



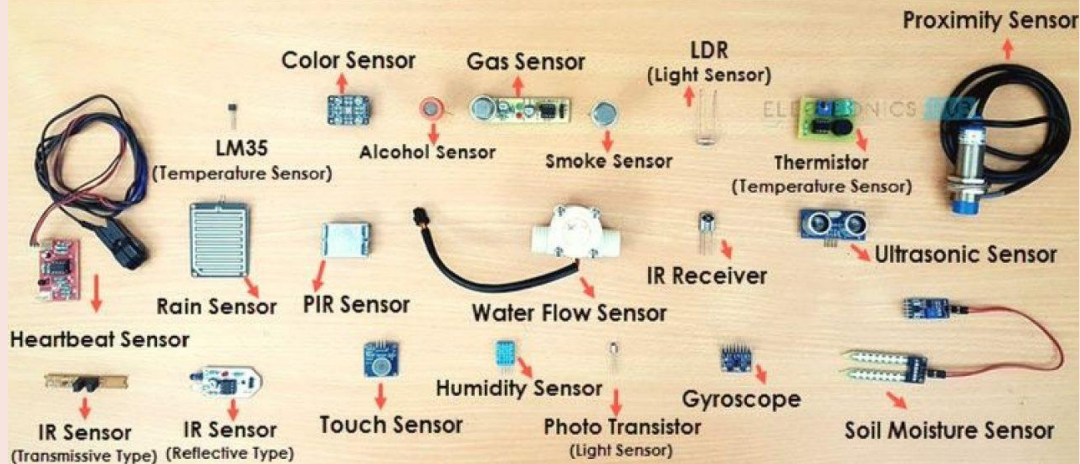
Special Topics in Design I
(IoT Prototyping)
DSL 810

Topic 3, 4
Input and Output Devices
Instructor: Jay Dhariwal,
Asst. Prof., IIT Delhi

8th September 2022

Input Devices

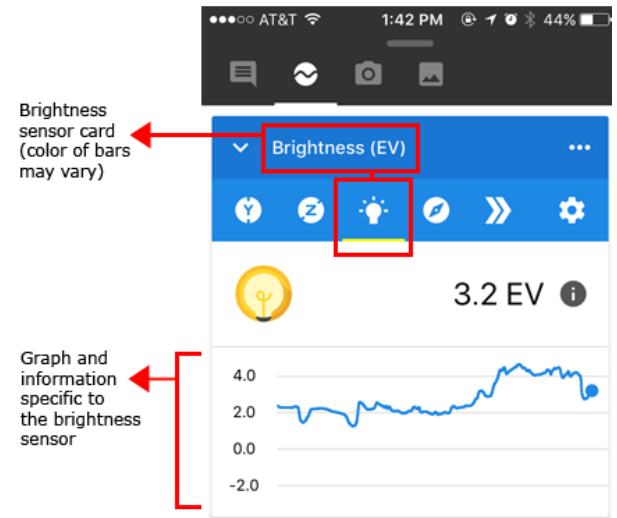
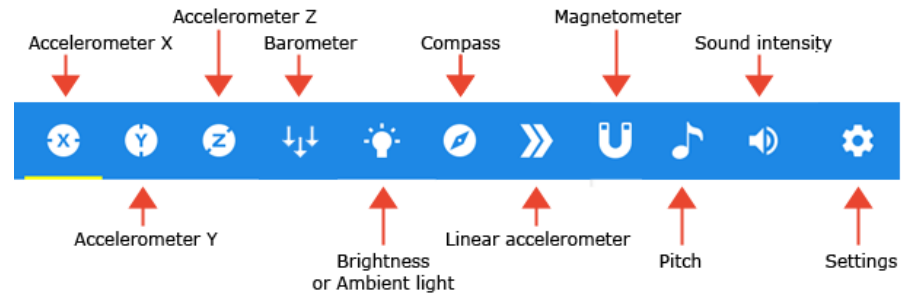
DIFFERENT TYPES OF SENSORS



- [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 Eye Tool for Refractive Assessment



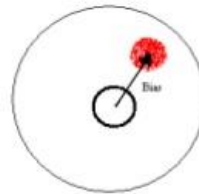
Vitor Pamplona, Ankit Mohan, Manuel Oliveira, Ramesh Raskar SIGGRAPH 2010

- 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](#)

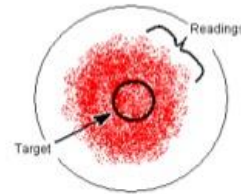
Sensor features

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

Accuracy vs. Precision



Precision without accuracy



Accuracy without precision

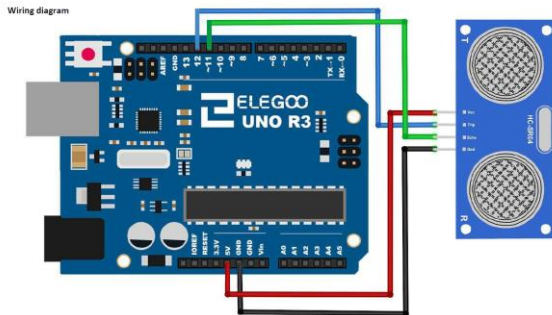


Precision and accuracy



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





4X4 Keypad module

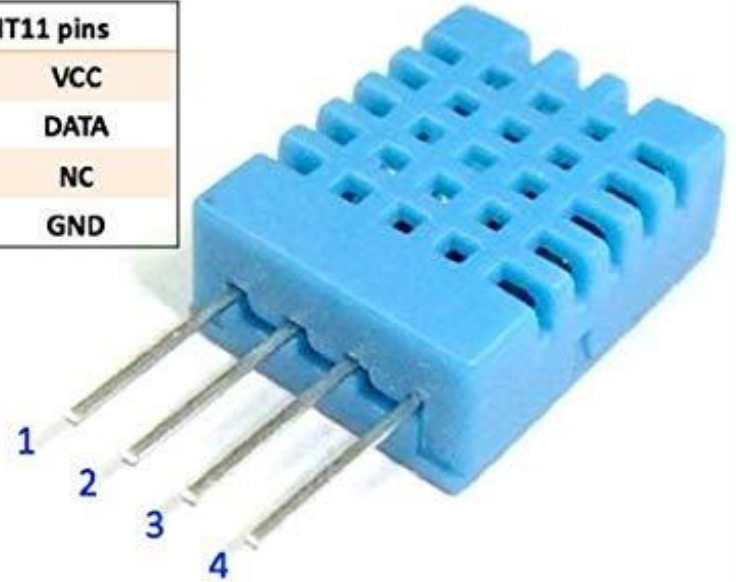
- Lesson 2.10
- Applications: cell phones, ovens, door locks, keyboards



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

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.”

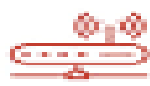
Sensor

Control Center

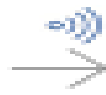
Actuator



Temperature sensor detects heat.



Sends this detect signal to the control center.

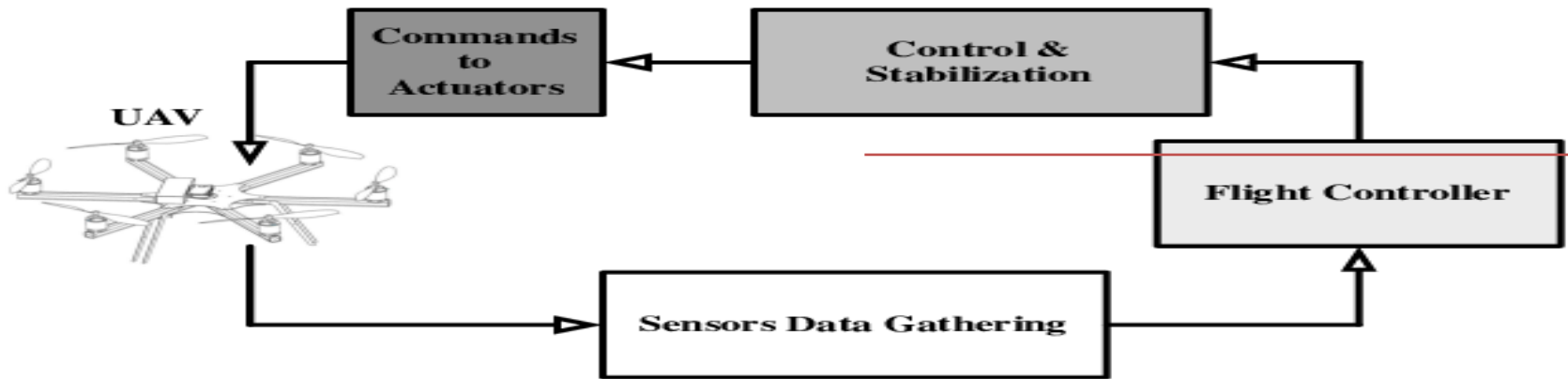


Control center sends command to sprinkler.



Sprinkler turns on and puts out flame.

Sensor to Actuator Flow



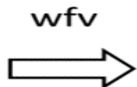
Sensor

Control center

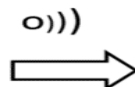
Actuator



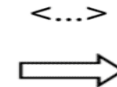
Soil moisture sensor detects unwanted water content



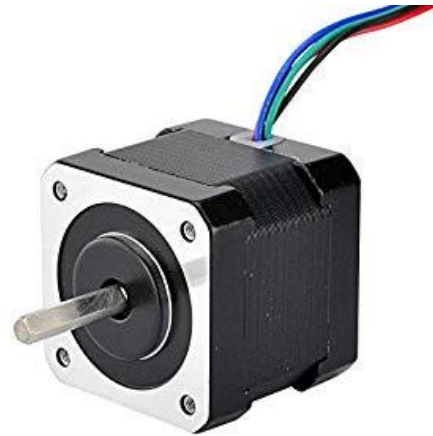
Sends detected value signal to the control center



Control center sends command to water pump

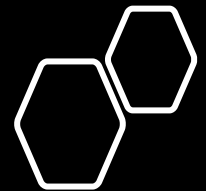


Water pump switched-off and halt to deliver water



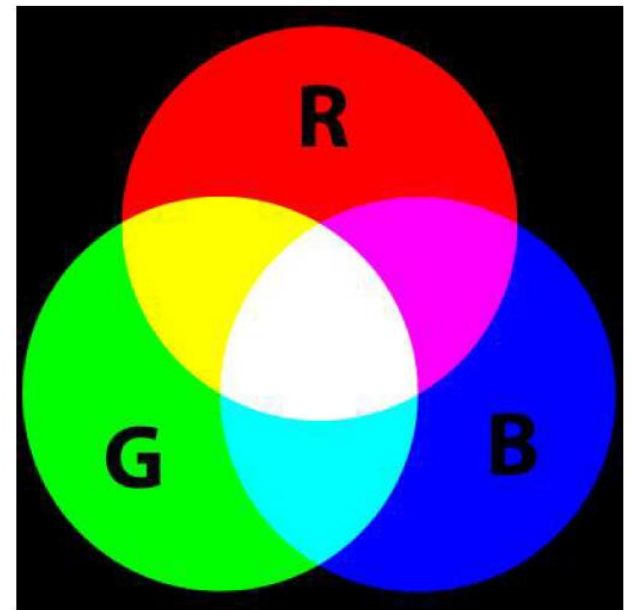
Output Devices

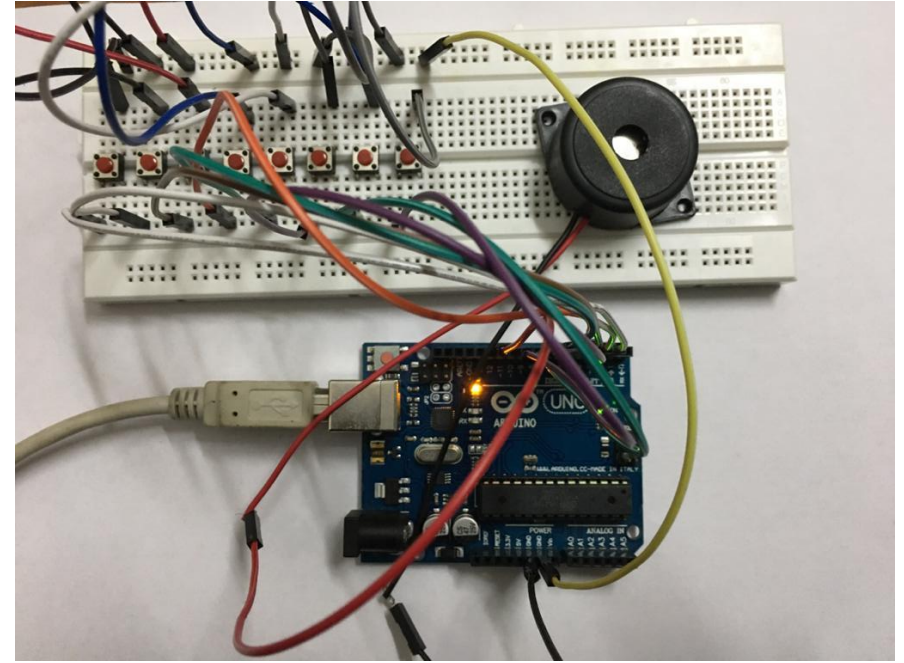
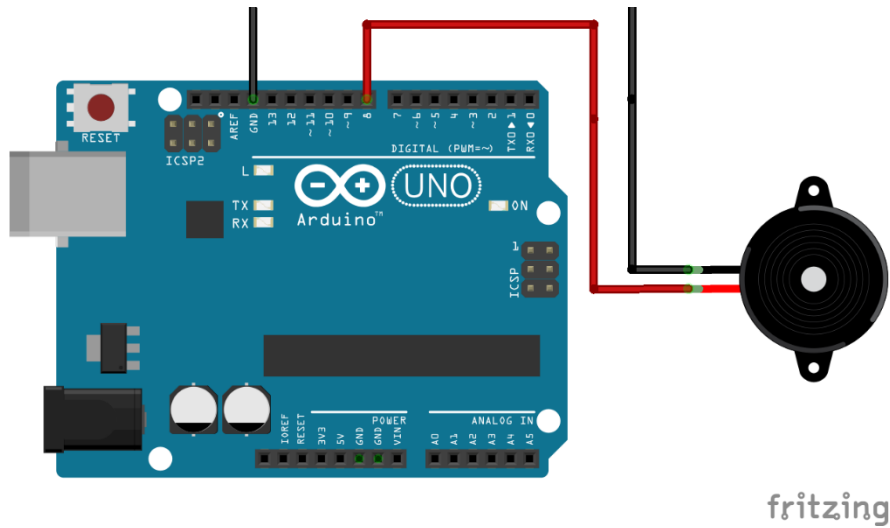
- LEDs, Displays, Speakers/ Buzzers, DC/Servo/Stepper Motors, Relays, Dataloggers



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](#)



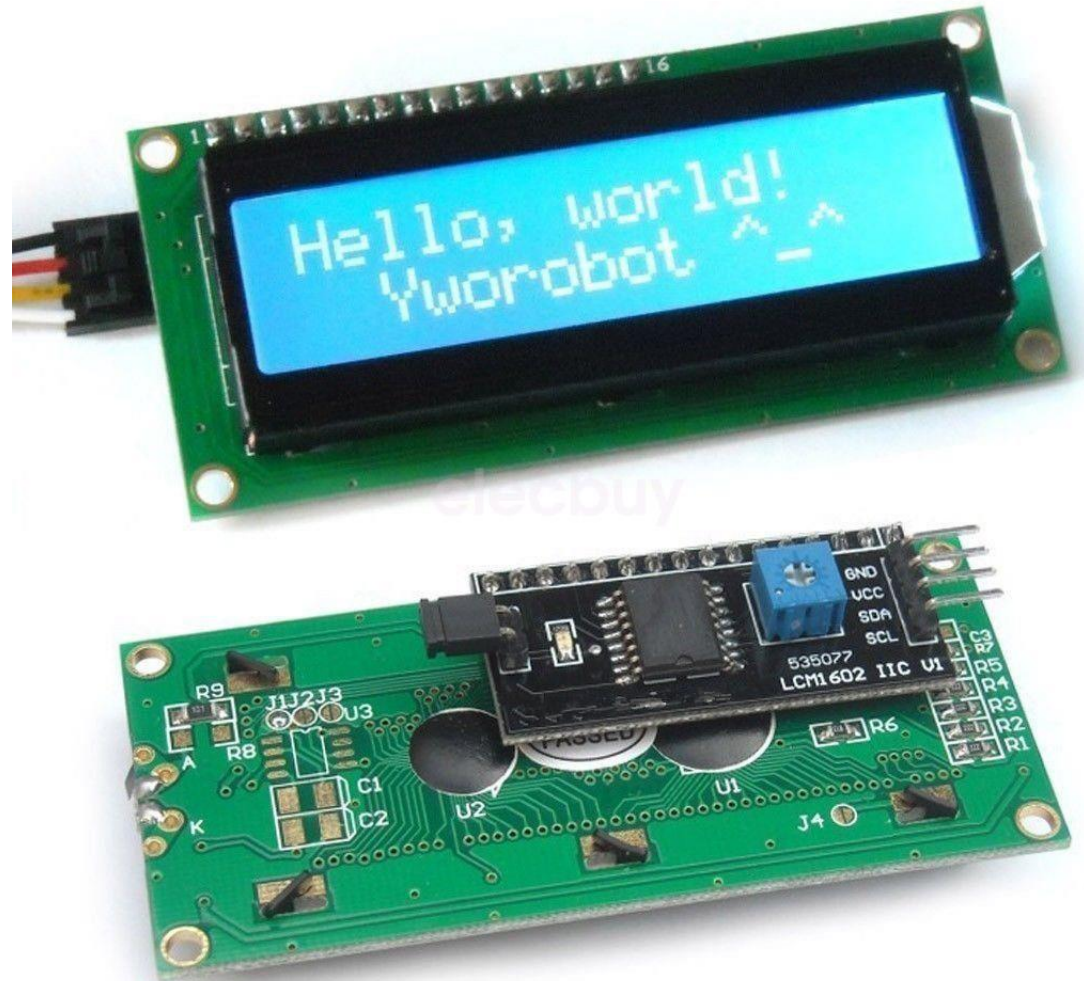


Basic musical instrument

Piezo buzzer (Lesson 2.6)

LCD display

- Lesson 2.21 (i2c)
 - Adjusting contrast with a screwdriver.
 - Connections:
SDA pin to A4 (Uno)
SCL pin to A5 (Uno)
- [Arduino code](#)
- Other examples



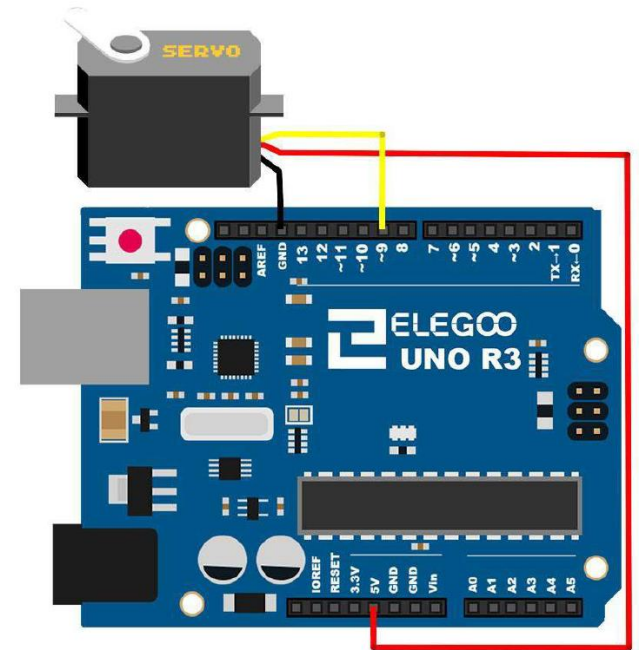
Stepper Motor



- [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

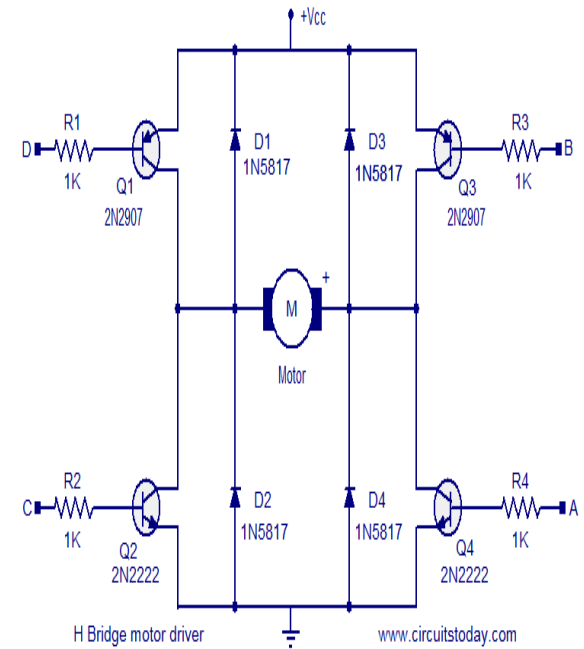
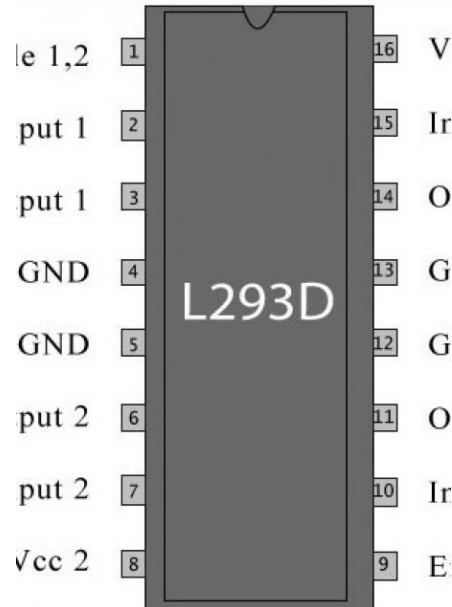
Servo Motor

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



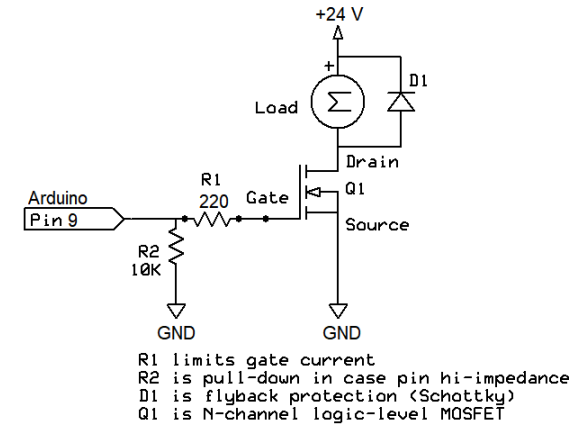
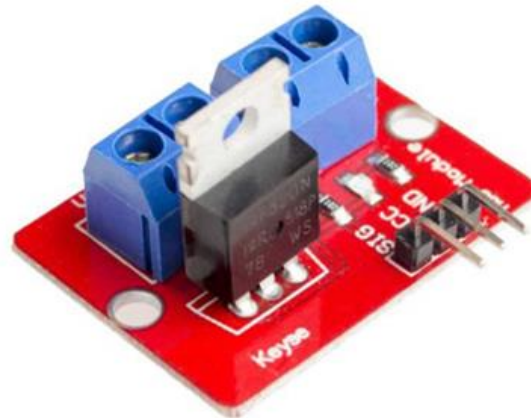
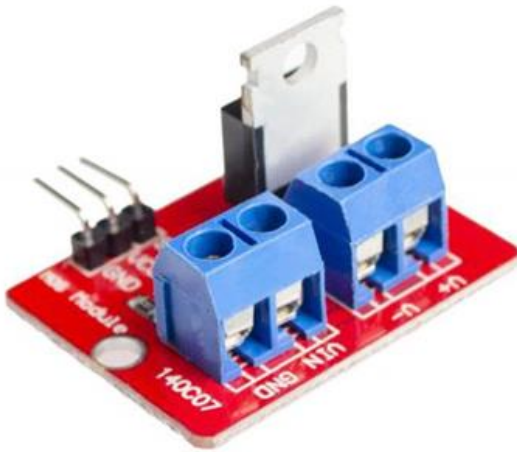


3-6 V DC Motor



DC motor control

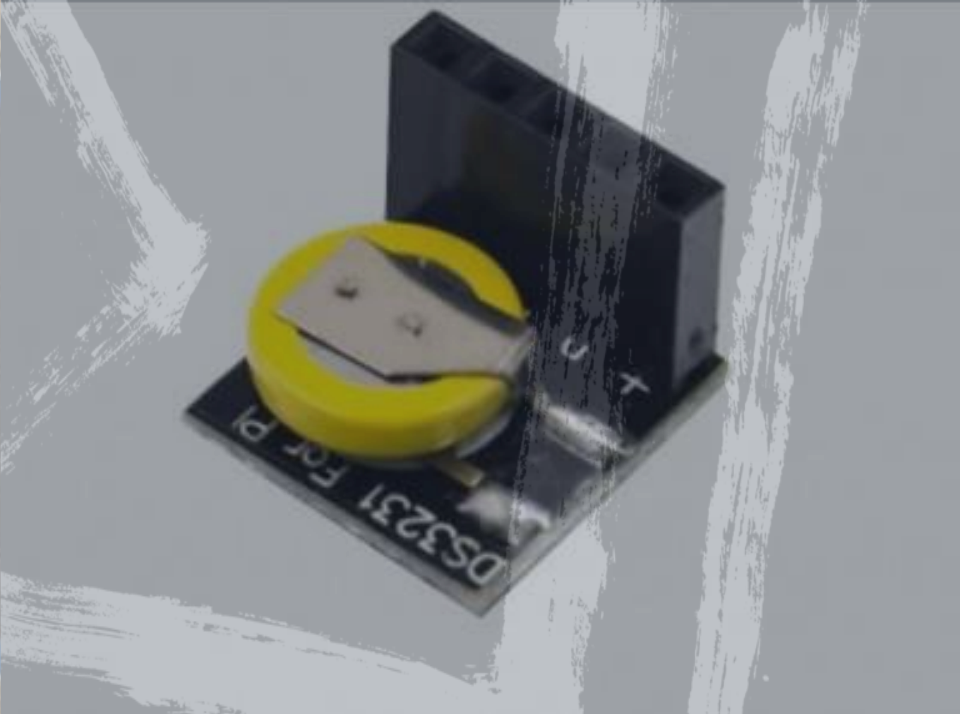
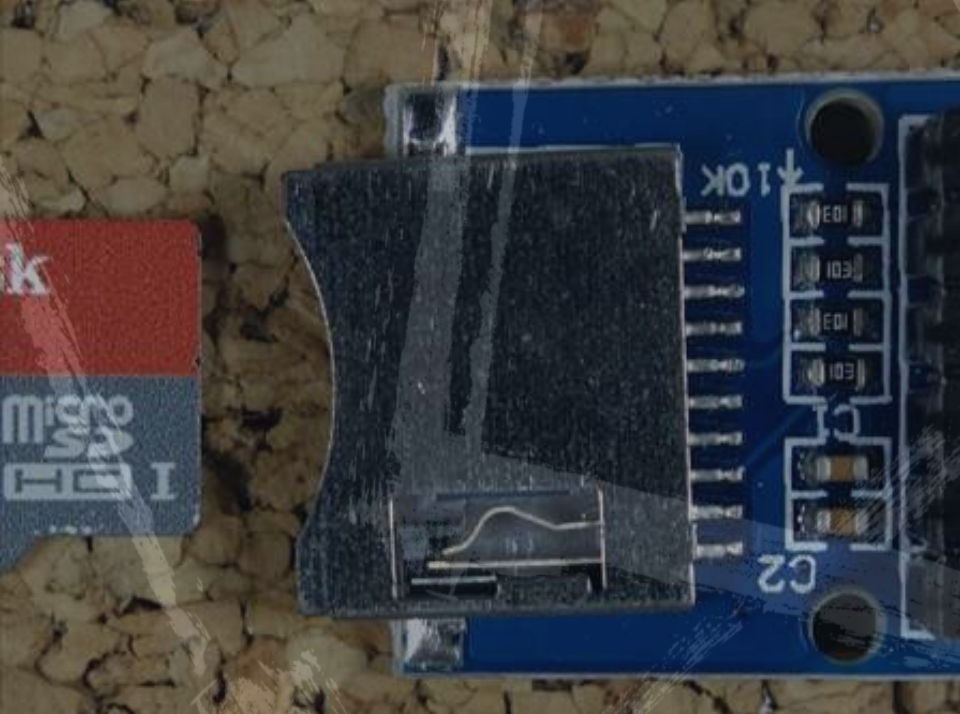
- Lesson 2.23
- L293D datasheet, Motor drivers
- PWM (speed control), potentiometer control
- Direction control
- DC power supply for higher current



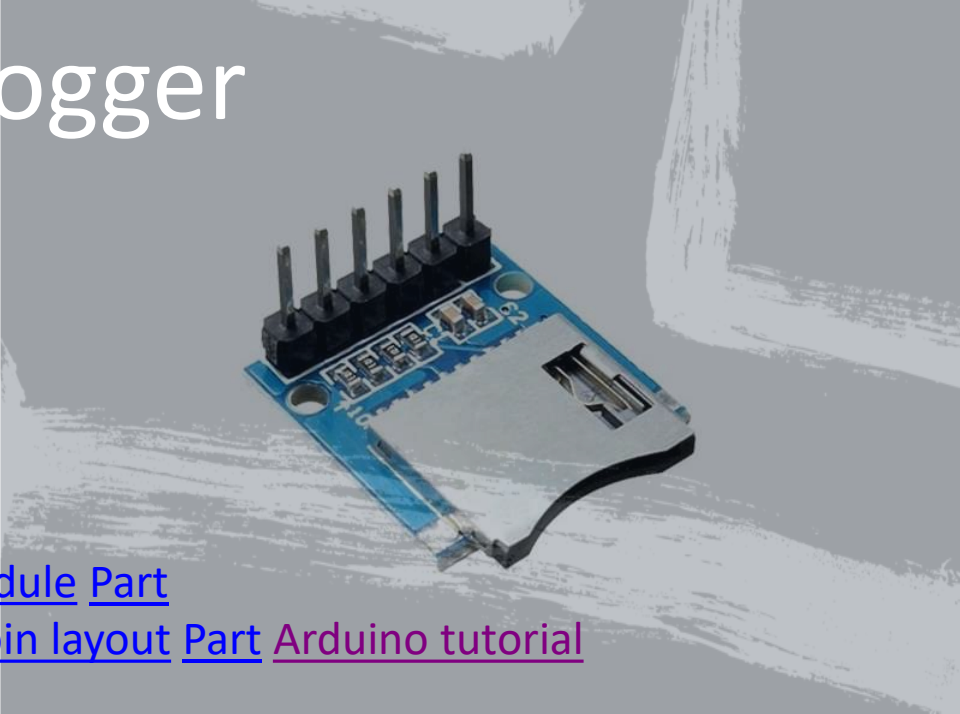
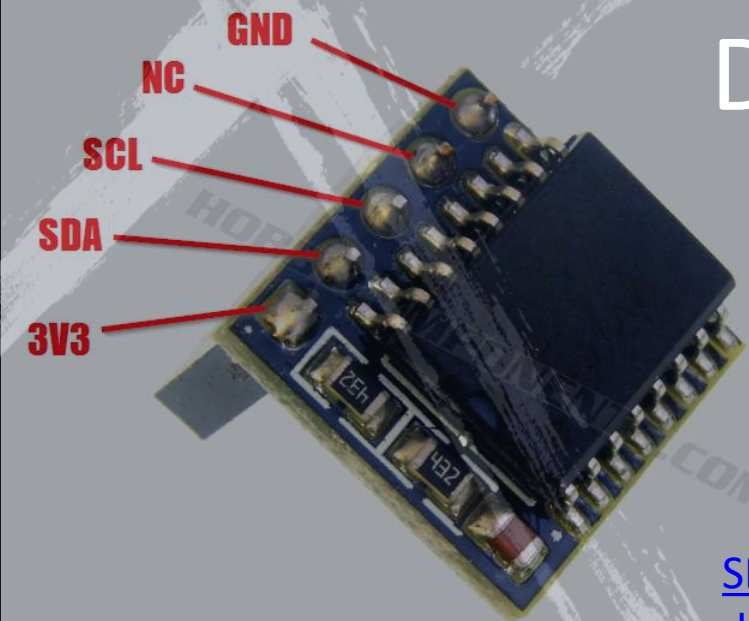
MOSFET module

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 LCD 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 an input and 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 LCD 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](#)/screenshots showing the interaction between the input and the output devices. Please also upload the codes used.

Assignment due on September 26th.