

Agenda

- Realy
- DC-Motors
 - Brushed vs Brushless
 - Control Brushed DC motor Speed
 - H-Bridge
 - Control Brushed DC motor Speed/Direction using H-Bridge
- DC- Servo Motor
- Stepper Motor
 - Unipolar
 - Bipolar



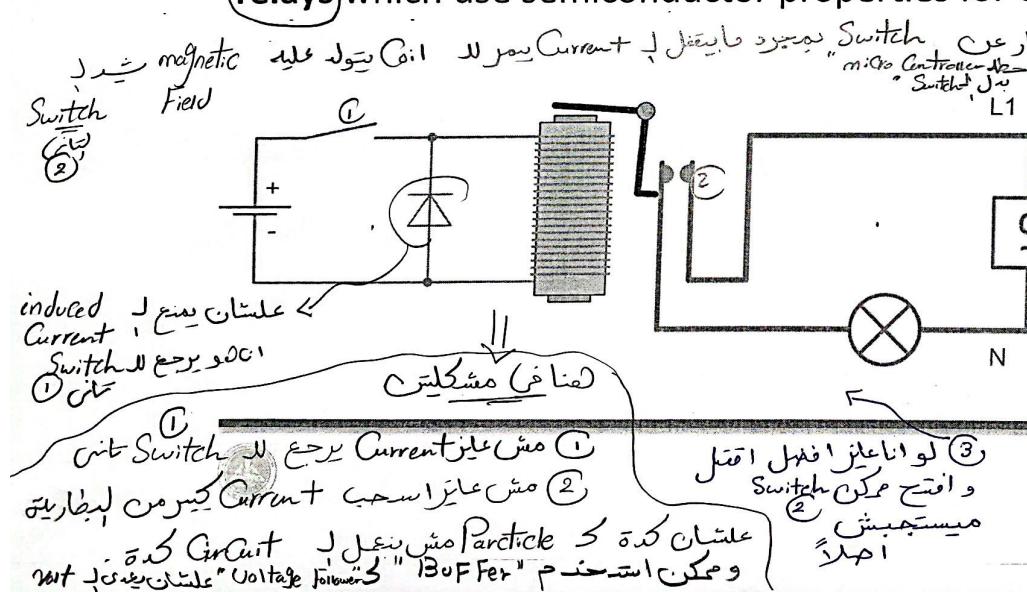
Relay

- A relay is an electrically operated switch. It consists of a set of terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.
- Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal.



Relay(Cont.)

- The traditional form of a relay uses an electromagnet to close or open the contacts, but other operating principles have been invented, such as in solid-state relays, which use semiconductor properties for control.



Relay(Cont.)

SEED TECHNOLOGY INC (SEEEDUINO) Electronic brick - 5V Relay module (digital) MELB115E4M

- Relay specifications

- Working by DC-5V
- 7A 240VAC
- 10A 120 VAC
- 10A 240 VDC

5V

load

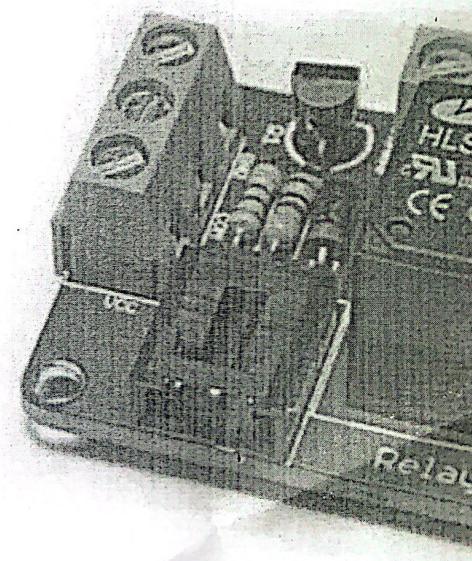
Switch

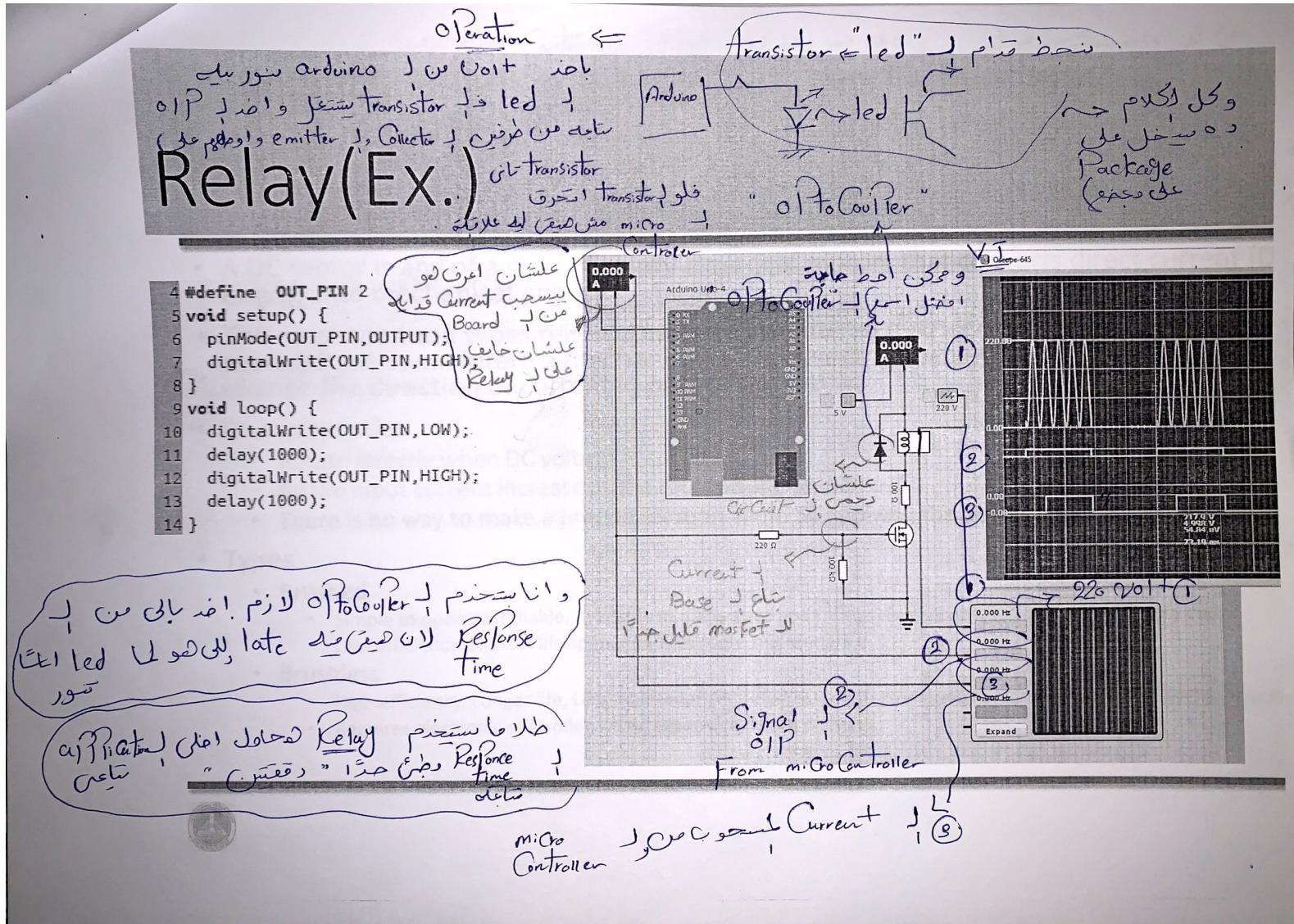
2

Current

لجهات

ممکن اوصل کرنا
Cascaded Relays " و ریلیس " Relay
مکانات لے احتط load
Conductor بجاع Coil
وقدر بفتح و بغل لو motor
کسر Phases





DC motor Control

DC motor

فریم های

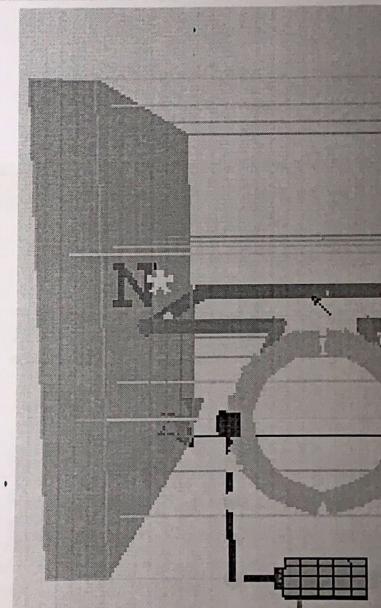
DC- Motors

- A DC motor is any of a class of rotary electrical motors that converts direct current (DC) energy into mechanical energy.
- The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.
- Characteristics
 - Rotate directly when DC voltage is applied
 - As the input current increase so does the rotation speed increase
 - There is no way to make a precise rotation angle by applying the power for a certain time.
- Types
 - Brushed
 - Simple to operate, reliable, Available in many sizes and ratings, Easy controls, Good for lower duty cycles
 - Less efficiency, Shorter life span, Requires more maintenance
 - Brushless
 - High efficiency, Longer life, Less maintenance, Better suited to continuous or long-running duty cycles, Precise control
 - Requires electronic controller, More expensive, More complex

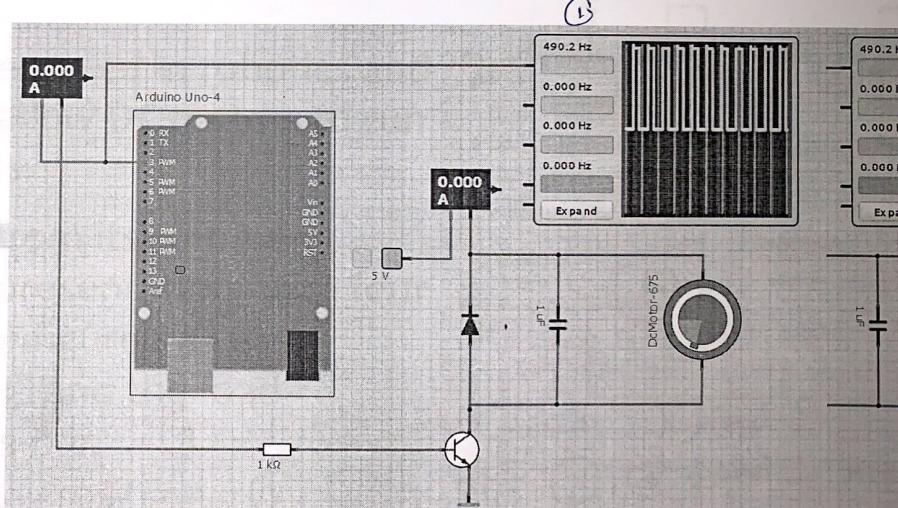
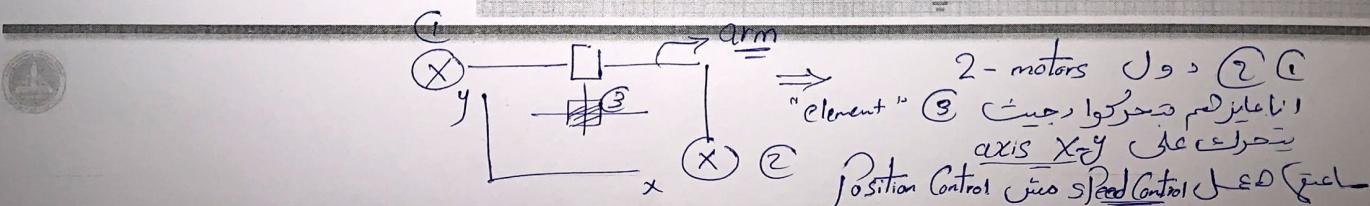
DC- Motors: (Brushed DC-Motor)

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes.

(Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.)



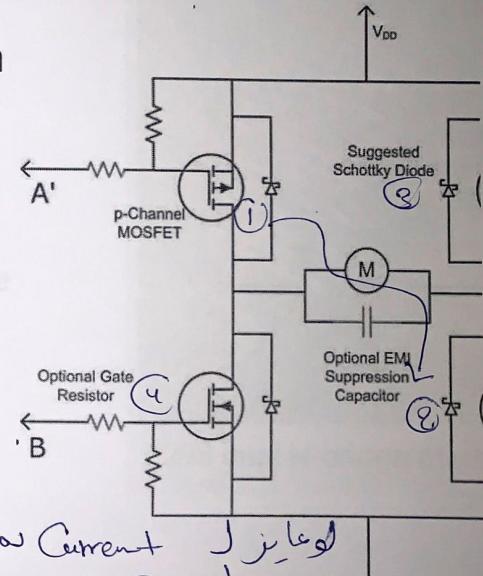
DC-Motor (Speed-Control) Example

4 #define OUT_PIN 3 PWM سخن
 5 void setup() { علشان اقدر اتحكم من سرعة لماتور
 6 pinMode(OUT_PIN,OUTPUT);
 7 analogWrite(OUT_PIN,0);
 8 } Pulse حدة
 9 void loop() { حيزره
 10 analogWrite(OUT_PIN,100);
 11 delay(1000);
 12 analogWrite(OUT_PIN,200);
 13 delay(1000);
 14 } Pulse حدة
 15 مرتفعه
 "سرعة" ① هيشغل لاول د 100 وبعدين مس
 "ثانية" وينتقل سرعة د 200 ②
 Speed Control ③



H-Bridge

- A H-bridge is an electronic circuit that switches the polarity of a voltage applied to a load.
- These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.
- The name is derived from its common schematic diagram representation, with four switching elements configured as the branches of a letter "H" and the load connected as the cross-bar.

② → ① gives Current
on ②, ① → OFF ④, ③ tie



H-Bridge(cont.) construction

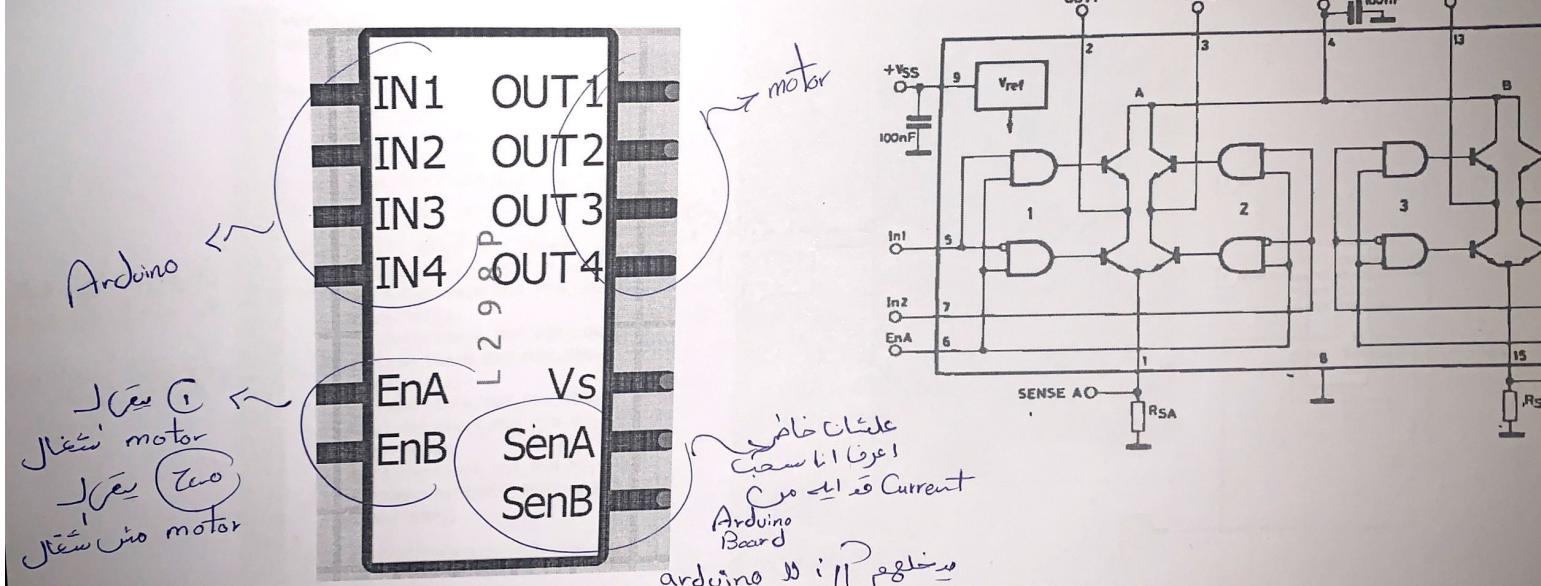
- One way to build an H-bridge is to use an array of relays from a relay board
- A "double pole double throw" (DPDT) relay can generally achieve the same electrical functionality as an H-bridge (considering the usual function of the device). However a semiconductor-based H-bridge would be preferable to the relay where a smaller physical size, **high speed switching**, or low driving voltage (or low driving power) is needed, or where the wearing out of mechanical parts is undesirable.
- L298 is an example for H-Bridge
 - The L298 is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input



L298 dual H-bridge moto

H-Bridge(cont.)

construction- L298



DC-Motor (Speed-Control/Direction) Example

```

1 #define A_OUT_PIN 9
2 #define B_OUT_PIN 10
3
4 void setup() {
5   pinMode(A_OUT_PIN,OUTPUT);
6   pinMode(B_OUT_PIN,OUTPUT);
7   analogWrite(A_OUT_PIN,0);
8   analogWrite(B_OUT_PIN,0);
9 }
10
11 void loop() direction, Speed
12   analogWrite(A_OUT_PIN,200);
13   digitalWrite(B_OUT_PIN,LOW);
14   delay(3000);
15   digitalWrite(A_OUT_PIN,LOW);
16   analogWrite(B_OUT_PIN,200);
17   delay(3000);
18   analogWrite(A_OUT_PIN,100);
19   digitalWrite(B_OUT_PIN,0);
20   delay(3000);
21   digitalWrite(A_OUT_PIN,0);
22   analogWrite(B_OUT_PIN,100);
23   delay(3000);
24 }
25

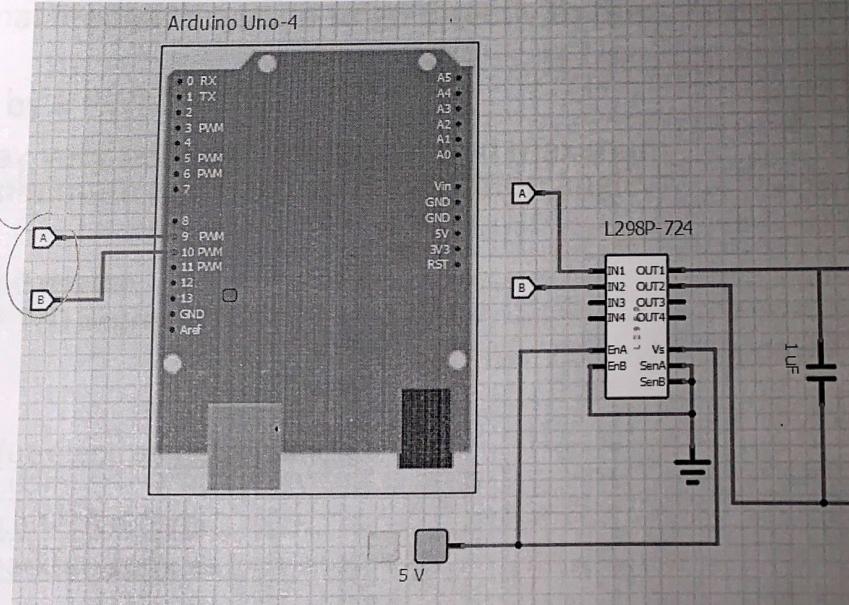
```

مدمج
لـ **PWM** عاشن اقدر
لـ **direction, Speed**

كدة هلفت كدة هلفت
الاتجاه الاتجاه

high A
Low B

high B
Low A



Servo Motors

Circuit + motor cycle

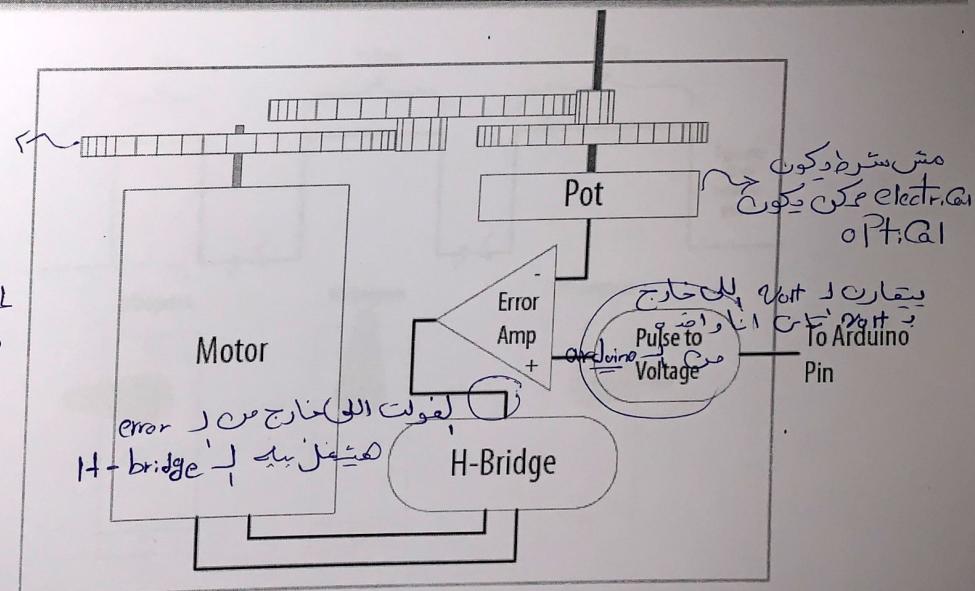
- Servo Motors uses internal feedback system to go directly to the required angle.
- Servo Motors controlled by a PWM input.
- The input pulse width may vary between minimum and maximum pulse width to produce minimum and maximum deviation angle.
- Typical values
 - Min Pulse width: 1ms → 0 degree
 - Max Pulse width: 2ms → 180 degree
 - PWM duty cycle: 20ms
- Models:
 - ROB12745M from www.fut-electronics.com and <http://www.seeedstudio.com>
 - HS-311 from <http://www.hitecrcd.com>
 - SM-S3317S from www.sparkfun.com

Servo Motors (cont.)

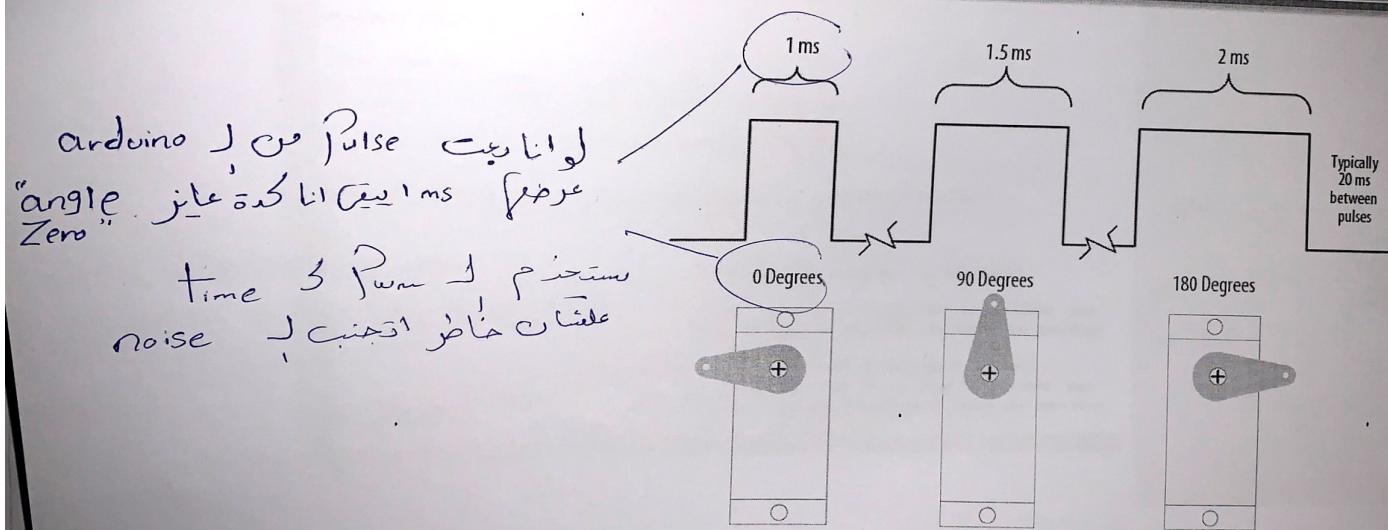
Internal Feedback Control

دی جی اس Servos علشان خاطر اقل سرعت دار
و بدل توریکو motor درست هم قوی عمل
Position Control

البروس ل جی اس Potentiometer (صلف)
و اونخله غل Circuit (مطاع)
Corrosion Volt "Amp" Position
To Pot Volt "Potentiometer" +

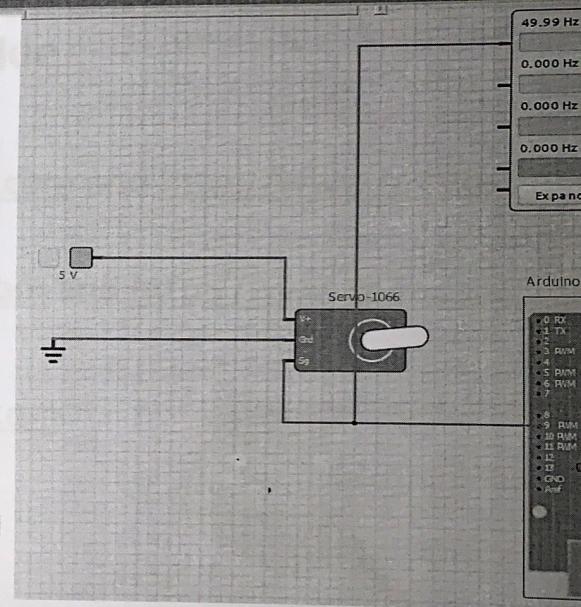


Servo Motors (cont.) PWM Angle Control



Servo Motors (Example)

```
1 #include <Servo.h>
2
3 Servo myservo;
4 // create servo object to control a servo
5 // twelve servo objects can be created on most boards
6
7 int pos = 0;      // variable to store the servo position
8
9 void setup() {
10   myservo.attach(9); // attaches the servo on pin 9 to the servo object
11 }
12
13 void loop() {
14   for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
15     // in steps of 1 degree
16     myservo.write(pos);          // tell servo to go to position in variable 'pos'
17     delay(15);                 // waits 15ms for the servo to reach the position
18   }
19   for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
20     myservo.write(pos);          // tell servo to go to position in variable 'pos'
21     delay(15);                 // waits 15ms for the servo to reach the position
22   }
23 }
```



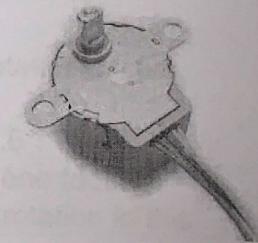
Stepper Motors

جسم فی "initially" سے عارف اسی میں سے عارف Position انا ہے اور Center Extra Torque

- Provide precise angular steps with fixed value.
- Uni-Polar Model
 - Motor: MOT106A3B from www.fut-electronics.com and <http://www.seeedstudio.com>
 - Driver Chip: L298 from www.mouser.com
 - Driver Board: L298 from www.fut-electronics.com and <http://www.seeedstudio.com>
- Bi-Polar Model
 - Motor: SM-42BYG011-25 from www.sparksun.com
 - Driver Chip: L293 from www.mouser.com



لنا پول اسی motor میں ② جو یہاں برعکس نہیں رکھا گی
Sensor یا سینسور



Stepper Motor (idea)

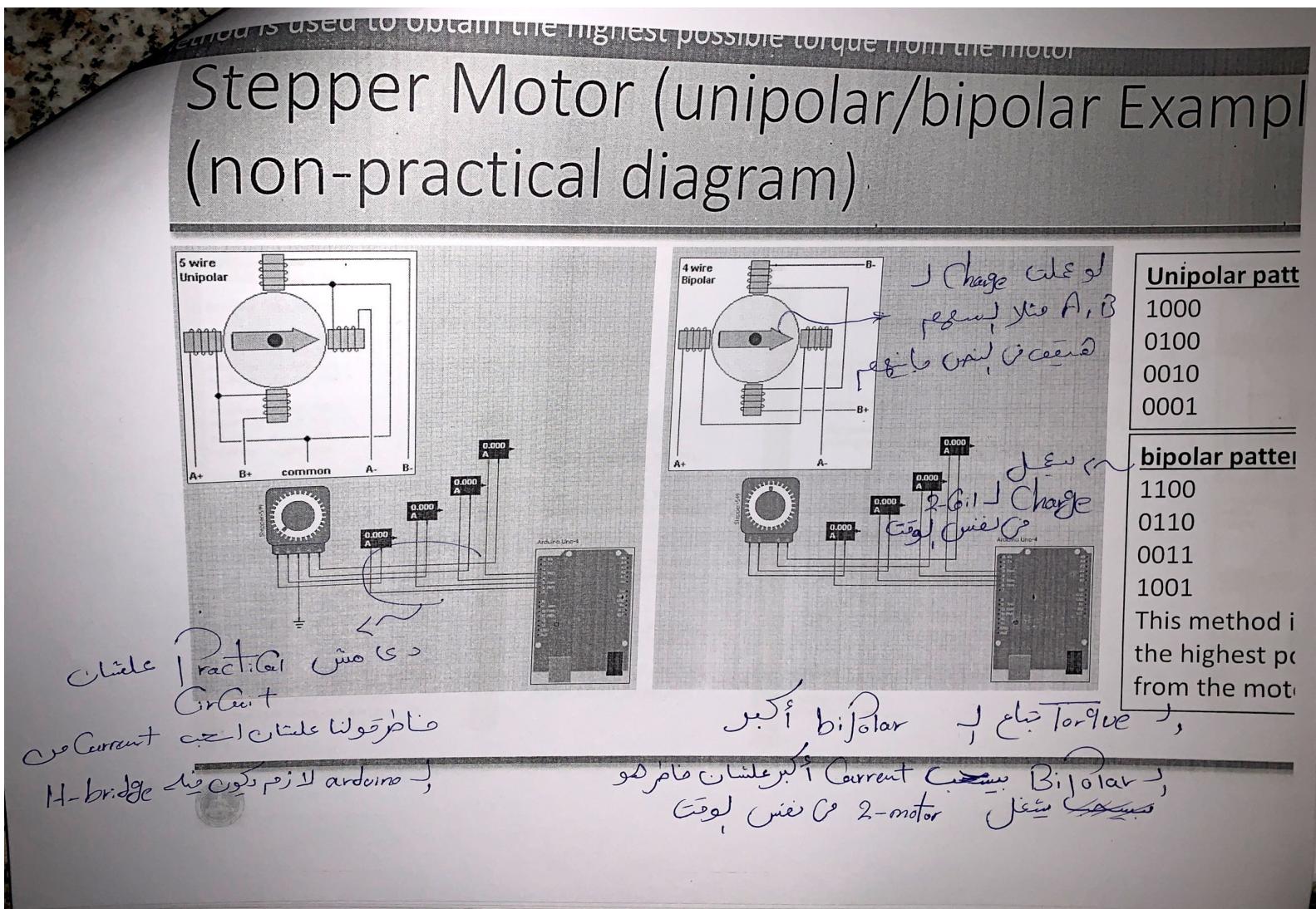
Animation of a simplified stepper motor (unipolar)

Frame 1: The top electromagnet (1) is turned on, attracting the nearest teeth of the gear-shaped iron rotor. With the teeth aligned to electromagnet 1, they will be slightly offset from right electromagnet (2).

Frame 2: The top electromagnet (1) is turned off, and the right electromagnet (2) is energized, pulling the teeth into alignment with it. This results in a rotation of 3.6° in this example.

Frame 3: The bottom electromagnet (3) is energized; another 3.6° rotation occurs.

Frame 4: The left electromagnet (4) is energized, rotating again by 3.6° . When the top electromagnet (1) is again enabled, the rotor will have rotated by one tooth position; since there are 25 teeth, it will take 100 steps to make a full rotation in this example.



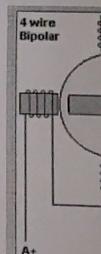
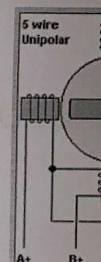
Stepper Motor (unipolar/bipolar Examples) (non-practical diagram)

```
1 #include <stdio.h>
2 #include <stdlib.h>
3
4 #define INP_PIN 2
5
6 #define Bn_OUT_PIN 3
7 #define An_OUT_PIN 4
8 #define Bp_OUT_PIN 5
9 #define Ap_OUT_PIN 6
10
11 #define A_OUT_PIN 3
12 #define B_OUT_PIN 4
13 #define C_OUT_PIN 5
14 #define D_OUT_PIN 6
15
16 #define DELAY 1000
17
18 #define V1 HIGH
19 #define V2 LOW
20
21 //#define V1 LOW
22 //#define V2 HIGH
23
24 void setup() {
25   pinMode(INP_PIN,INPUT_PULLUP);
26   pinMode(A_OUT_PIN,OUTPUT);
27   pinMode(B_OUT_PIN,OUTPUT);
28   pinMode(C_OUT_PIN,OUTPUT);
29   pinMode(D_OUT_PIN,OUTPUT);
30
31   digitalWrite(A_OUT_PIN,V1);
32   digitalWrite(B_OUT_PIN,V1);
33   digitalWrite(C_OUT_PIN,V2);
34   digitalWrite(D_OUT_PIN,V2);
35 }
36
```

```
36
37 void unipolar_driver()
38 {
39   digitalWrite(A_OUT_PIN,V1);
40   delay(DELAY);
41
42   digitalWrite(A_OUT_PIN,V2);
43   digitalWrite(B_OUT_PIN,V1);
44
45   delay(DELAY);
46
47   digitalWrite(B_OUT_PIN,V2);
48   digitalWrite(C_OUT_PIN,V1);
49
50   delay(DELAY);
51
52   digitalWrite(C_OUT_PIN,V2);
53   digitalWrite(D_OUT_PIN,V1);
54
55   delay(DELAY);
56
57   digitalWrite(D_OUT_PIN,V2);
58 }
```

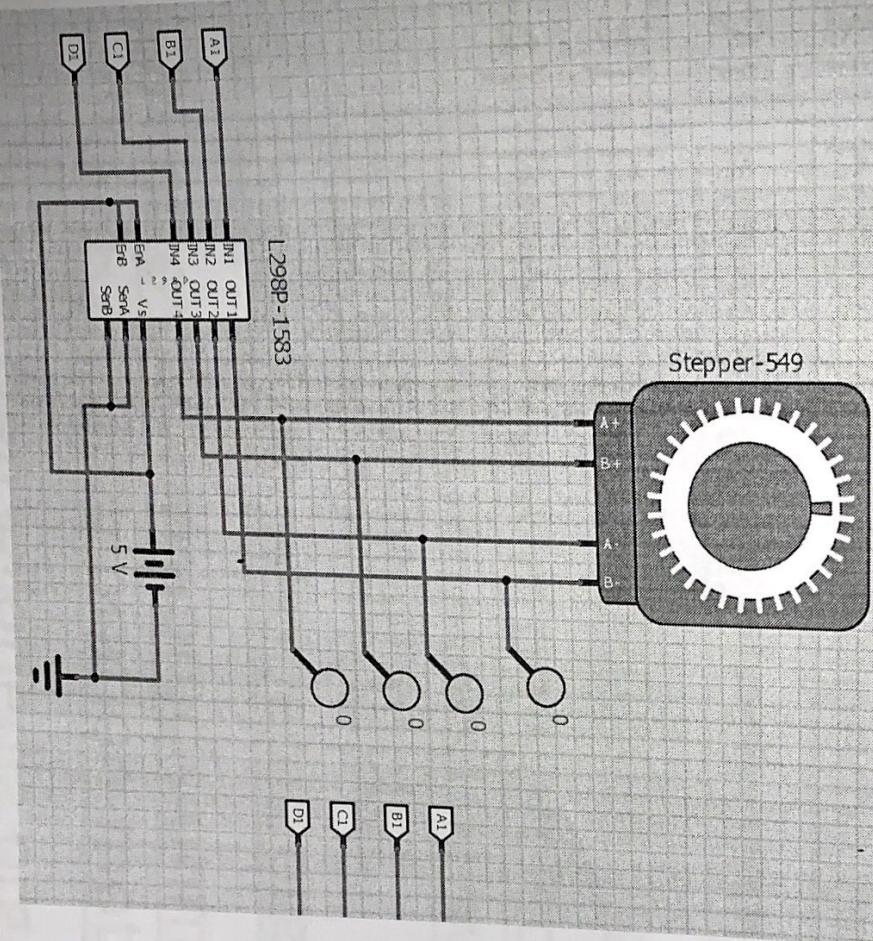
```
69
70 void bipolar_driver()
71 {
72
73   digitalWrite(A_OUT_PIN,V1); مدى لمحطة دى
74   digitalWrite(B_OUT_PIN,V1); مدى من تشغيل
75
76   delay(DELAY);
77
78   digitalWrite(A_OUT_PIN,V2); طبع لـ A و تشغيل
79   digitalWrite(C_OUT_PIN,V1); المحطة دى تشغيل A, B, C, D
80
81   digitalWrite(B_OUT_PIN,V2);
82   digitalWrite(D_OUT_PIN,V1);
83
84   delay(DELAY);
85
86 }
```

```
87
88 void loop() {
89
90   unipolar_driver();
91   //bipolar_driver();
92
93 }
```



Stepper motor with H-Bridge

Stepper-549



Ready made library for stepper

<https://www.arduino.cc/reference/en/libraries/stepper/>