

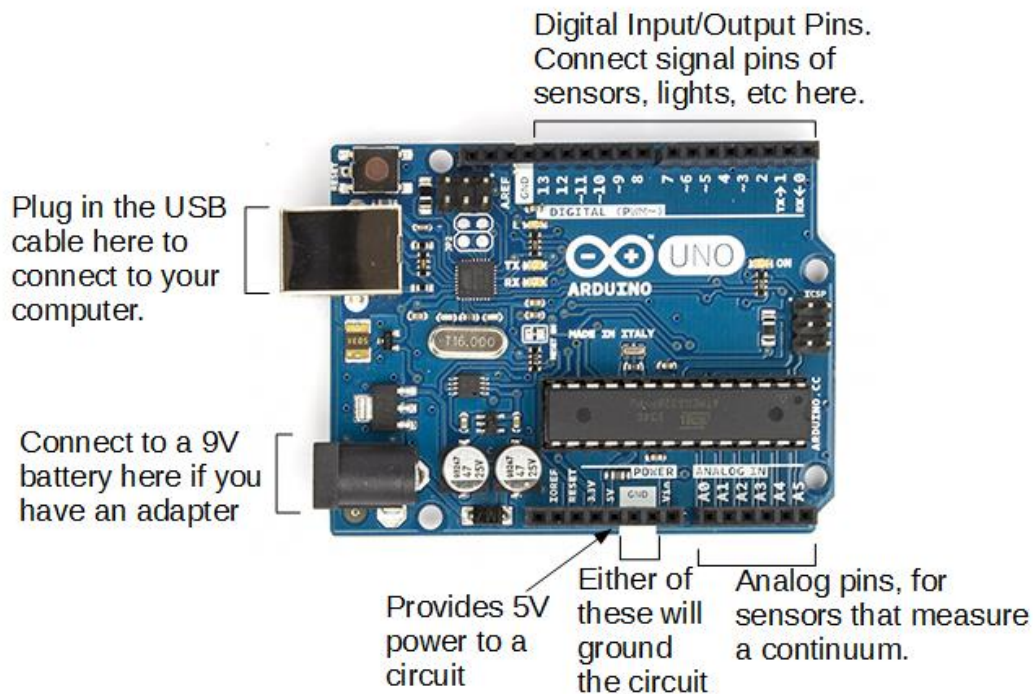
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# Arduino UNO

## Summary

<b>Microcontroller</b>	ATmega328
<b>Operating Voltage</b>	5V
<b>Input Voltage (recommended)</b>	7-12V
<b>Input Voltage (limits)</b>	6-20V
<b>Digital I/O Pins</b>	14 (of which 6 provide PWM output)
<b>Analog Input Pins</b>	6
<b>DC Current per I/O Pin</b>	40 mA
<b>DC Current for 3.3V Pin</b>	50 mA
<b>Flash Memory</b>	32 KB (ATmega328) of which 0.5 KB used by bootloader
<b>SRAM</b>	2 KB (ATmega328)
<b>EEPROM</b>	1 KB (ATmega328)
<b>Clock Speed</b>	16 MHz



# Syntax examples

C language syntax	Description	Arduino syntax	Description
<b>Initializing</b>			
int a;	Initializing integers.	pinMode(13,OUTPUT);	Set pin 13 to output.
int a=0;		pinMode(13,INPUT);	Set pin 13 to input.
char a;	Initializing characters.	digitalWrite(13,LOW/HIGH);	Turn pin 13 to 1or 0.
char a='A';		digitalRead(13);	Read pin 13's value either 1 or 0.
char a[10];	Initializing array.	analogWrite(3,250);	Write PWM on pin 4 with 0-255 level.
char a[5]={'a','b','c'};		analogRead(A0);	Read analog value at "A0", between 0-1023.
<b>Arithmetic operators</b>		delay(1000);	Wait for 1 sec before executing next statement.
a++;	Add 1 in "a".	delayMicroseconds(10);	Wait for 10 us before executing next statement.
a=a+1;	Add 1 in "a".	Serial.begin(9600);	Initialize serial monitor.
a=a+b;	Store sum in "a".	Serial.print("abc");	Print "abc" on serial monitor.
a--;	Subt. 1 from "a".	Serial.println("abc");	Same as above syntax but jumps to next line.
a=a-1;	Subt. 1 from "a".		
a=a-b;	Store diff. in "a".		
a=b*c;	Store product in "a".		
a=b/c;	Store division in "a".		
a=b%c;	Store remndr. in "a".		
<b>comparison operator</b>			
a==b;	Equal.		
a!=b;	Not equal.		
a<b;	Less than.		
a>b;	Greater than		
a<=b;	Less than equal to		
a>=b;	Greater than equal to		
<b>loops</b>			
for(i=0;i<15;i++) { //statements }	Execute statement 15 times.		
while(a>b) { //statement }	Execute repeatedly until condition is true.		
<b>If/else</b>			
If(a==b) { //statements } else { //statement }	Execute until condition is true, Otherwise execute "else"(optional).		

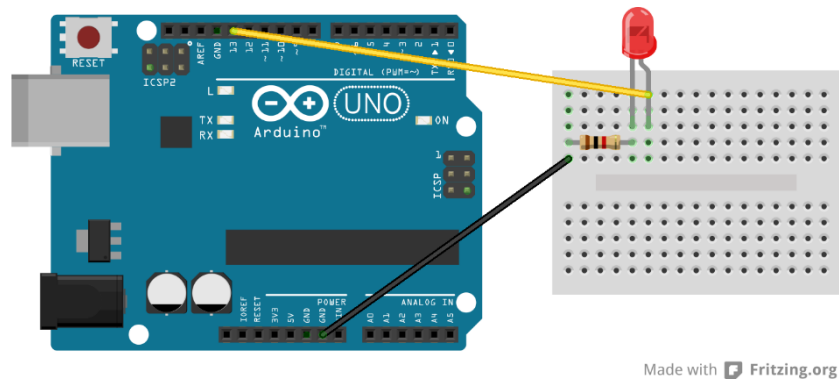
## PRACTICALS

### Practical 1

Object: to learn the function of digitalWrite() with a LED.

#### Circuit:

- use 1k ohm resistor in series with LED.



S NO.	ALGORITHM	PROGRAM
1	//set pin 13 as output	void setup()
		{
		pinMode(13,OUTPUT);
2	//turn on the led	}
		void loop()
		{
3	//wait for 500ms	digitalWrite(13,HIGH);
4	//turn off the led	delay(500);
5	//wait for 500ms	digitalWrite(13,LOW);
		delay(500);
		}

Task 1: make one way traffic signal to control the traffic.

Hint: use 3 leds(red,green,yellow), connect each to a different output.

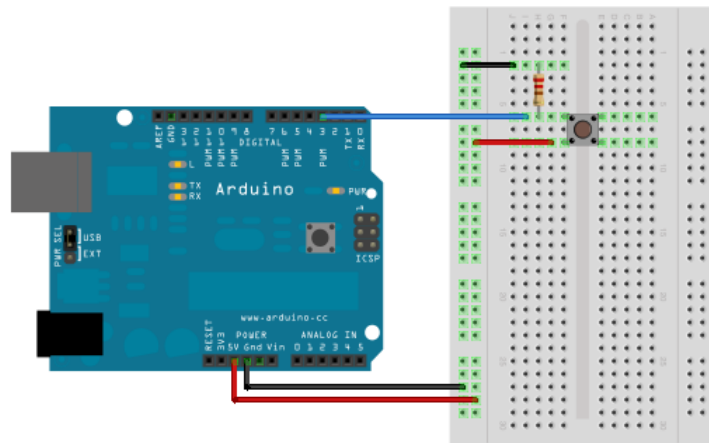
Task 2 : show 0-9 no.s on 7-segment display.

## Practical 2

Object: to learn the function of digitalWrite() with a switch.

### Circuit:

- use 10K ohm resistor to ground the switch.



S NO.	ALGORITHM	PROGRAM
1	//integer to store switch state	int a=0;
		void setup()
		{
2	//set pin 3 as input	pinMode(3,INPUT);
	//set pin 13 as output	pinMode(13,OUTPUT);
		}
		void loop()
		{
3	//store switch state in "a"	a=digitalRead(3);
4	//check for switch condition	if(a==1)
		{digitalWrite(13,HIGH);}
5	//otherwise	Else
		{digitalWrite(13,LOW);}
		}

Task: use 2 leds, control them through switch in such a way that one is "onn" and other is "off" at "high" state. similarly alter the condition for "low" state.

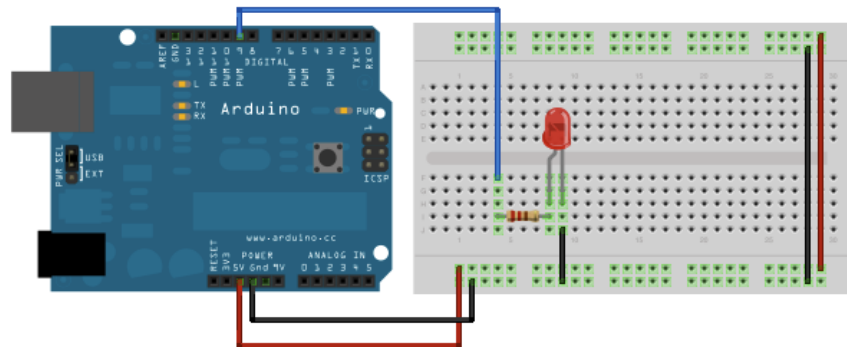
Hint: set one to "high" and other to "low" in very next line.

### Practical 3

Object: to learn the function of analogWrite() with a LED.

#### Circuit:

- use 1k ohm resistor in series with LED.



S NO.	ALGORITHM	PROGRAM
		void setup()
		{
1	//set pin 9 as output	pinMode(9,OUTPUT);
		}
		void loop()
		{
2	//turn on the led with 50 level	analogWrite(9,50);
3	//wait for 500ms	delay(500);
4	//turn on the led with 255 level	analogWrite(9,255);
5	//wait for 500ms	delay(500);
		}

Task: glow led in such a manner that level start from 0 and go to 255 Using “for loop”.

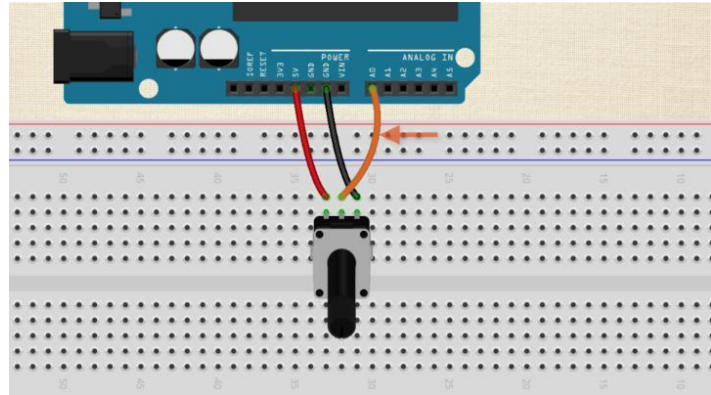
Hint: set loop from 0 to 255 and use loop integer in place of constant level value.

## Practical 4

Object: to learn the function of analogRead() with a VR.

### Circuit:

- use 10K ohm VR
- Extream legs are for vcc and ground
- Connect mid leg to "A0" pin of Arduino.



S NO.	ALGORITHM	PROGRAM
1	//integer to store VR value	int a=0;
		void setup()
		{
2	//set pin 13 as output	pinMode(13,OUTPUT);
3	//initialize serial monitor	Serial.begin(9600);
		}
		void loop()
		{
4	//store VR value in "a"	a=analogRead(A0);
5	//print value of "a" on screen	Serial.println(a);
6	//check for VR condition	if(a>500)
		{digitalWrite(13,HIGH);}
7	//otherwise	Else
		{digitalWrite(13,LOW);}
		}

Task: control led brightness through VR.

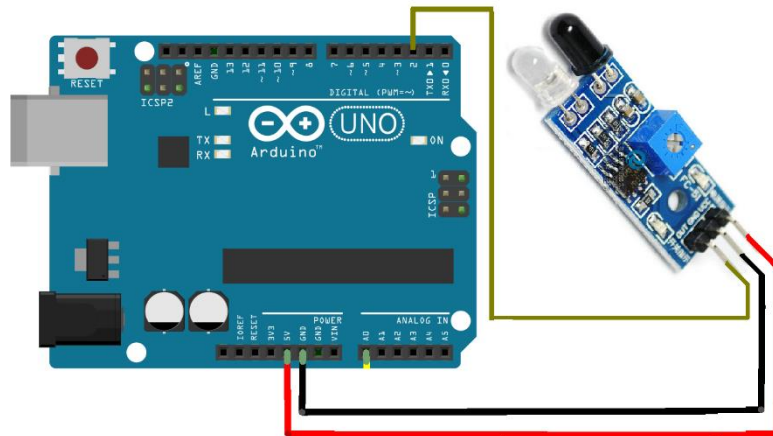
Hint: simply use "a" value in analogWrite().

## Practical 5

Object: to display the readings of IR sensor on serial monitor.

### Circuit:

- Connect signal pin to pin 2 of Arduino.



S NO.	ALGORITHM	PROGRAM
1	//integer to store VR value	int a=0;
		void setup()
		{
2	//initialize serial	Serial.begin(9600);
		}
		void loop()
		{
3	//store VR value in "a"	a=digitalRead(2);
4	//print value of "a" on screen	Serial.println(a);
		}

Task: turn on the led when detects any object.

Hint: use if / else

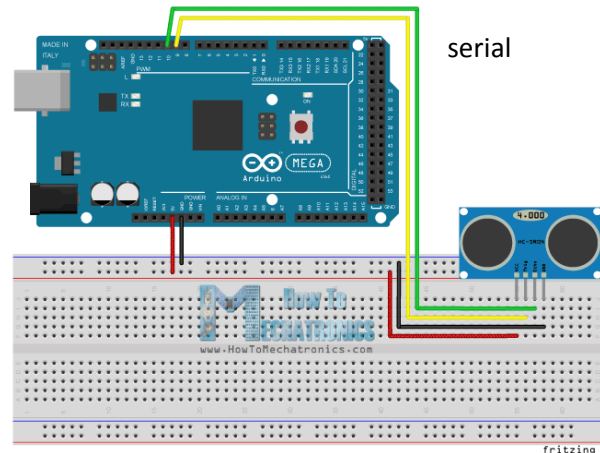


**Practical 6**

Object: to display the readings of ultrasonic sensor on monitor.

**Circuit:**

- Connect trigger pin to pin 9 of Arduino.
- Connect echo pin to pin 10 of Arduino.



S NO.	ALGORITHM	PROGRAM
1	//long int to store time	long duration;
2	// int to store distance calculated	int distance;
		void setup()
		{
3	//set pin 9 to output	pinMode(9,OUTPUT);
4	//set pin 10 to input	pinMode(10,INPUT);
5	//initialize serial	Serial.begin(9600);
		}
		void loop()
		{
6	//turn pin 9 to low	digitalWrite(9,LOW);
7	//wait for 2 micro sec	delayMicroseconds(2);
8	//turn pin 9 to high	digitalWrite(9,HIGH);
9	//wait for 10 micro sec	delayMicroseconds(10);
10	//turn pin 9 to low	digitalWrite(9,LOW);
11	//store received value in duration	duration= pulseIn(10, HIGH);
12	//conversion	distance=duration*0.034/2;
13	//print value of distance on screen	Serial.print(distance);
14	//print "cm" after value	Serial.println(" cm");
		}

Task: turn on LED when distance is less than 20cm.

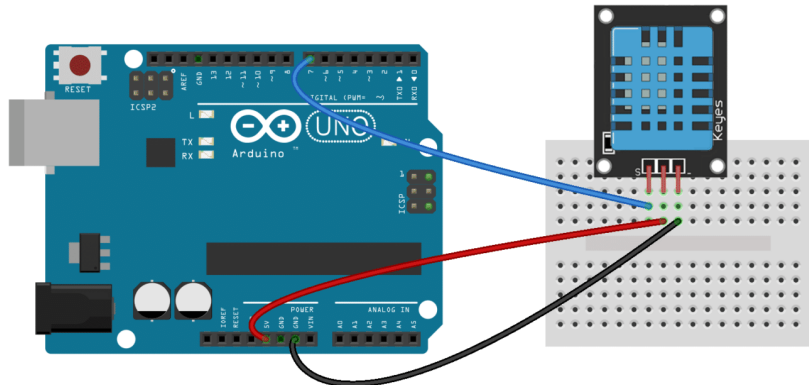
Hint: use if/else.

## Practical 7

Object: to display the readings of DHT11 sensor on serial monitor.

### Circuit:

- Connect signal pin to pin 7 of Arduino.



S NO.	ALGORITHM	PROGRAM
1	//include dht library	#include <dht.h>
2	//declare dht	dht DHT;
3	//sig pin connected to 7	#define DHT11_PIN 7
		void setup()
		{
4	//initialize serial	Serial.begin(9600);
		}
		void loop()
		{
5	//read values from sensor	int chk = DHT.read11(DHT11_PIN);
		Serial.print("temp = ");
6	//print temp value	Serial.println(DHT.temperature);
		Serial.print("humidity = ");
7	//print humidity value	Serial.println(DHT.humidity);
8	//wait for 1 sec	delay(1000);
		}

Task: turn on fan/led when temp is above 40 degree

Hint: if/else

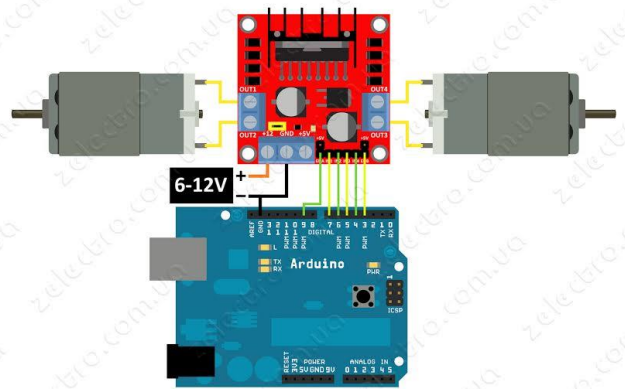
**caution: do not connect any fan directly to Arduino without motor driver !**

## Practical 8

Object: to control a dc motor with suitable driver and vary the speed.

### Circuit:

- Connect "EnA" with pin 9 of Arduino.
- Connect "1" to pin 7 of Arduino.
- Connect "2" to pin 6 of Arduino.



S NO.	ALGORITHM	PROGRAM
		void setup()
		{
1	//set pin 6 to output	pinMode(6,OUTPUT);
2	//set pin 7 to output	pinMode(7,OUTPUT);
3	//set pin 9 to output	pinMode(9,OUTPUT);
		}
		void loop()
		{
4	//turn pin 6 to low	digitalWrite(6,LOW);
5	//turn pin 7 to high	digitalWrite(7,HIGH);
6	//control pwm/speed on pin 9	analogWrite(9,100);
		}

Task: now operate both motors by using EnB pin also.

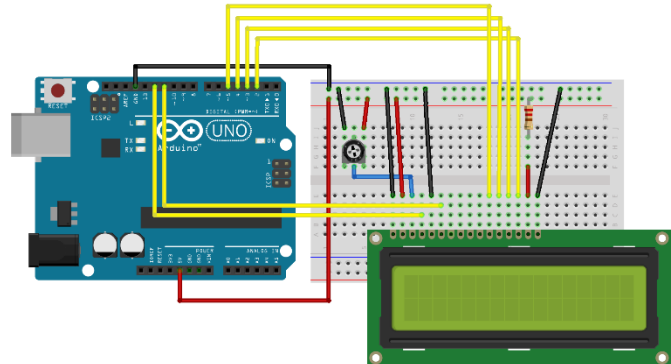
Hint: same work for another motor just change pin no.s .

## Practical 9

Object: write your name and roll no. on 16x2 lcd.

### Circuit:

- LCD RS pin to digital pin 12
- LCD Enable pin to digital pin 11
- LCD D4 pin to digital pin 5
- LCD D5 pin to digital pin 4
- LCD D6 pin to digital pin 3
- LCD D7 pin to digital pin 2



S NO.	ALGORITHM	PROGRAM
1	//include lcd library	#include <LiquidCrystal.h>
2	//defining pins	LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
		void setup()
		{
3	// lcd size	lcd.begin(16,2);
4	//print name on lcd	lcd.print("Hassam Mohiuddin");
5	//set cursor to column=1, row=2	lcd.setCursor(0,1);
6	//print roll no. on lcd	lcd.print("Roll # EL-107);
7	//initialize serial	}
		void loop()
		{
		}

Task: run your name on lcd from right to left. Also practice different lcd syntaxes.

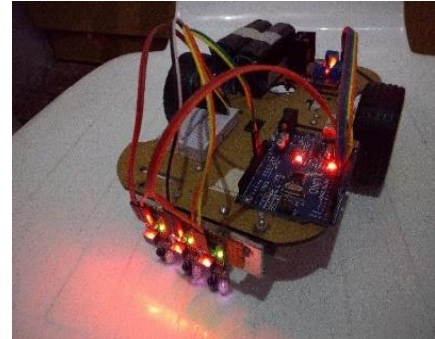
Hint: use lcd.autoscroll();

## EXTRA PROJECTS TO TRY

- Serial monitor interface
- Servo motor control
- Android linkage through bluetooth
- Make counter using IR module and LCD
- Make counter using IR module and 7 segment
- Use relay module
- Gesture switch using IR
- hex keypad interfacing

## Final Project

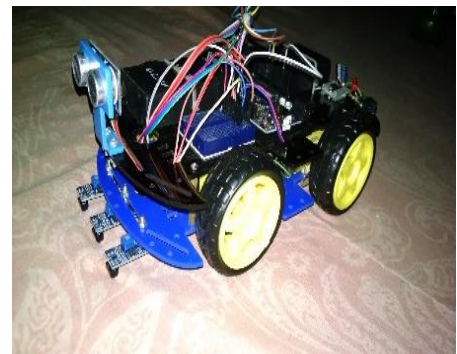
### Line Following Robot



### BT Controlled Android Robot



### LFR + Obstacle avoidance Robot



# REFERENCES

**Download Arduino IDE :**

<https://www.arduino.cc/en/Main/Donate>

**About Arduino uno SMD :**

<https://www.arduino.cc/en/Main/ArduinoBoardUnoSMD>

**Basic Arduino Syntax :**

<https://www.arduino.cc/en/Reference/HomePage>

**C-language Syntax:**

[https://en.wikipedia.org/wiki/Operators\\_in\\_C\\_and\\_C%2B%2B](https://en.wikipedia.org/wiki/Operators_in_C_and_C%2B%2B)

**Class 1 :**

<https://www.arduino.cc/en/Reference/DigitalWrite>

**Class 2 :**

<https://www.arduino.cc/en/Reference/DigitalRead>

**Class 3 :**

<https://www.arduino.cc/en/Reference/AnalogWrite>

**Class 4 :**

<https://www.arduino.cc/en/Reference/AnalogRead>

**Class 5 :**

<http://blog.circuits4you.com/2016/04/arduino-ir-proximity-sensor-interfacing.html>

**Class 6 :**

<http://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/>

**Class 7 (dht library) :**

<http://www.circuitbasics.com/how-to-set-up-the-dht11-humidity-sensor-on-an-arduino/>

**Class 7 :**

<http://www.circuitbasics.com/wp-content/uploads/2015/10/DHTLib.zip>

**Class 8 :**

<http://www.instructables.com/id/How-to-use-the-L298-Motor-Driver-Module-Arduino-Tu/>

**Class 9 :**

<https://www.arduino.cc/en/Tutorial>HelloWorld>