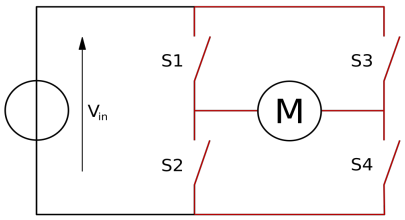
1. Literature survey:

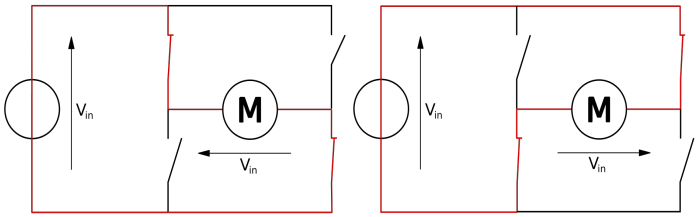
*[1]_ **H-Bridge:**

H-bridge is an electronic circuit that is used to drive the wheels (DC motors) of Shodak. Basically, H-Bridge is a combination of 4 switches namely S1, S2, S3, S4. The structure of the H-Bridge is as follows:



H-bridge

Structure of the H-Bridge



Symbolic representation of switching off and switching on S3 and S2

Operation of H-Bridge:

There are 4 switches in the H-Bridge. Therefore, 16 cases of operation are possible.

S1	S2	S3	S4	Inference
0	0	0	0	Motor Runs
0	0	0	1	Motor Runs
0	0	1	0	Motor Runs
0	0	1	1	Short Circuited
0	1	0	0	Motor Runs
0	1	0	1	Motor Brakes
0	1	1	0	Motor moves left
0	1	1	1	Short circuited
1	0	0	0	Motor Runs
1	0	0	1	Motor turns right
1	0	1	0	Motor Brakes
1	0	1	1	Short Circuited
1	1	0	0	Short Circuited
1	1	0	1	Short Circuited
1	1	1	0	Short Circuited

1	1	1	1	Short Circuited

From the above table, it is clear that whatever maybe the condition of the switches S3 and S4, if S1 and S2 are HIGH,it is short circuited and whatever maybe the condition of the switches S1 and S2, if S3 and S4 are HIGH, then also it is short circuited. There fore, the above table can be summarized as follows:

S1	**S2**	**S3**	**S4**	**Inference**
1	0	0	0	Motor runs
0	1	0	0	Motor runs
0	0	1	0	Motor runs
0	0	0	1	Motor runs
0	0	0	0	Motor runs
0	1	1	0	Motor turns Left
1	0	0	1	Motor turns Right
0	1	0	1	Motor Brake
1	0	1	0	Motor Brake
x	x	1	1	Short Circuited
1	1	x	x	Short Circuited

***[2]_L298N motor driver module:**

L298N motor driver module is used for driving high power DC motors using dual H-bridge motor driver. It is a combination of L298 IC and a 5V 78M05 regulator.

L298N module can perform directional control and speed control for up-to 2 DC motors.
A heat sink is mounted on L298 IC.

L298N Module Pin Configuration:

S. No	Pin	Description
1	ENA	ENA stands for *Enable A*. It is used for setting the speed of motor A. It's a PWM pin.
2	ENB	ENB stands for *Enable* B. It is used for setting the speed of motor B. It's a PWM pin.
3	IN1 & IN2	IN stands for *Input*. Input is fetched from the controller. Accordingly motor A's movement is set.
4	IN3 & IN4	IN stands for *Input*. Input is fetched from the controller. Accordingly motor B's movement is set.

5	OUT1 & OUT2	OUT stands for *Output*. According to the input received from ENA, IN1 and IN2, the output pin is set for the motor A's movement.
6	OUT3 & OUT4	OUT stands for *Output*. According to the input received from ENB, IN3 and IN4, the output pin is set for the motor B's movement.
7	12V	DC Power Supply to both the motors is taken from this 12V.
8	GND	GND stands for *Ground*.

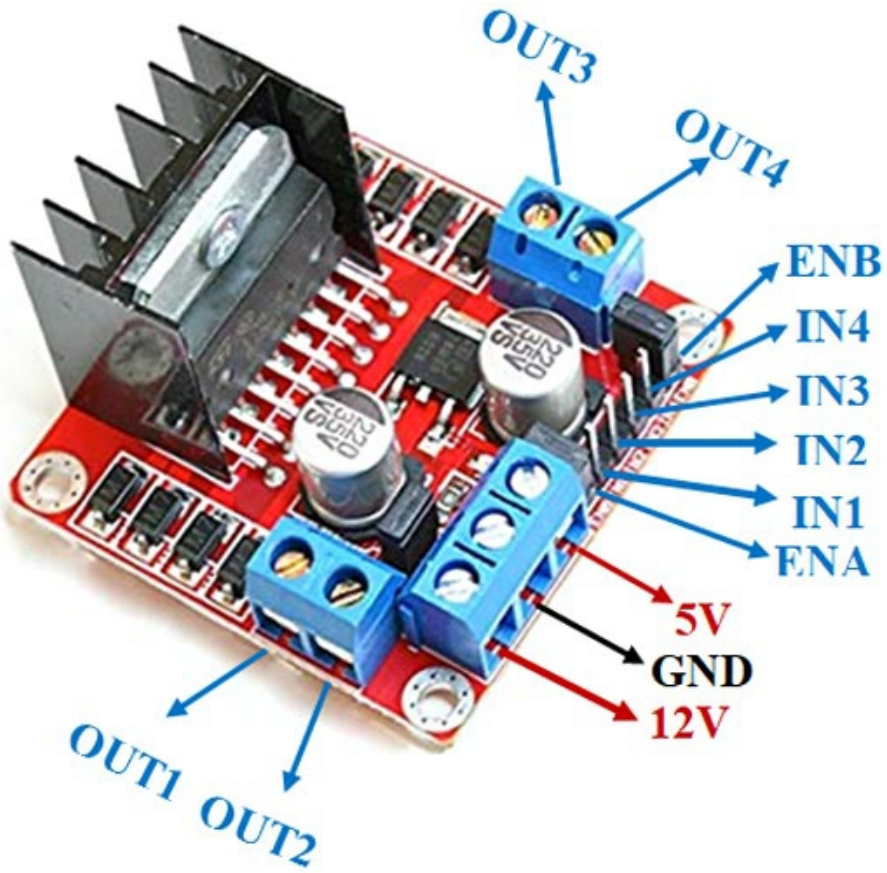


Image src:Motor_Driver_shodak_doc

[3]_Sensors:

(I) IR Sensor:

IR sensor is an infrared sensor that has an LM358 Op amp,variable resistor, IR receiver and transmitter. When no object blocks the IR transmitter and the receiver, the comparator's output will be LOW and the output LED doesn't glow indicating that nothing is there. When there is some object that is blocking the light of the IR transmitter and receiver, photodiode(Receiver)'s series resistor voltage drops meaning that the threshold voltage will be nothing bu the HIGH output of the Op amp. The Op amp basically acts like a voltage comparator in the IR sensor. The comparator will compare the threshold voltage using the IR receiver and transmitter.

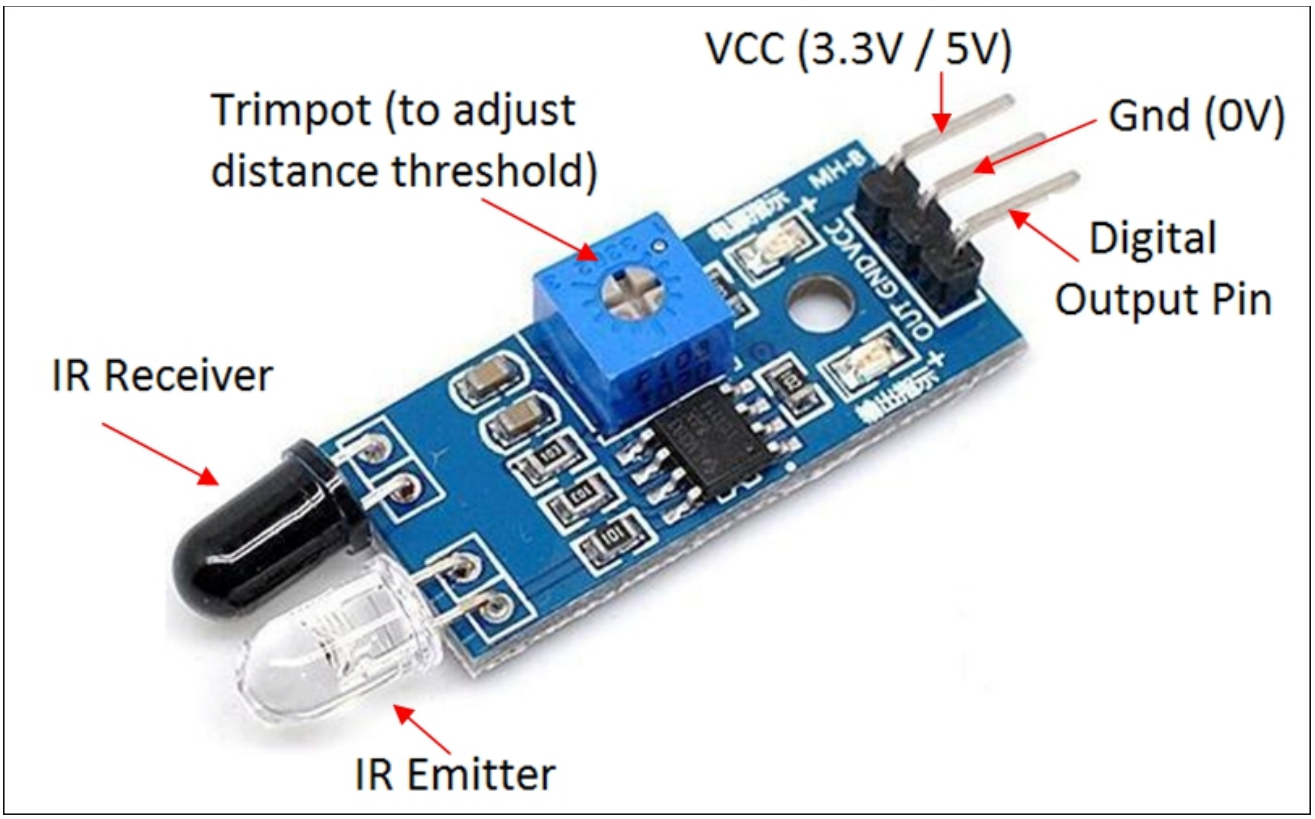


Image Source: IR_Sensor

(II) **Ultrasonic Sensor:**

Ultrasonic Sensor is based on sending and receiving the same signal. When there is an obstacle, the transmitted sound signal will hit the obstacle and the signal will travel back as an echo to the sensor. With this principle, we can calculate the distance of the obstacle.

We also know that, speed = distance * time

as we are sending sound wave,

the speed of sound in air = 340m/s = 34000cm/sec = 34000/1000000 cm/µsec

=> distance = time * 34000cm/sec

Now, the time we obtain is the time required to send the trigger and receive the echo. This implies that, the time we get is twice that of the trigger time.

Therefore, time = obtained_time/2

=> **distance_in_cm** = (time/2) *(34000 /1000000)

= (time/2)/29.4

The pinout diagram for HC-SR04-Ultrasonic Range Finder:

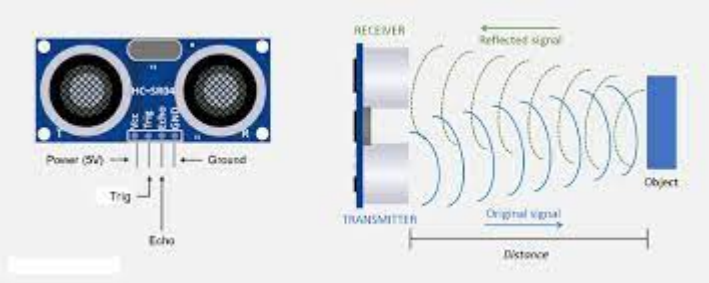


Image Source: https://osoyoo.com/wp-content/uploads/2018/09/hc-sr04.png

Sensor Shield V5 Expansion Board:

It is difficult to provide the power supply to more than one sensor application as there is only 1 5V power supply out port in Arduino Uno. To supply/support more than 1 sensor at a time, we can use a breadboard as well. It is often not a good practice to use breadboards for a mobile applications as there are high chances for disconnection of wires. Sensor Shield Expansion board offers power supply and GND option for all the 14 digital pins as well as for 6 analog pins. It also provides RB URF v1.1 ultrasonic sensor interface, servo controller interface, Bluetooth module communication interface, SD card module communication interface and LCD display interface.

The pin out diagram for the Sensor Shield V5 Expansion Board is as follows:

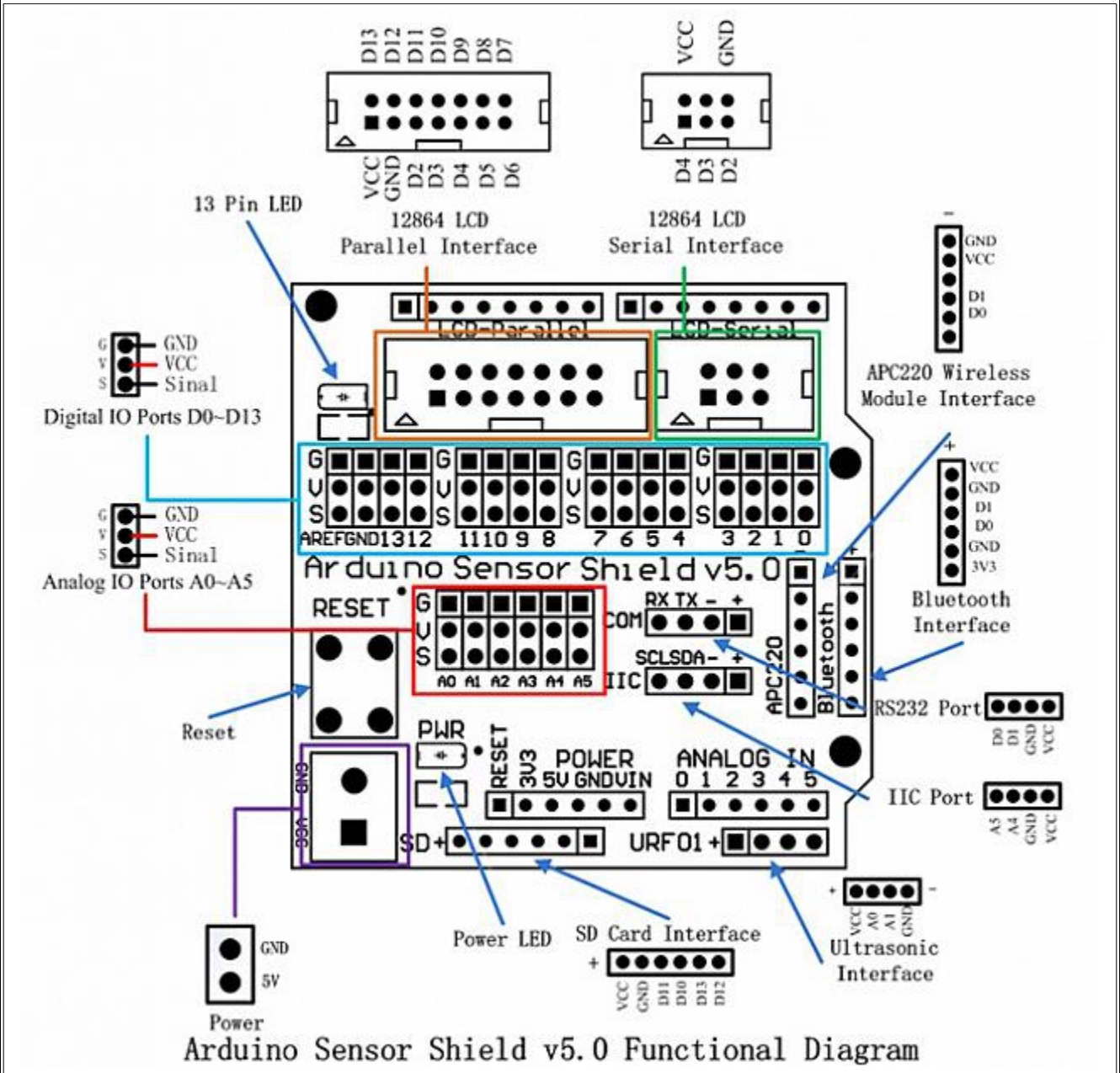


Image Source: [Sensor_shield_expansion board]

References:

[1] https://en.wikipedia.org/wiki/H-bridge
[2] https://create.arduino.cc/projecthub/ryanchan/how-to-use-the-l298n-motor-driver-b124c5
[3] https://components101.com/sensors/ir-sensor-module