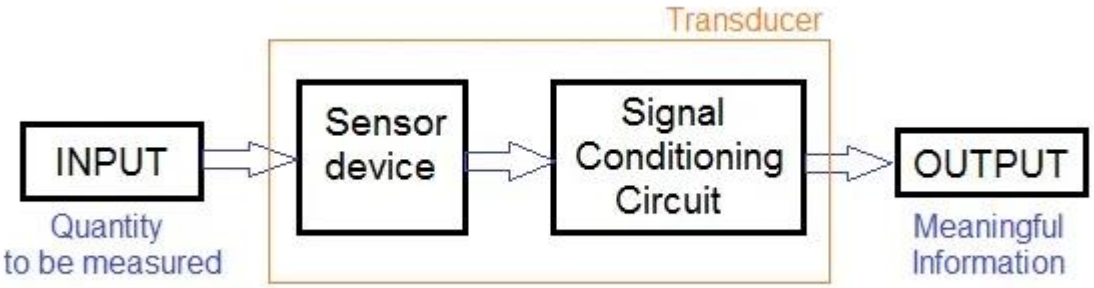
Near **E**ye **T**ool for **R**efractive **A**ssessment

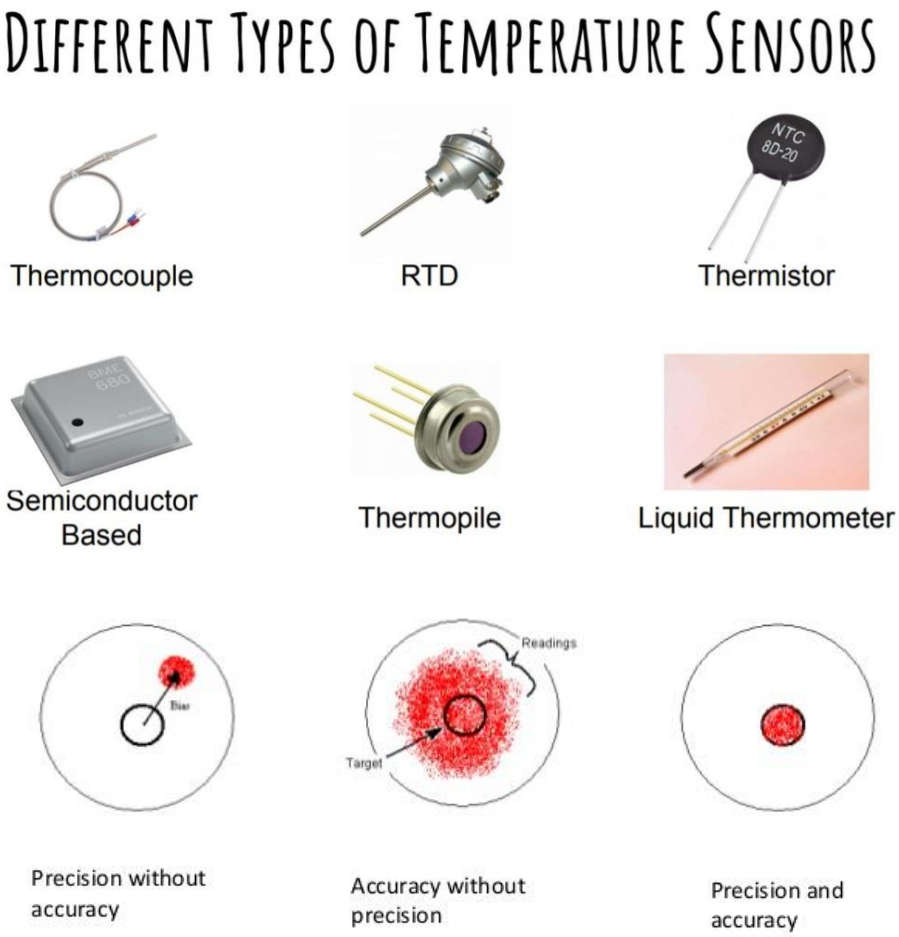
Vitor Pamplona, Ankit Mohan, Manuel Oliveira, Ramesh Raskar SIGGRAPH 2010

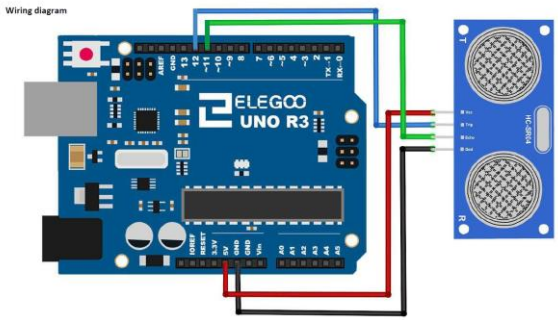
- Ramesh Raskar, Camera Culture group, MIT Media Lab – innovating for billions
- eye-NETRA REDX.io
- INK talk: Idea Hexagon for innovation
- Scaling up of design solutions?
- Mobile phone users in India

Sensor features

- Sensor vs transducer
- Sensor resolution, range, speed of response, cost, reliability (datasheet)
- Sensor calibration





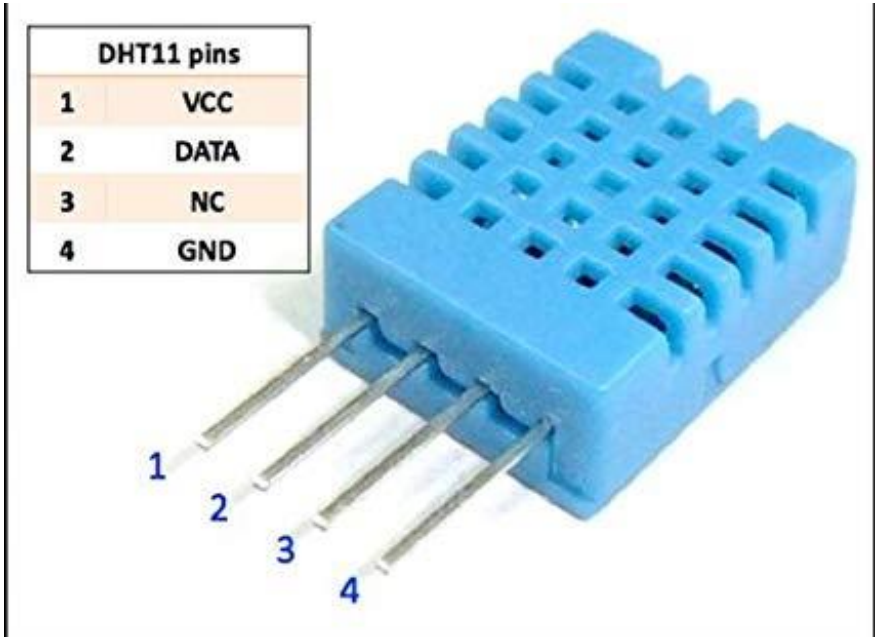


Distance Measurement

- Ultrasonic sensor module (Lesson 2.9)
- Read datasheet (2 cm- 400 cm range)
- Lesson 1.5 (install library)
- Reading library
- Smart cane, other applications

DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND

DHT11 pins	
1	VCC
2	DATA
3	NC
4	GND



Temperature, RH measurement

- DHT11 sensor (Lesson 2.11)
- DHT22 sensor Another library
- Datasheet

4X4 Keypad module

- Lesson 2.10
- Applications: cell phones, ovens, door locks, keyboards

Input Devices Summary

- Smart phone sensors
- Sensor characteristics
- Examples: Ultrasonic sensor, Keypad module, Temp/RH. Other sensors similar procedure.
- Fab Academy webpage video
- Think of applications as a design student

Electrical Safety

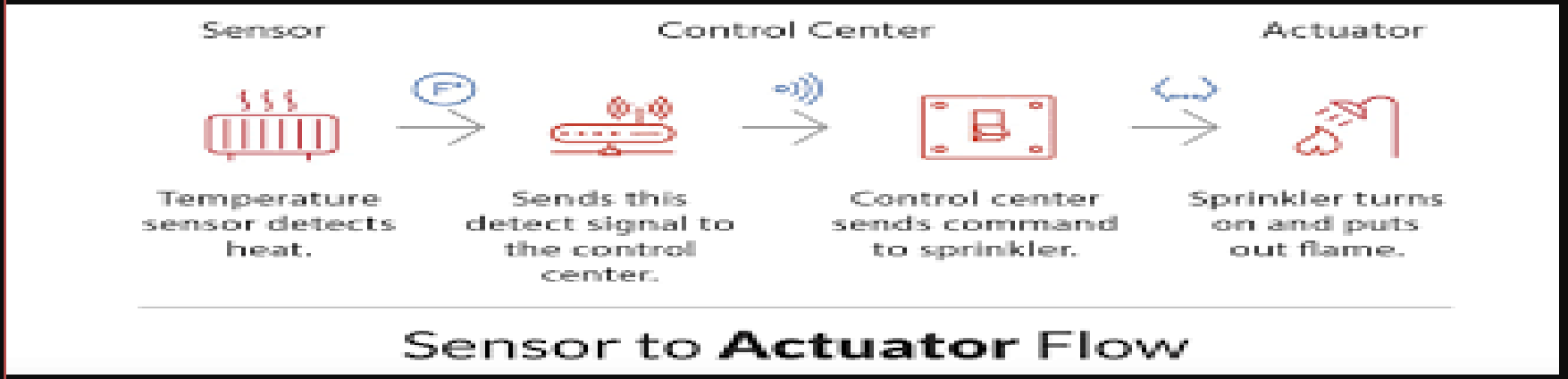
~1 mA: fine

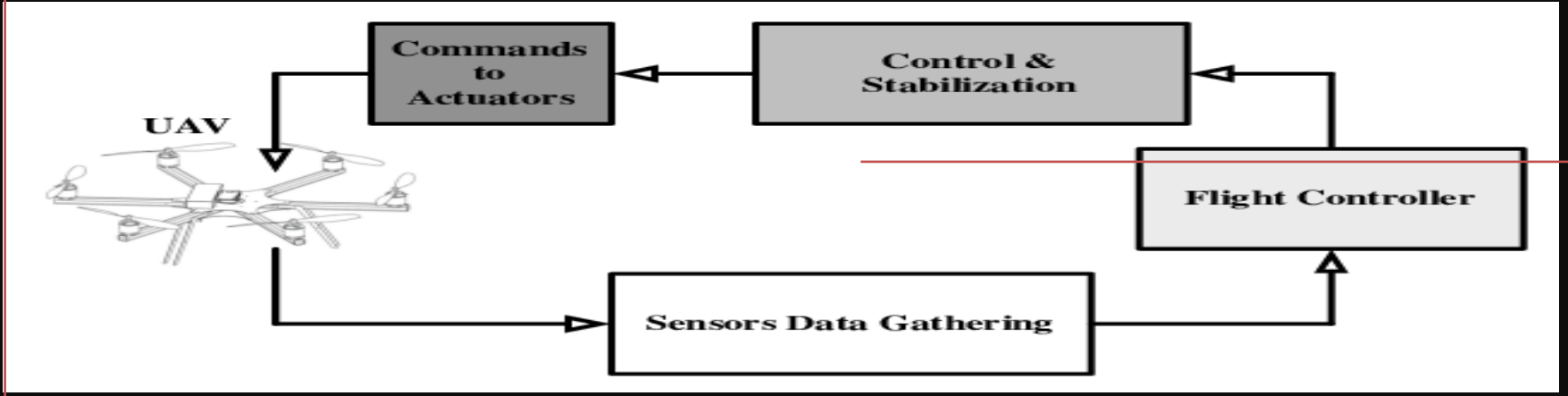
~10 mA: shock, contraction

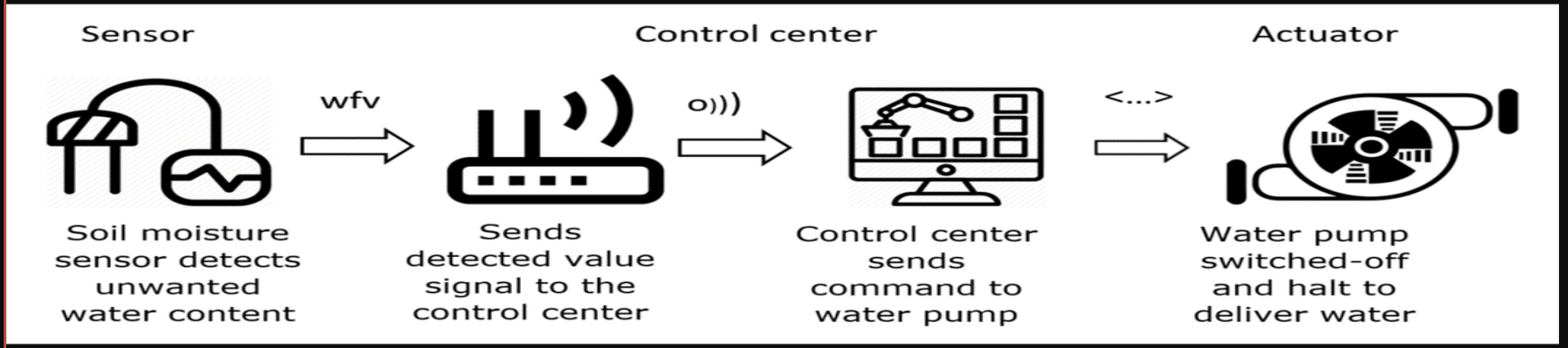
~100 mA: fibrillation

- body: M ohm external, k ohm internal

"Don't touch him! He's a conductor."


Sensor
Control Center
Actuator
Temperature sensor detects heat.
Sends this detect signal to the control center.
Control center sends command to sprinkler.
Sprinkler turns on and puts out flame.
Sensor to Actuator Flow


Commands to Actuators
Control & Stabilization
UAV
Flight Controller
Sensors Data Gathering


Sensor
Control center
Actuator
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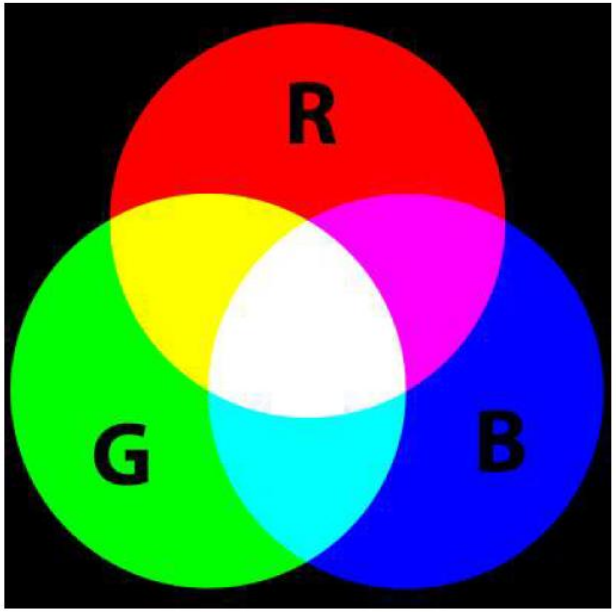
Soil moisture sensor detects unwanted water content
Sends detected value signal to the control center
Control center sends command to water pump
Water pump switched-off and halt to deliver water

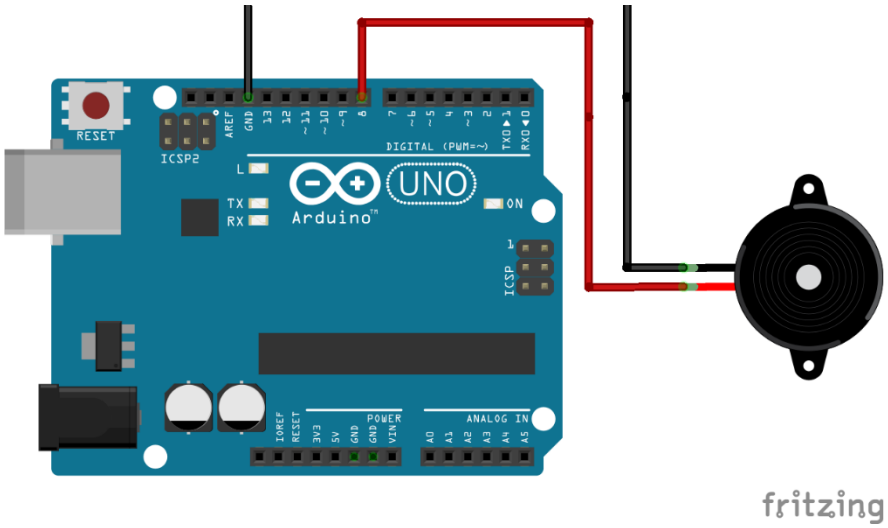
Output Devices

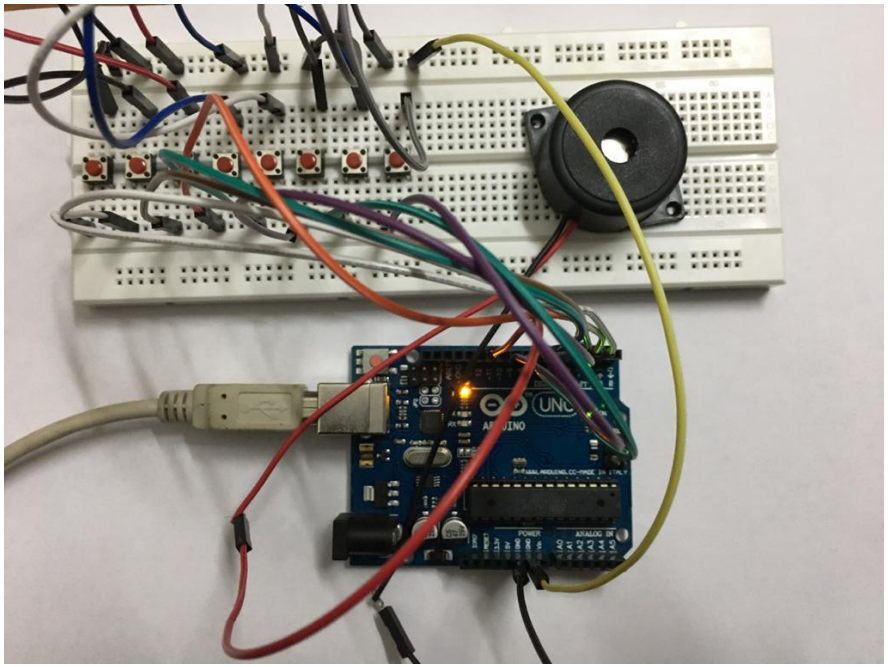
- LEDs, Displays, Speakers/ Buzzers, DC/Servo/Stepper Motors, Relays, Dataloggers

RGB LED

- PWM with RGB LED with common anode (Lesson 2.2). NOTE: Longest leg of RGB LED goes to 5V pin.
- RGB_basic RGB_favorite_color

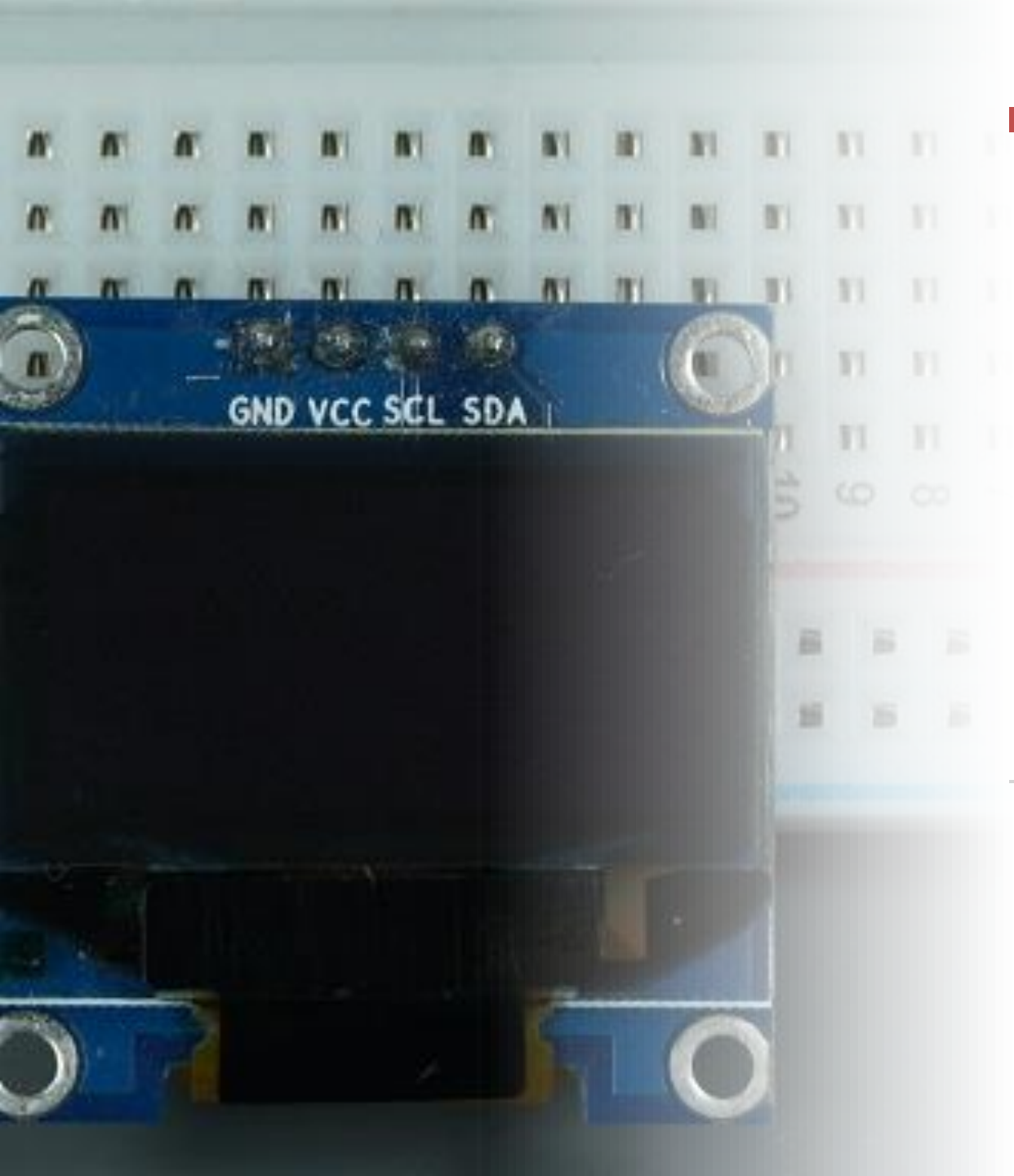






[Basic musical instrument]

Piezo buzzer (Lesson 2.6)



0.96 inch OLED display

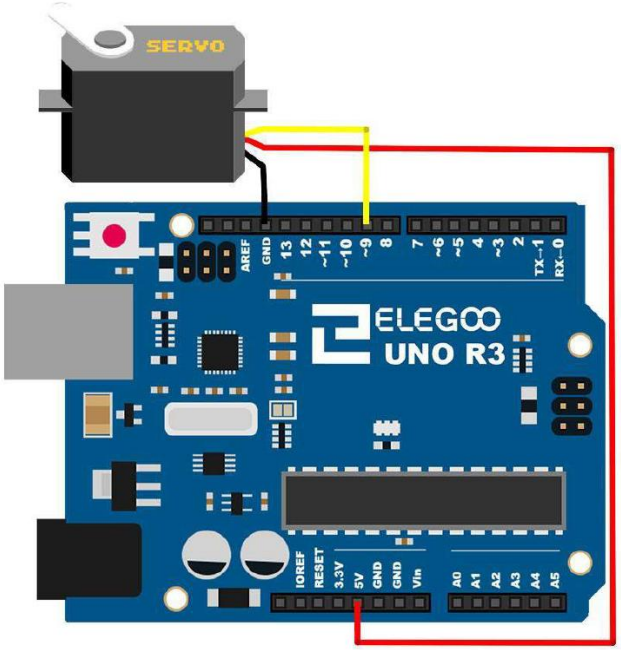
https://randomnerdtutorials.com/guide-for-oled-display-with-arduino/

Stepper Motor

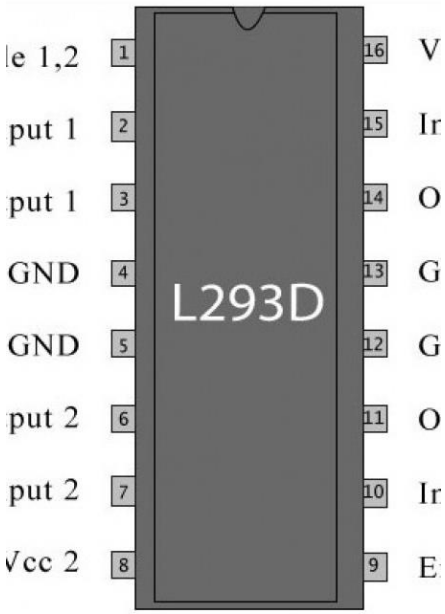
- Stepper motor rotates in steps, open loop position control
- Basis for many machines (motion control)
- XY plotter, 3D printer, Laser cutter, CNC router
- 28BYJ-48 stepper motor, ULN2003 Driver Board
- Lesson 2.24, Examples

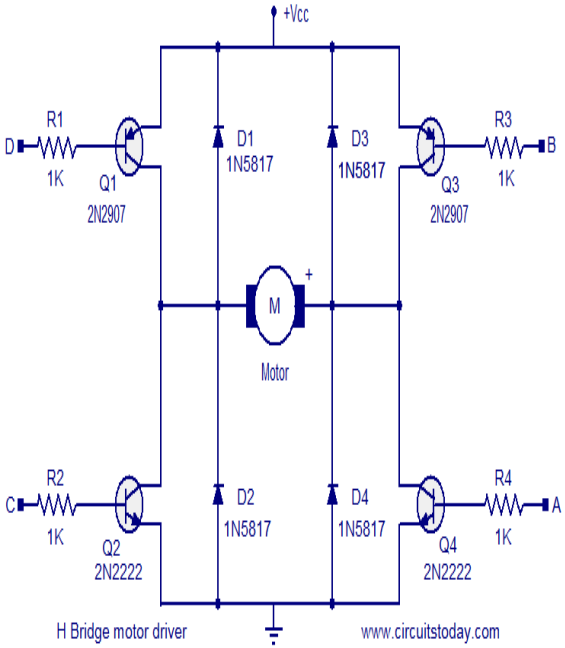
Servo Motor

- Rotate 180 degrees
- SG90, Datasheet
- Lesson 2.8
- Applications: pen lift mechanism for XY plotter
- Potentiometer example – Gouri's project



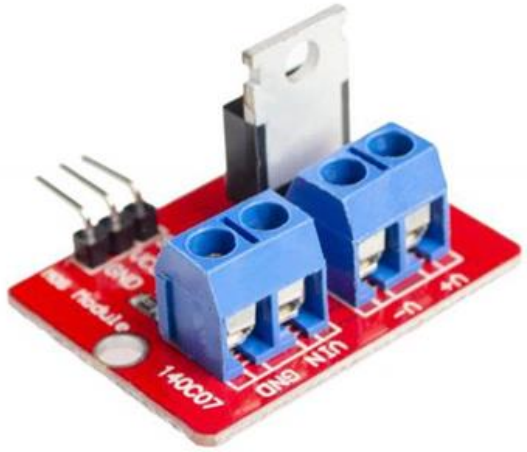
[3-6 V DC Motor]

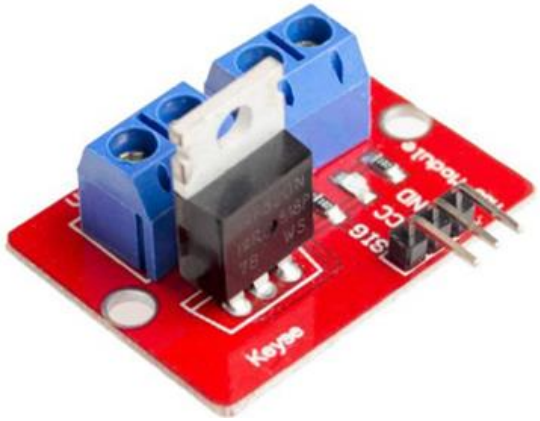


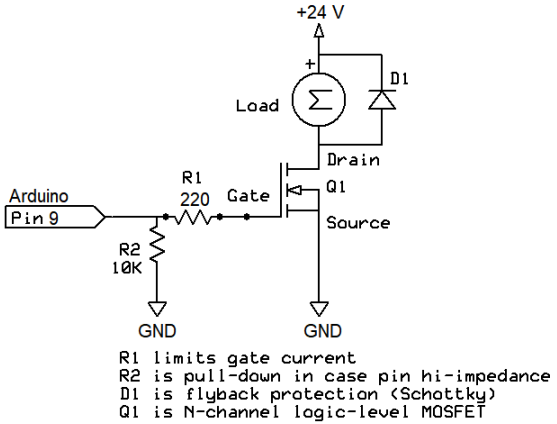


DC motor control

- Lesson 2.23
- L293D datasheet, Motor drivers
- PWM (speed control), potentiometer control
- Direction control
- DC power supply for higher current



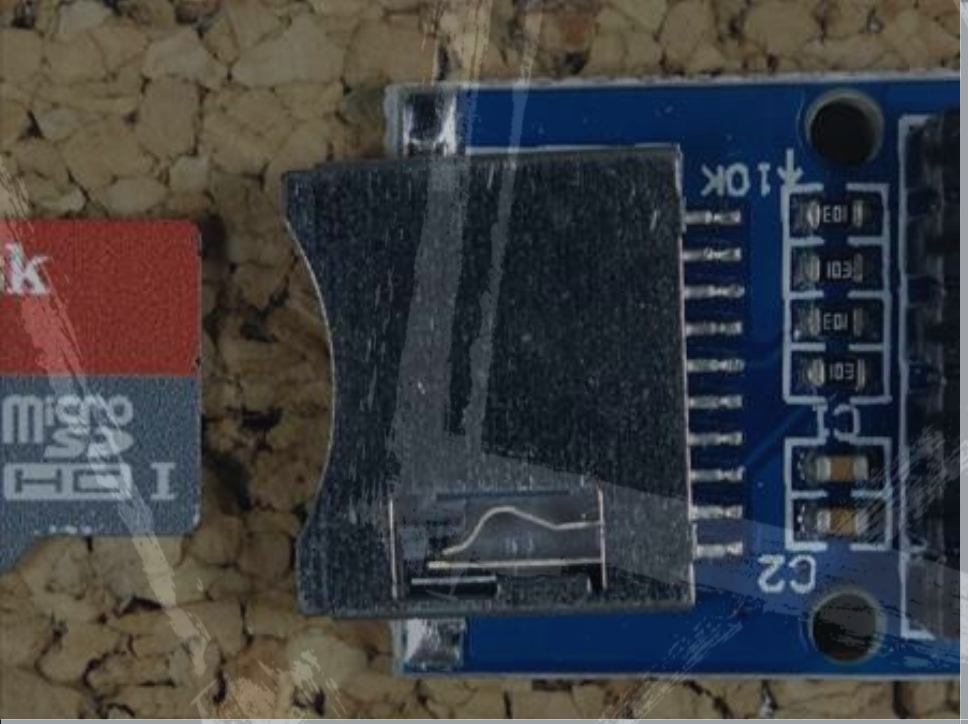




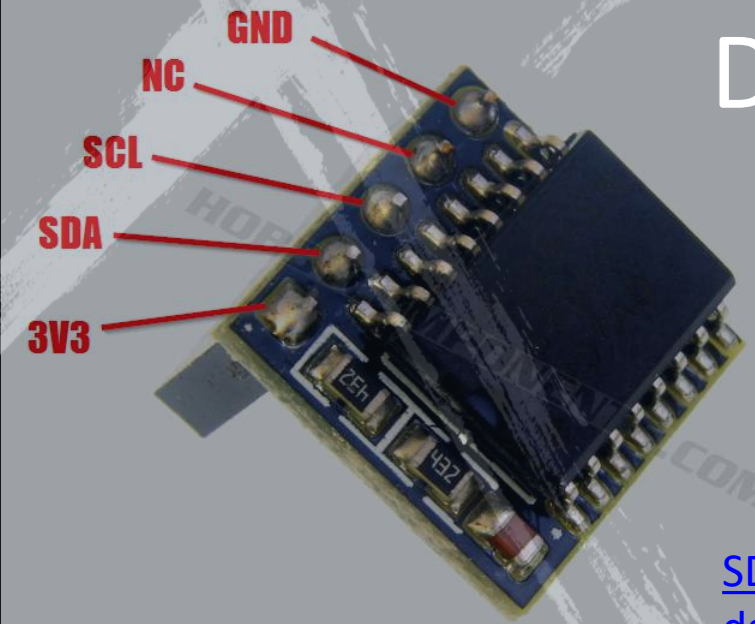
[MOSFET module]

High Power DC Loads

- Controlling a high power DC load with a microcontroller
- MOSFET GATE acts as a switch for high power DC loads, Fade Arduino code
- IRF520 MOSFET datasheet
- LED strip, DC fan, DC motors, etc.
- AC light dimmer module (dangerous!) for AC loads



Datalogger



[SD Card Module Part]
[ds3231 rtc pin layout Part Arduino tutorial]

Output Devices Summary

- Output devices
- Examples: LCD display, RGB LED, Motors, Buzzer
- Fab Academy webpage video
- Think of applications as a design student
- Explore other input and output devices

Examples integrating input and output devices

- Displaying output from temperature, RH sensor on OLED Display
- Smart Fan (DC motor + T, RH sensor)
- Sounds of different frequencies from the Buzzer as the distance computed from a proximity sensor varies
- Dustbin – full vs. half vs. empty, LED is RED, YELLOW, GREEN.

Assignment

A. What are the different sensors in your phone and what do they do? Use Science Journal App to conduct an experiment to measure and analyze the data from a sensor and report your findings.

B. Combine a sensor with an output device together and collect data for an activity connected to you. Analyze that data and make sense of it. e.g. some examples could be displaying output from temperature/Rh sensor on OLED Display to find the thermal comfort in your room, sounds of different frequencies from the Buzzer as the distance computed from a proximity sensor varies, Dustbin (full vs. half vs. empty) shows LED to be RED, YELLOW, GREEN. Please documents the steps and create a video showing the interaction between the sensor and the output devices. Please also upload the codes used.

Assignment due on 19th March 2024.