



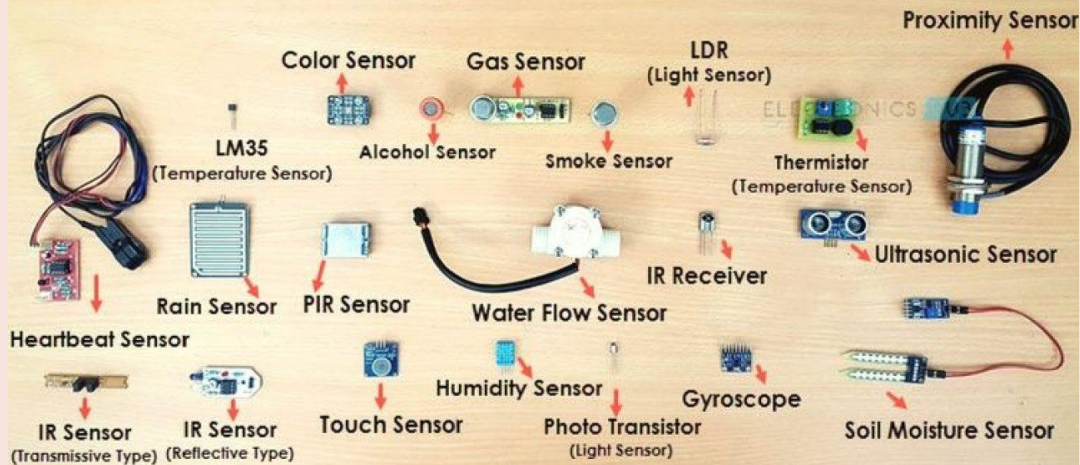
Special Topics in Design I
(Prototyping in IOT)
DSL 810

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

17th February 2020

Input Devices

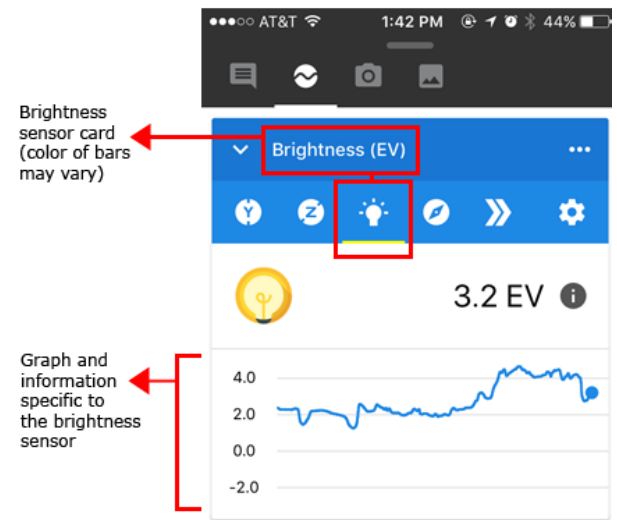
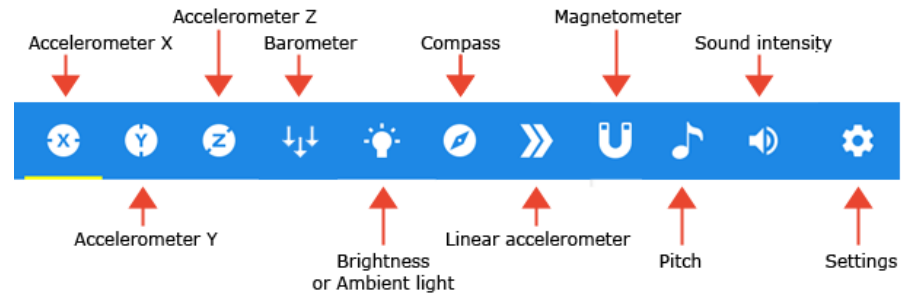
DIFFERENT TYPES OF SENSORS



- [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](#)

Google Science Journal App

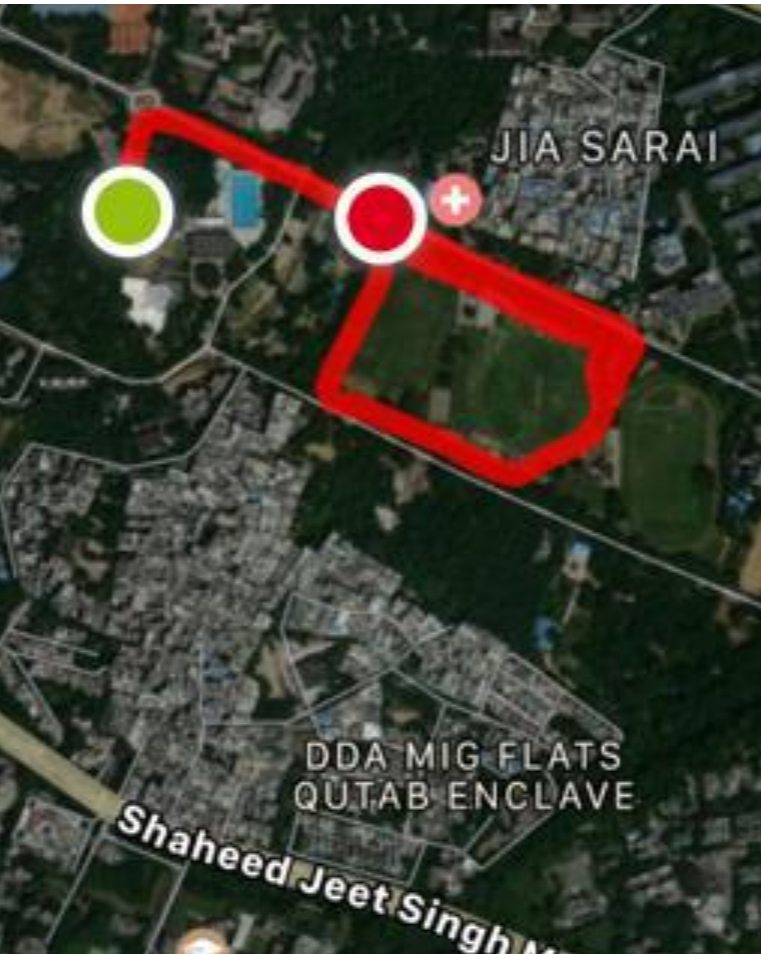
Sensors in your phone

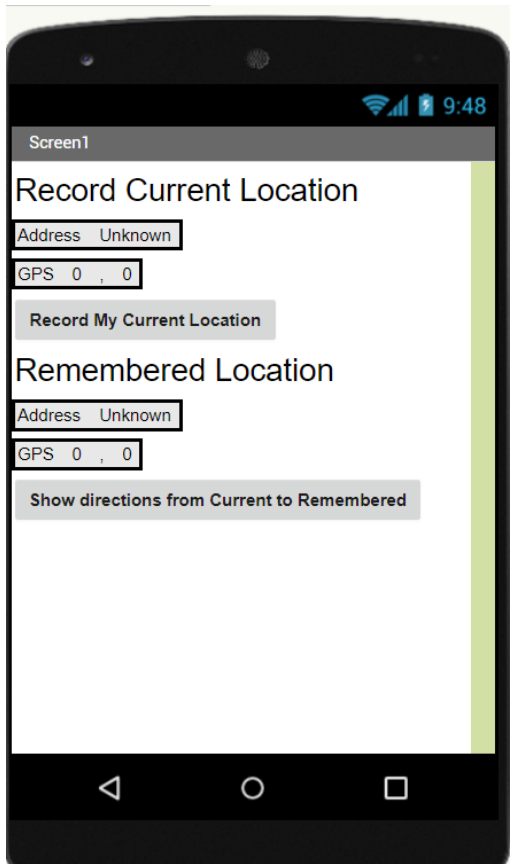




Map My Ride GPS Cycling Riding

MapMyFitness, Inc. Health & Fitness





GPS Visualizer: Do-It-Yourself Mapping

GPS Visualizer is an online utility that creates maps and profiles for powerful and extremely customizable. Input can be in the form of addresses, or simple coordinates. Use it to see where you've been geographic data (scientific observations, events, business locator

Get started now!

Upload a GPS file: sensod...3.csv

Choose an output format:

To set more options:

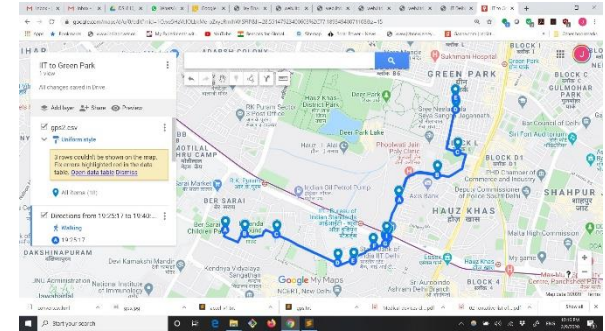
[Google Maps](#) /

[Google Earth KML](#)

[JPEG/PNG/SVG](#)

[Plot data points](#)

[Profiles \(elevation\)](#)



- Convert txt to csv and then [csv to kml](#)
- Use GPS Visualizer, My maps from google

Mobile App with GPS



Design solutions for Mobile phones

- Mobile apps, add-ons to connect digital and physical worlds
- [Thermal imaging attachment for smart phone](#)



[DIY Smart Phone Spectrometer using CD as diffraction grating](#)



Innovating for billions

NETRA

Near Eye Tool for Refractive Assessment



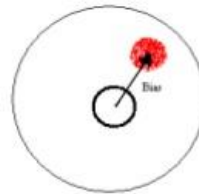
Vitor Pamplona, Ankit Mohan, Manuel Oliveira, Ramesh Raskar SIGGRAPH 2010

- 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](#)

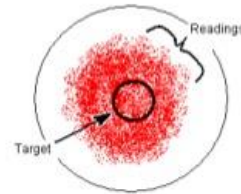
Sensor features

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

Accuracy vs. Precision



Precision without accuracy



Accuracy without precision

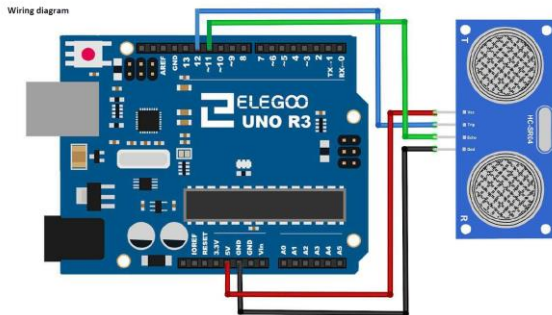


Precision and accuracy



Distance Measurement

- Ultrasonic sensor module (Lesson 10)
- Read datasheet (2 cm- 400 cm range)
- Lesson 1 (install library)
- Reading library
- Smart cane, other applications





4X4 Keypad module

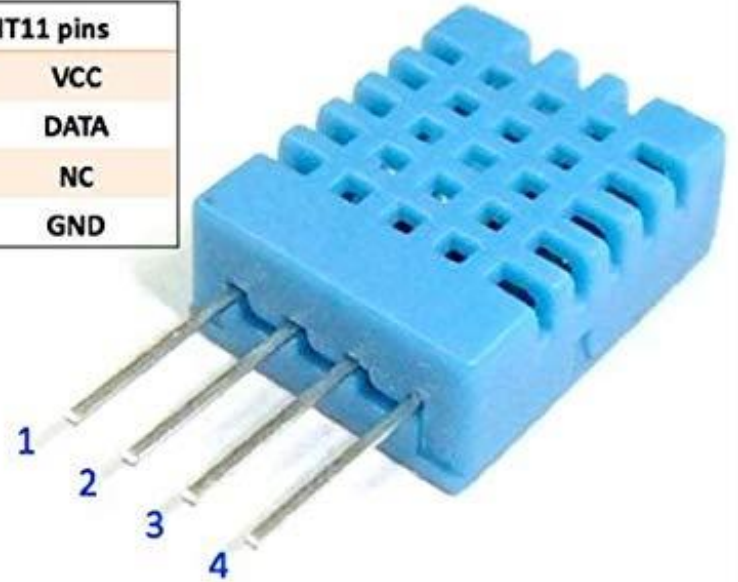
- Lesson 11
- Applications: cell phones, ovens, door locks, keyboards



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 12)
- 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

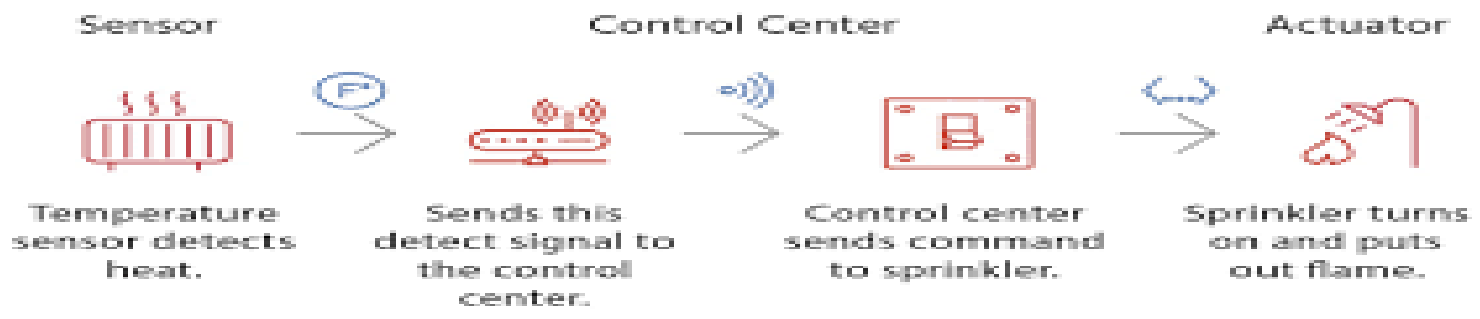
~10 mA: shock,
contraction

~100 mA:
fibrillation

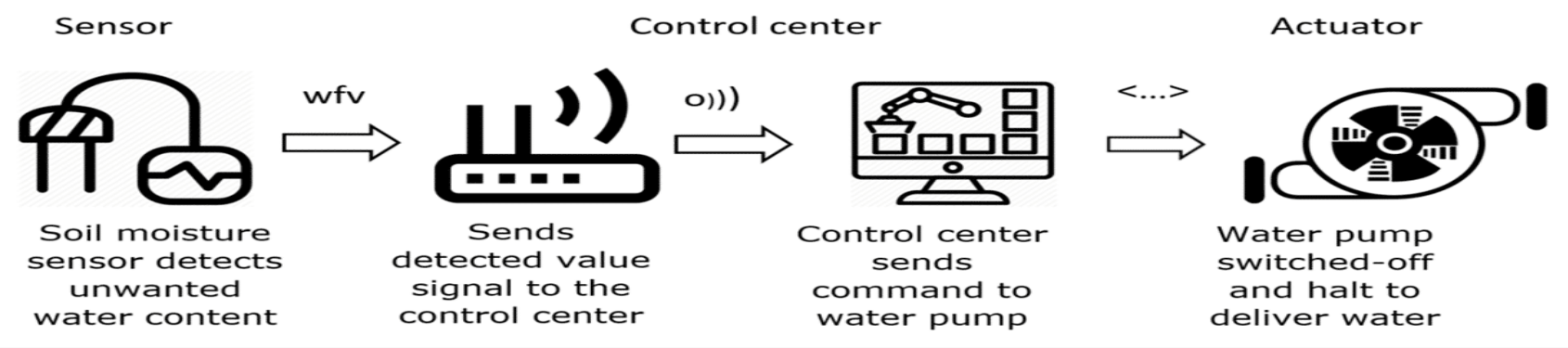
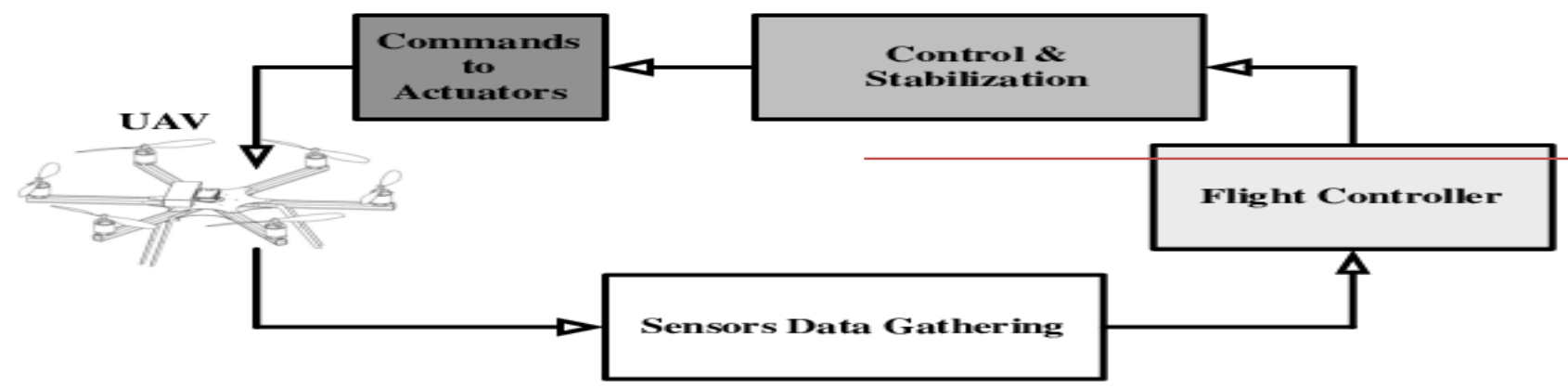
- body: M ohm
external, k
ohm internal

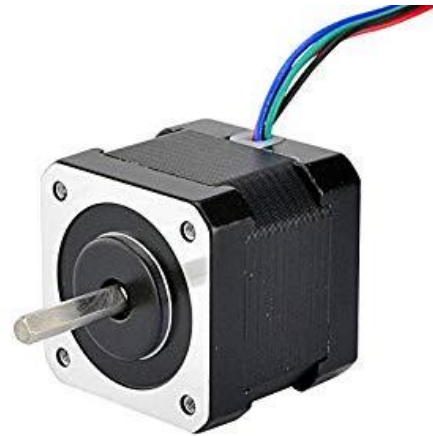


“Don’t touch him! He’s a conductor.”



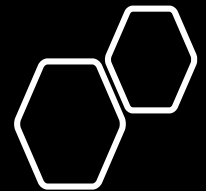
Sensor to Actuator Flow





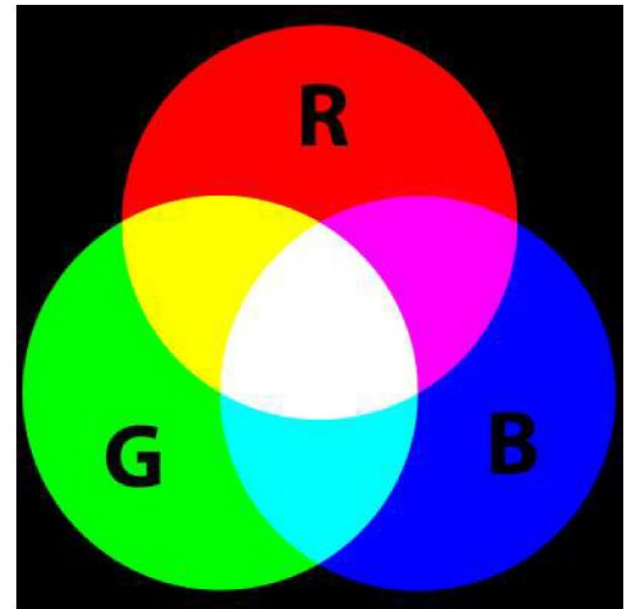
Output Devices

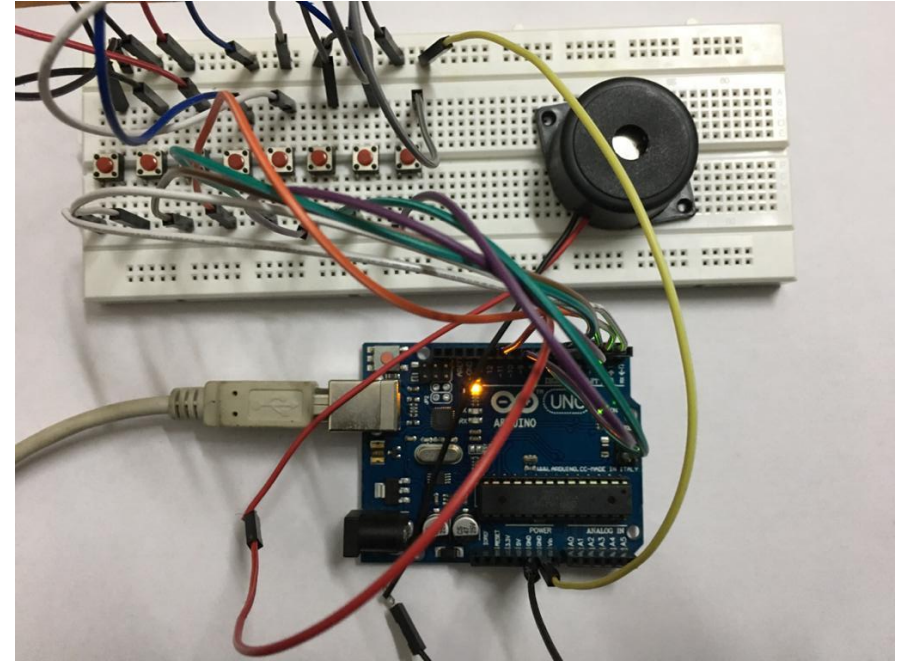
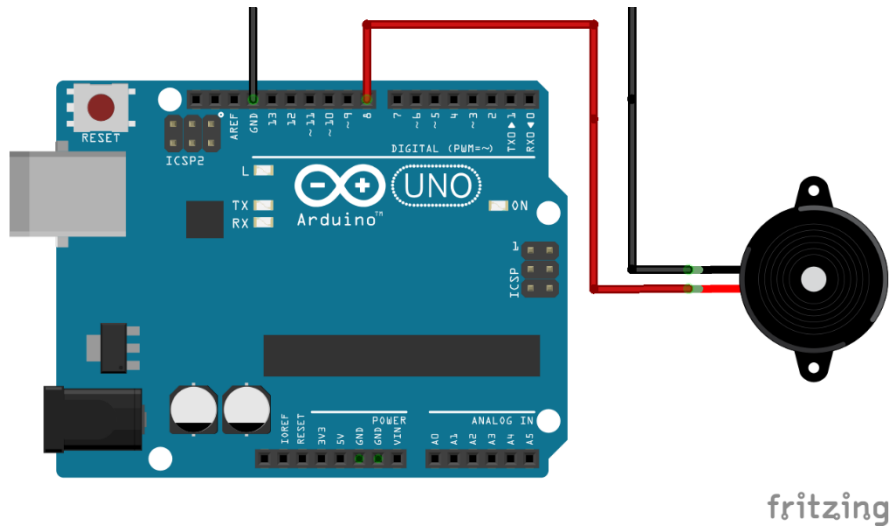
- LEDs, Displays, Speakers/ Buzzers, DC/Servo/Stepper Motors, Relays, Dataloggers



RGB LED

- PWM with RGB LED with common anode (Lesson 4). NOTE: Longest leg of RGB LED goes to 5V pin.
- [RGB basic RGB favorite color Interfacing with Arduino and Processing](#)



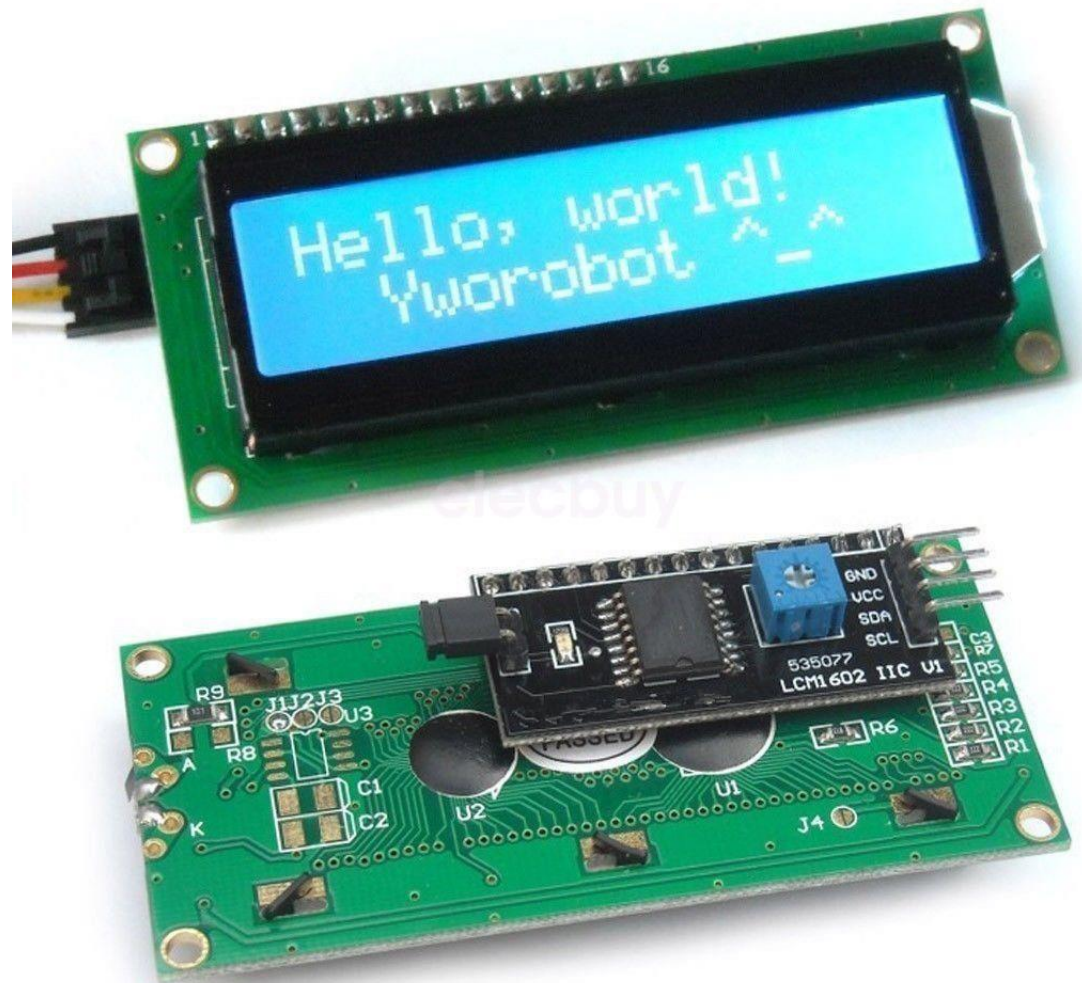


[Basic musical instrument Music Player with Processing Interface](#)

Piezo buzzer (Lesson 7)

LCD display

- Lesson 22 (i2c)
 - Adjusting contrast with a screwdriver.
 - Connections:
SDA pin to A4 (Uno)
SCL pin to A5 (Uno)
- [Arduino code](#)
- Other examples



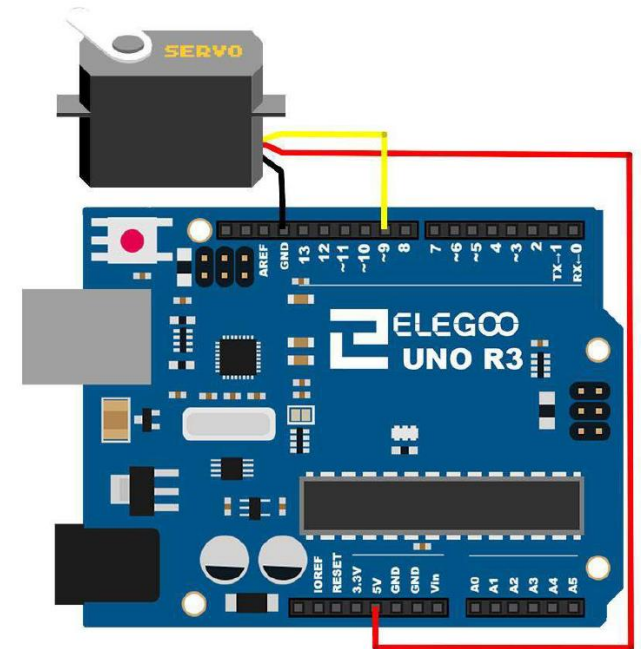
Stepper Motor



- [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 31, Examples

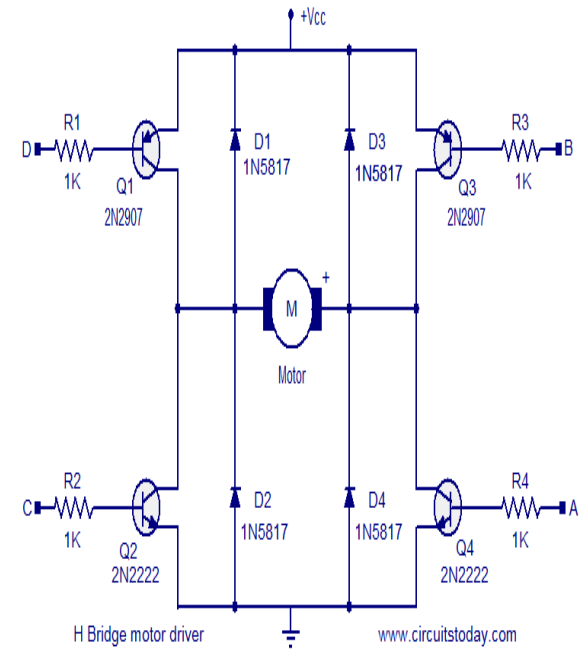
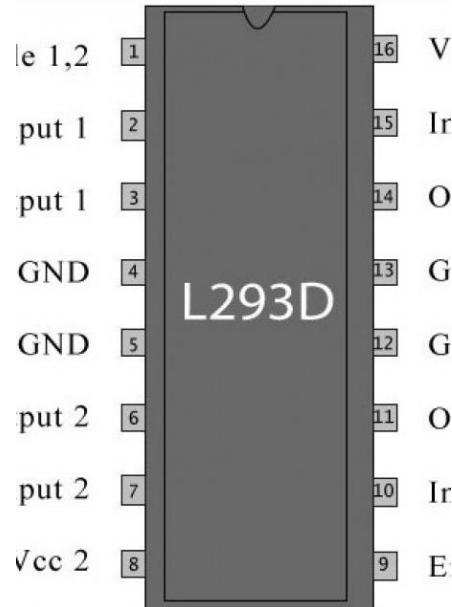
Servo Motor

- Rotate 180 degrees
- SG90, Datasheet
- Lesson 9
- Applications: pen lift mechanism for XY plotter
- Potentiometer example – [Gouri's project](#)



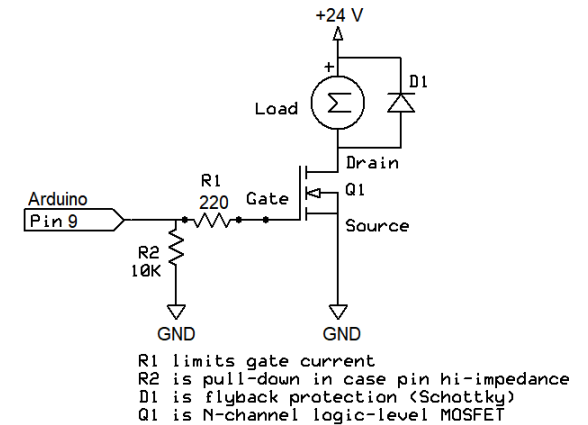
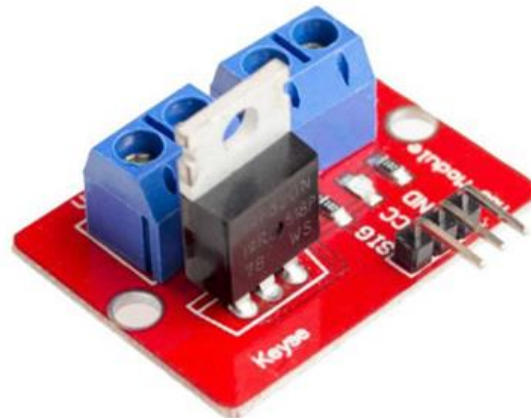
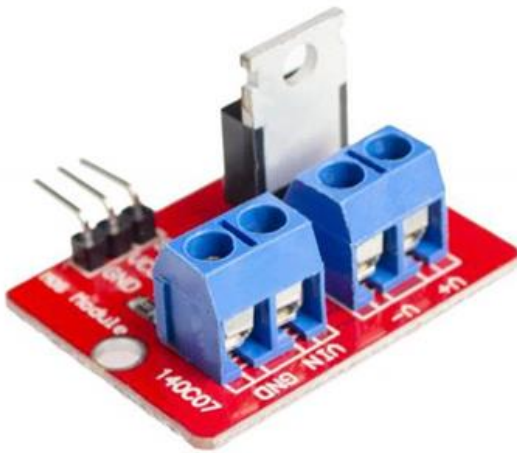


3-6 V DC Motor



DC motor control

- Lesson 29
- 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

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 March 5th.

Announcements



- Reschedule 27th February class to 4th March 6:30 pm to 8 pm?
- We would discuss about the components that you need to buy for your projects on Monday.
- Please take good care of the electronics so that they are in working condition for the students learning this content later. Thanks!