Build your own microcontroller project

9 October 2021
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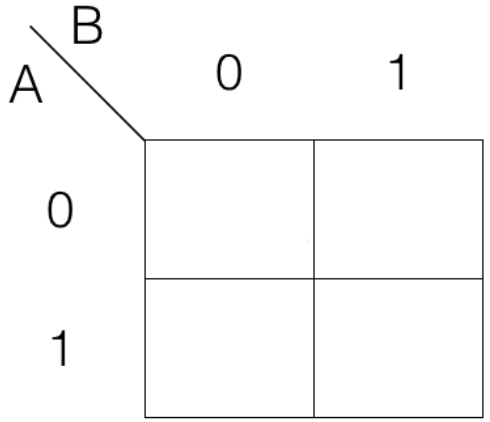
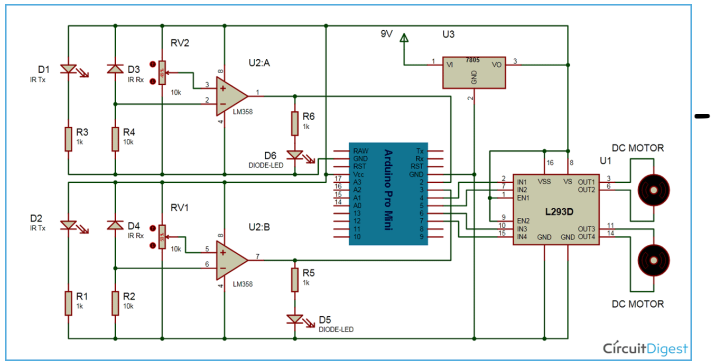
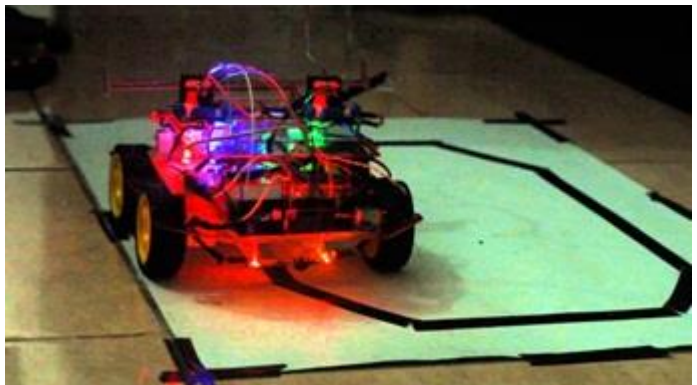
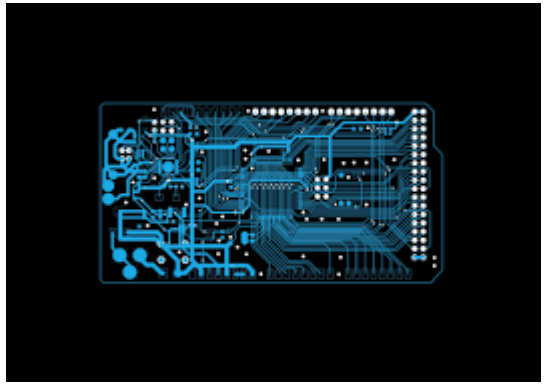


Content :

- Electronics project
- Step by step do an electronics project
- What is microcontroller
- Microcontroller vs without microcontroller
- Solving electronics project simulation







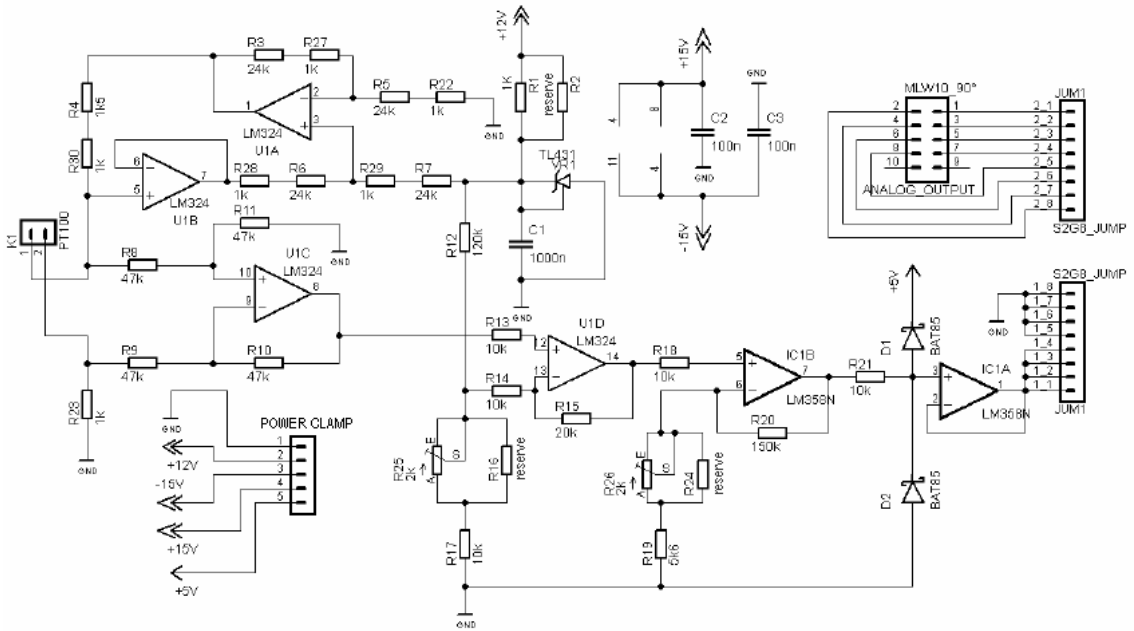
Speaker : Muhammad Husni, S. Pd
control system and electronics engineer

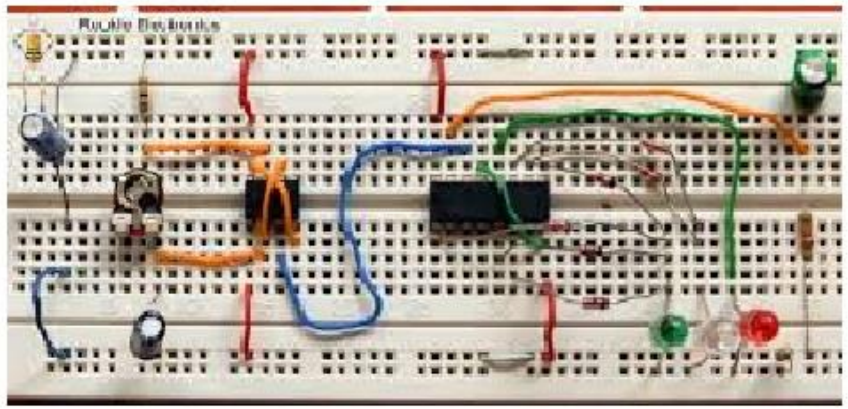
About me

- Name : Muhammad Husni Muttaqin, S. Pd.
- Birth date : 5 June 1998
- Hometown : Bandung
- Current Job : electronics and control system engineer at PT Syergie Automa Teknologi
- Experiences :
  - 2019 : Dynamics Positioning System control system engineer on cable ship kalibaru – untung jawa 20Kv cable installation (PT Syergie Indoprima)
  - 2019 : Dynamics Positioning System control system engineer on cable ship lampung – pahawang 20Kv cable installation (PT Syergie Indoprima)
  - 2020 : Dynamics Positioning System control system engineer on cable ship palapa ring tengah cable maintenance (PT Syergie Indoprima)
  - 2021 - now : Electronics and control system engineer for Vent-I (PT Syergie Automa Teknologi)

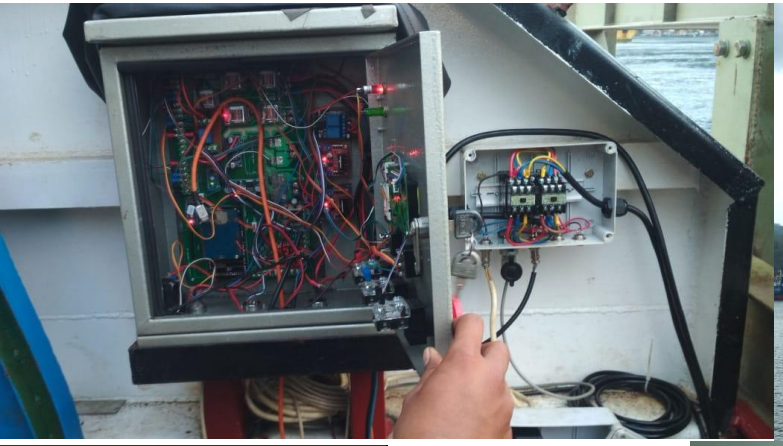

Kang Agus
online
About and phone number
Kita semua adalah kawan.
4 June

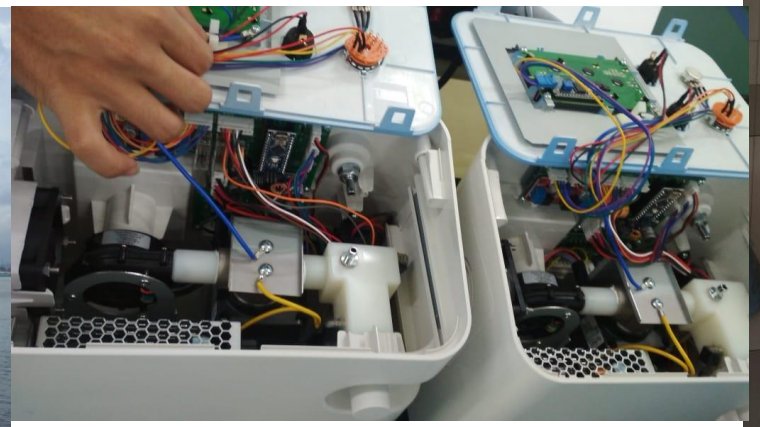
Electronics project

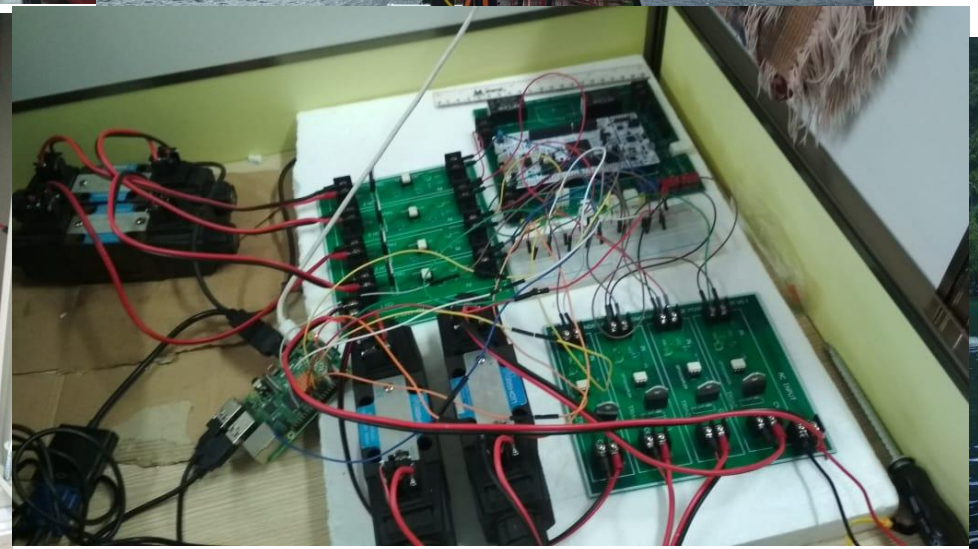




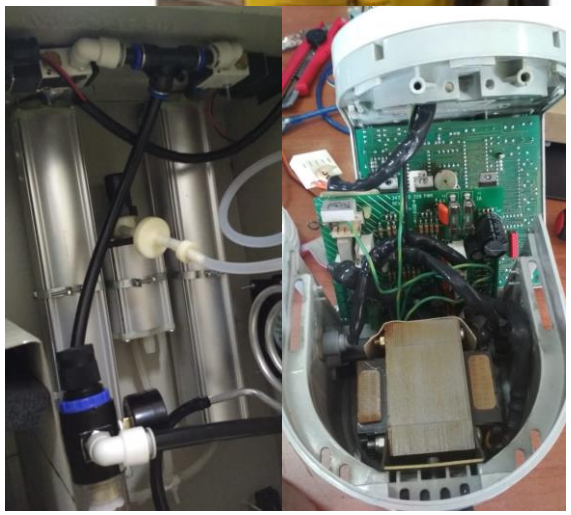
Electronic project








Dynamic Positioning System



Step by step to do an electronics project

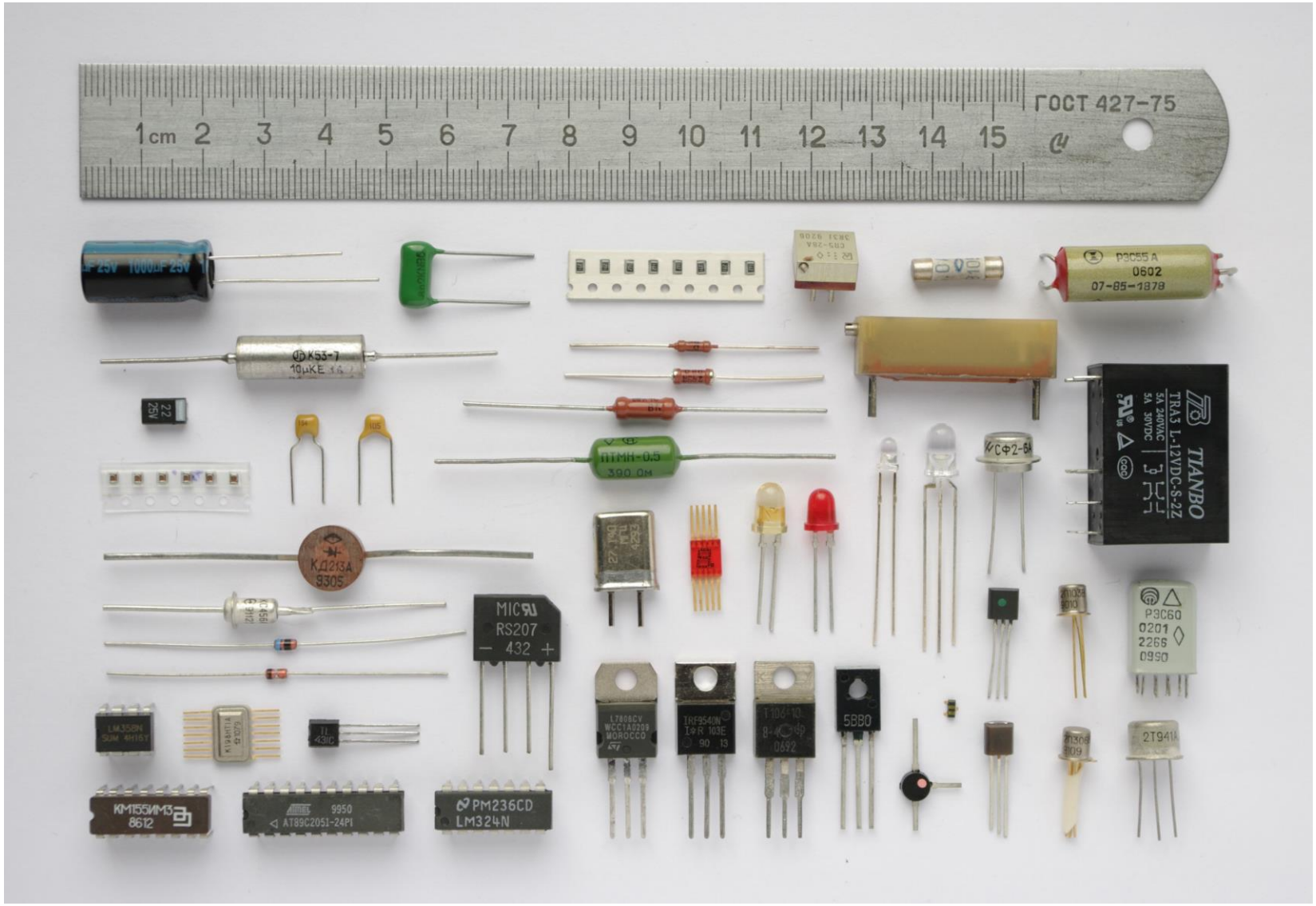
- Choose what tools/ system that you will make
- Think about input components
- Think about output components
- Think about process
- Think about safety for the system

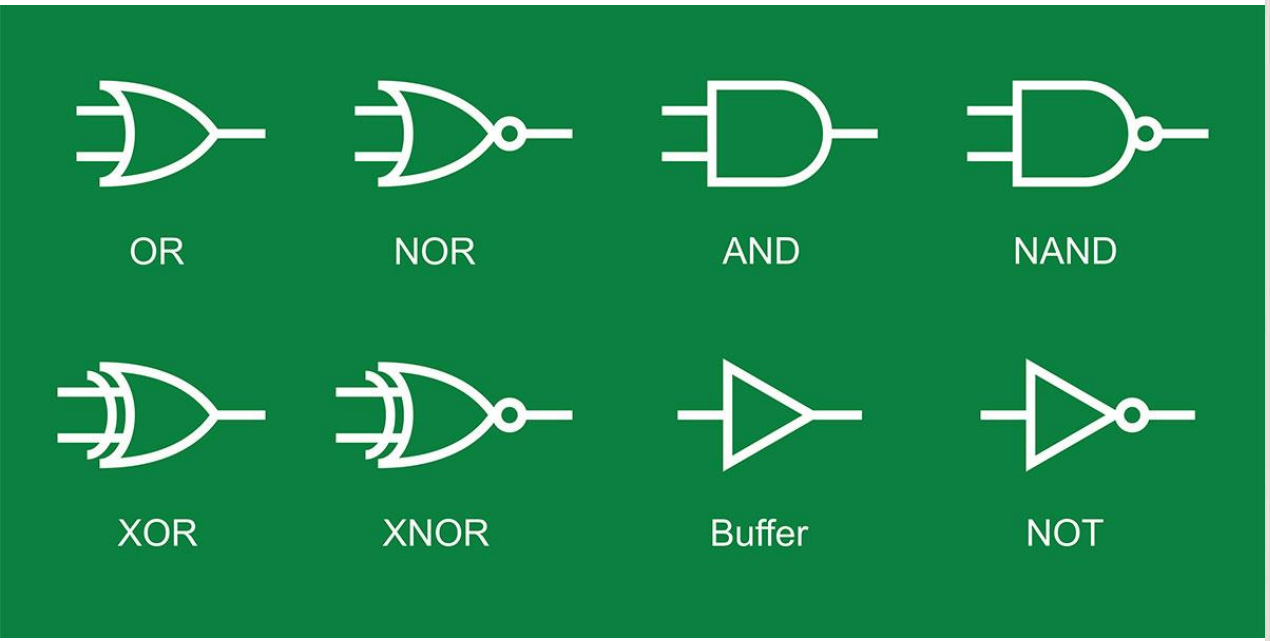

with microcontroller

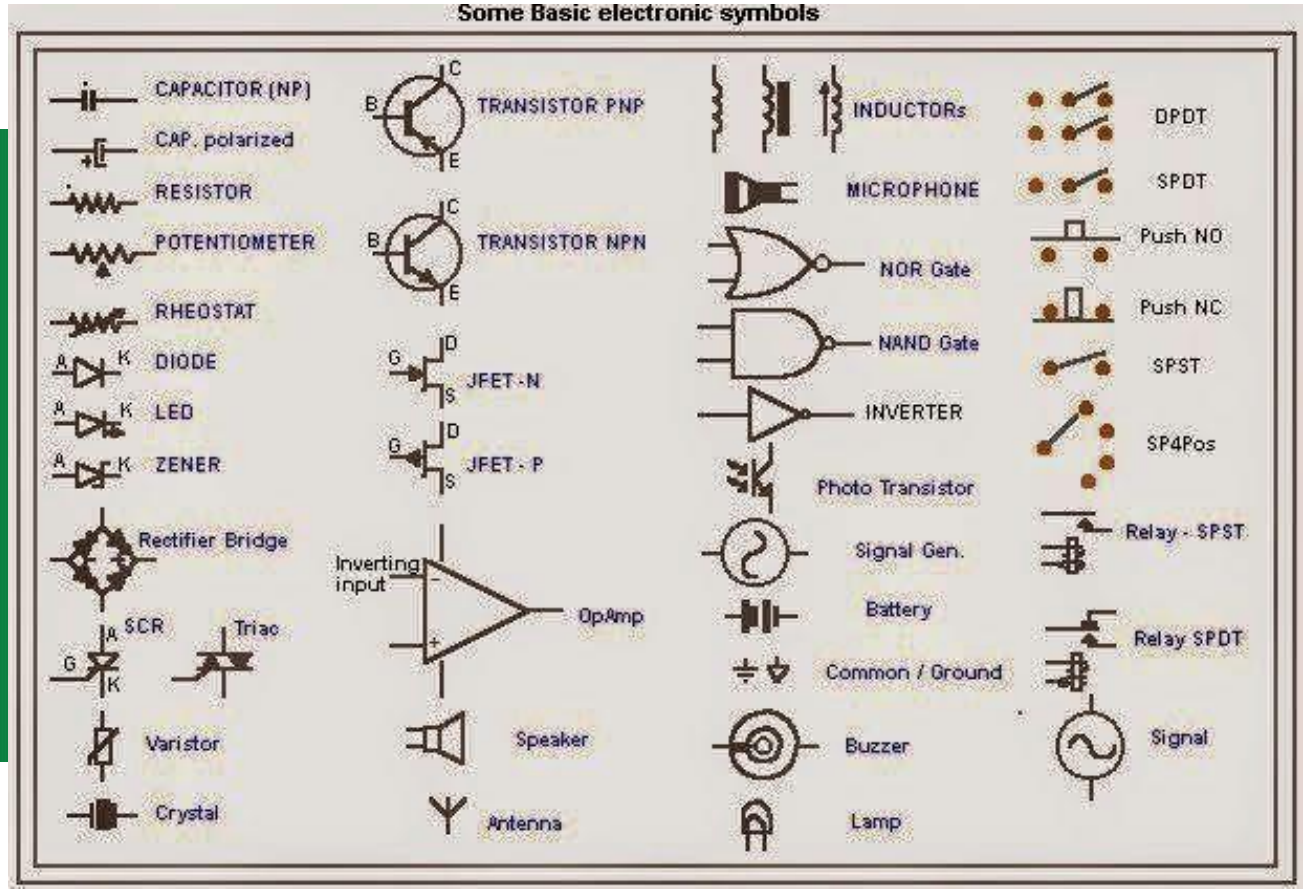

without microcontroller


MARVEL
CIVIL WAR
CAPTAIN AMERICA
MAY 6, 2016

Without microcontroller




OR
NOR
AND
NAND
XOR
XNOR
Buffer
NOT


Some Basic electronic symbols
CAPACITOR (NP)
CAP. polarized
RESISTOR
POTENTIOMETER
RHEOSTAT
DIODE
LED
ZENER
Rectifier Bridge
SCR
Triac
Varistor
Crystal
TRANSISTOR PNP
TRANSISTOR NPN
JFET - N
JFET - P
Inverting input
OpAmp
Speaker
Antenna
INDUCTORs
MICROPHONE
NOR Gate
NAND Gate
INVERTER
Photo Transistor
Signal Gen.
Battery
Common / Ground
Buzzer
Lamp
DPDT
SPDT
Push NO
Push NC
SPST
SP4Pos
Relay - SPST
Relay SPDT
Signal

With microcontroller

So what is the difference ?

Pradeep, Research in Robotics and Digital Signal Processing
Answered 4 years ago · Author has **53** answers and **137.5K** answer views

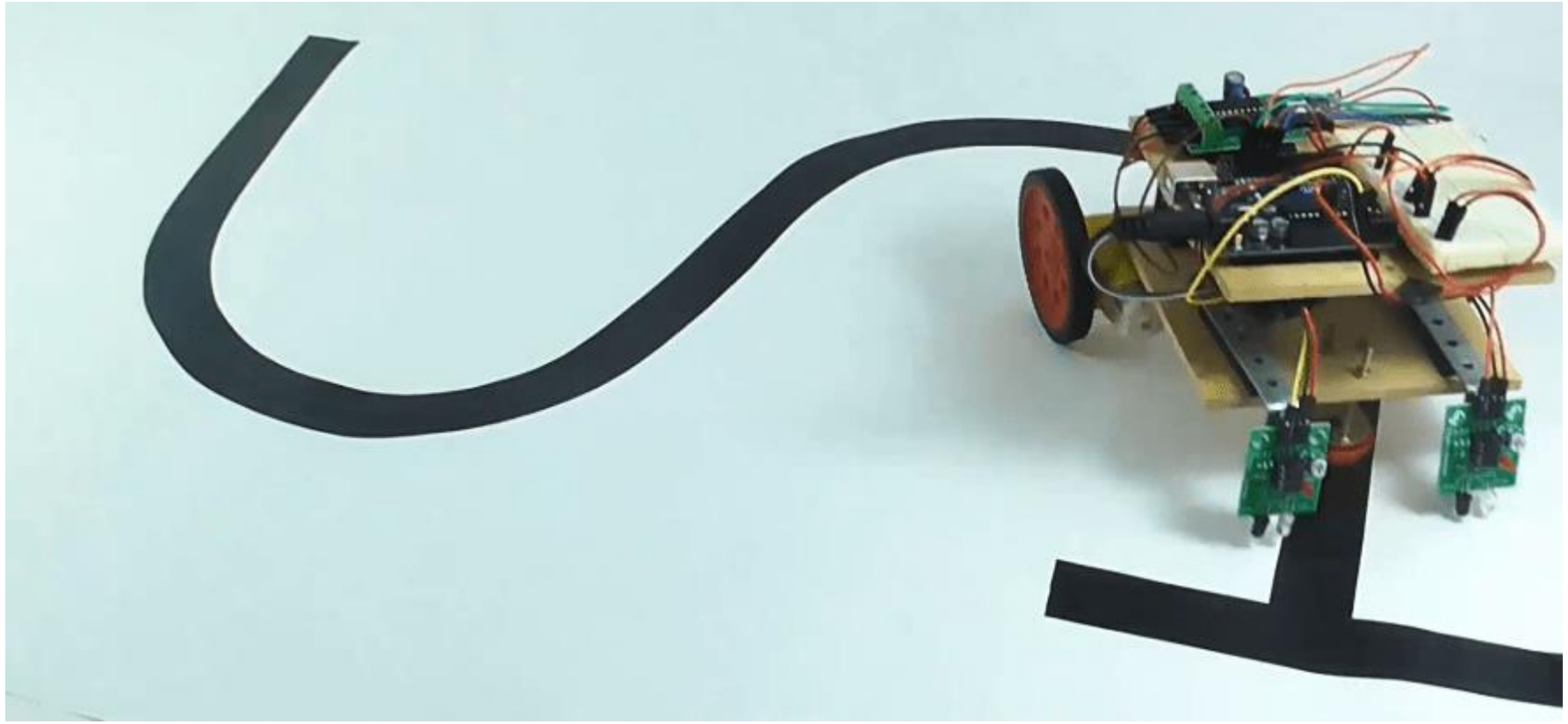
An IC is manufactured for a single purpose. We cannot expect that IC to perform an operation of our choice.

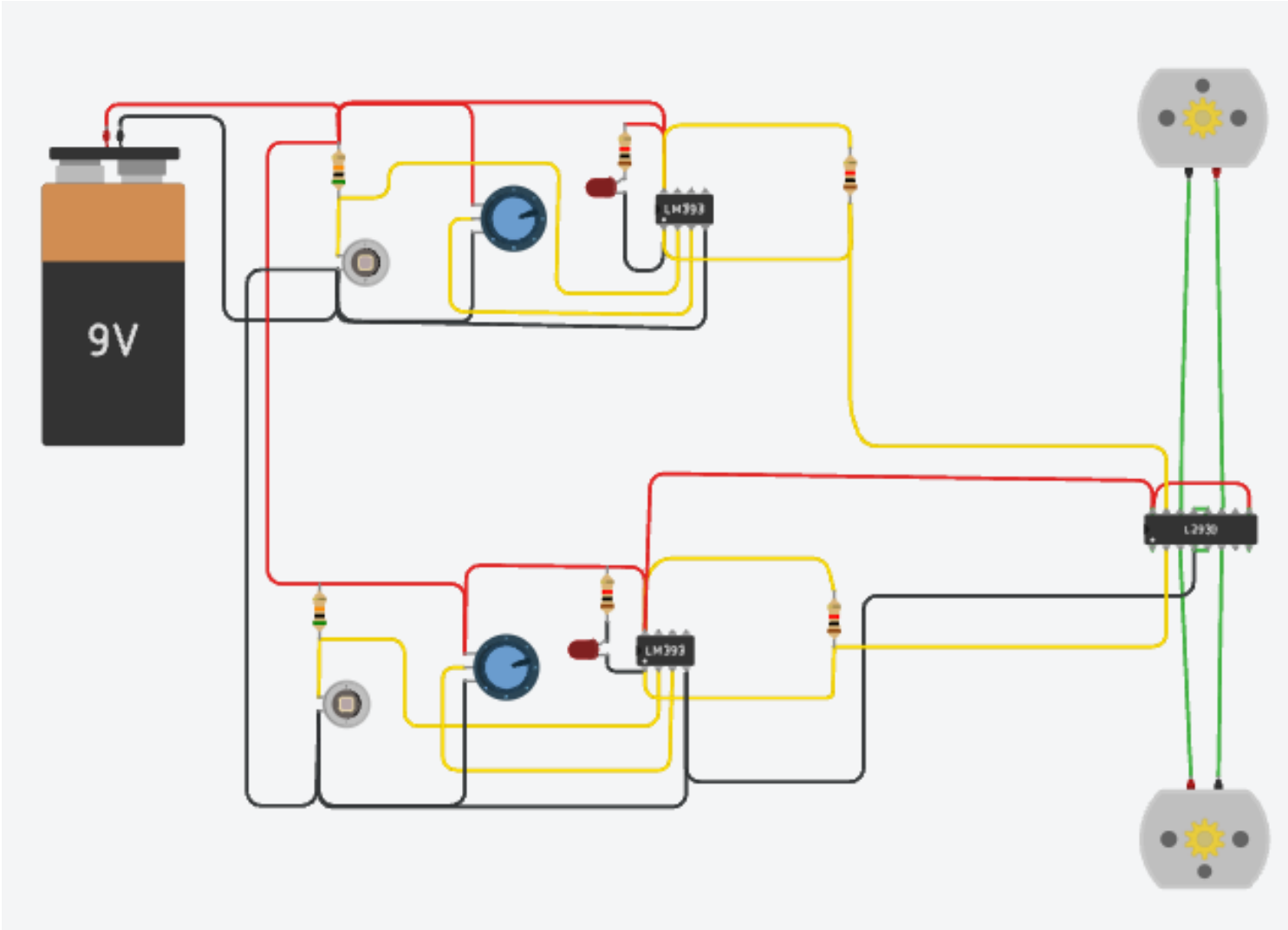
But a microcontroller is programmable, we can flash the program of our choice to achieve multiple operations.

An IC is always faster because of hardware execution but the speed of operation of Microcontroller depends on quality of code and configuration of Microcontroller.

Okay lets go to practical example

Line follower level 1 (without microcontroller)




9V
LM393
LM393
L293D

BUT WHY ?

How you make that robot/system without microcontroller

Please remember what i say :

1.Choose what tools/ system that you will make

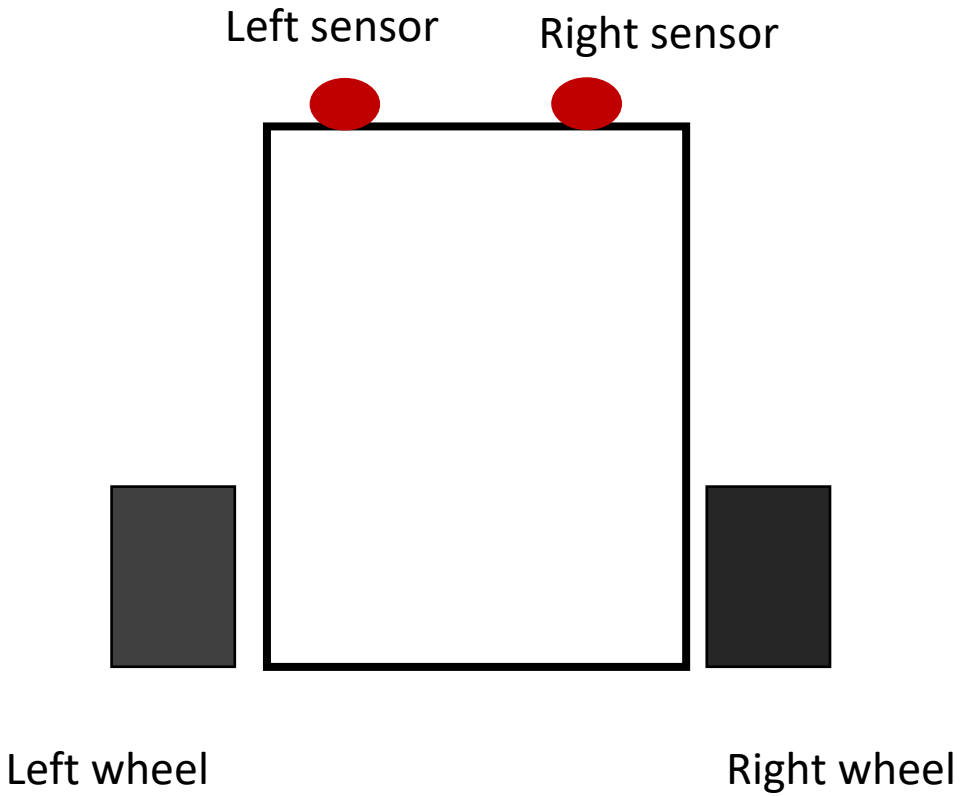
2.Think about input components

3.Think about output components

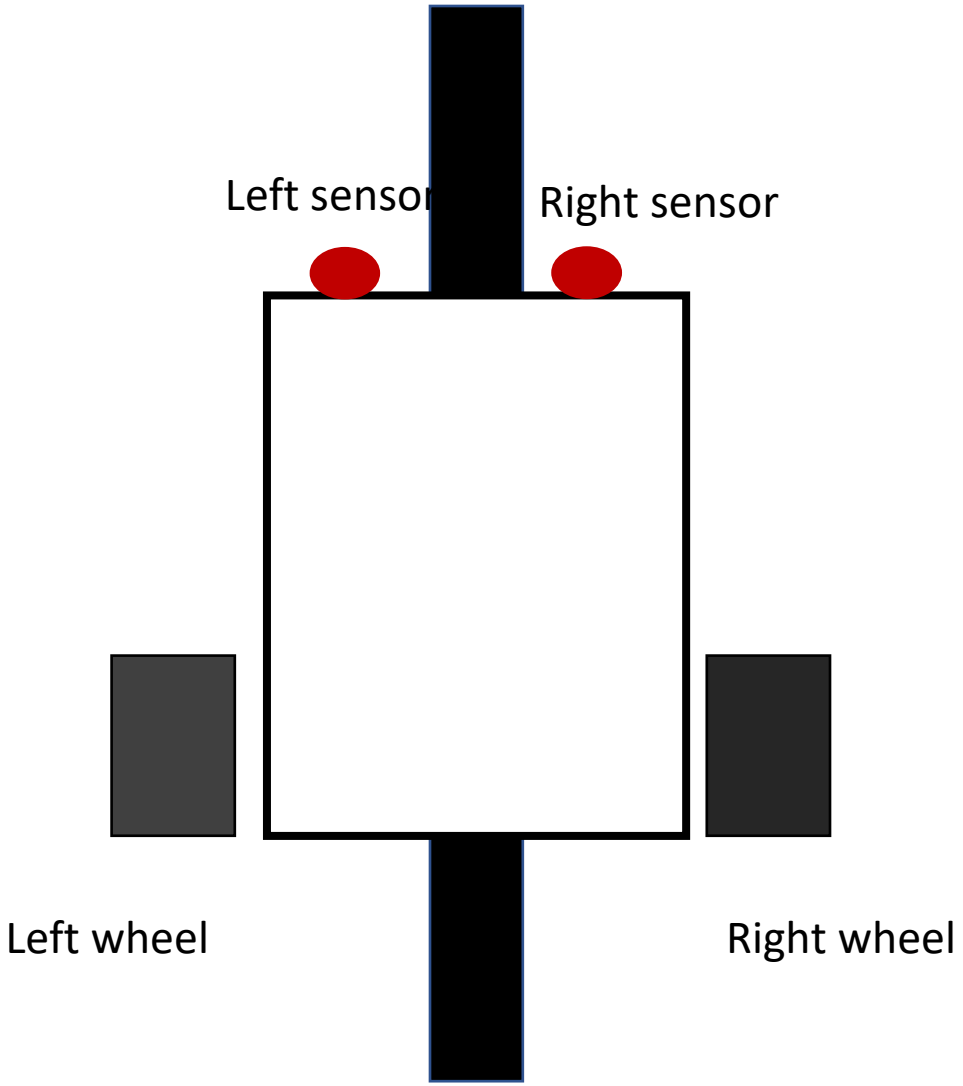
4.Think about process

5.Think about safety for the system (optional)

1. Choose what you will make (line follower)

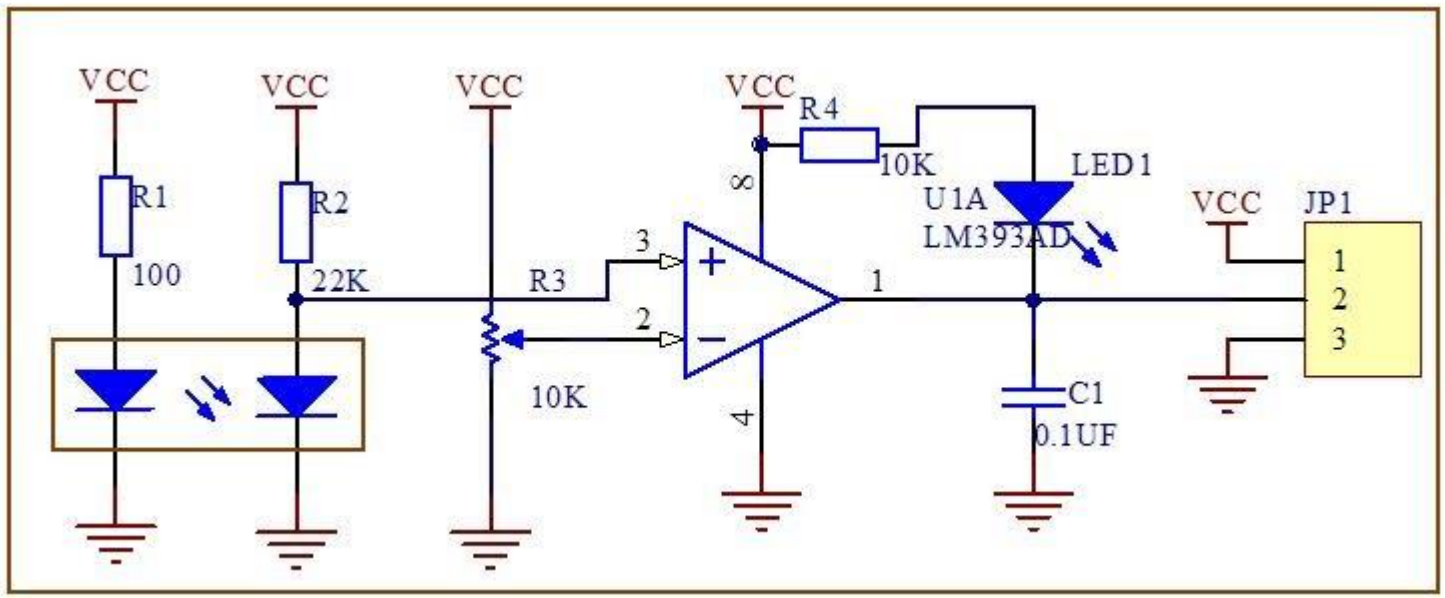


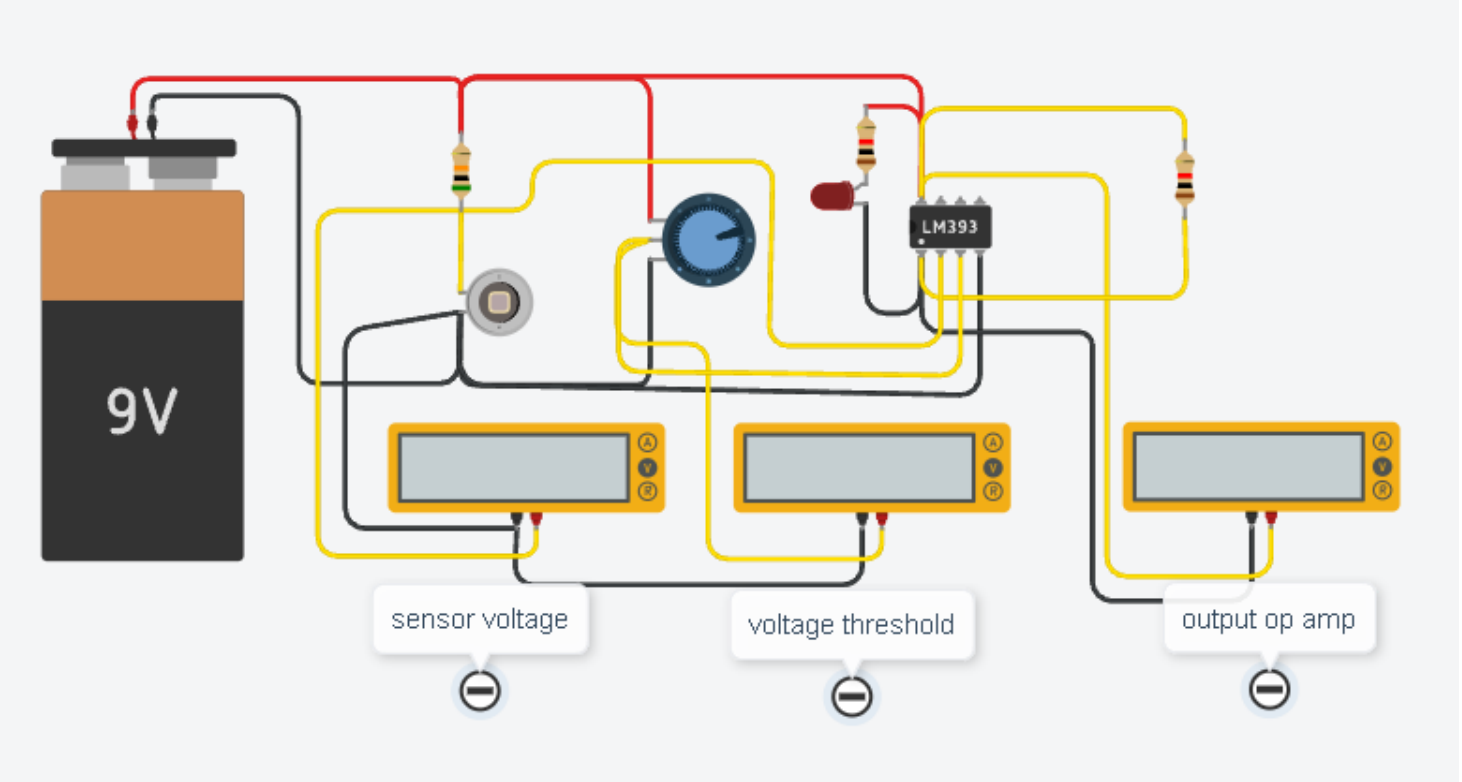
How it work



2. Think about input component (sensor)

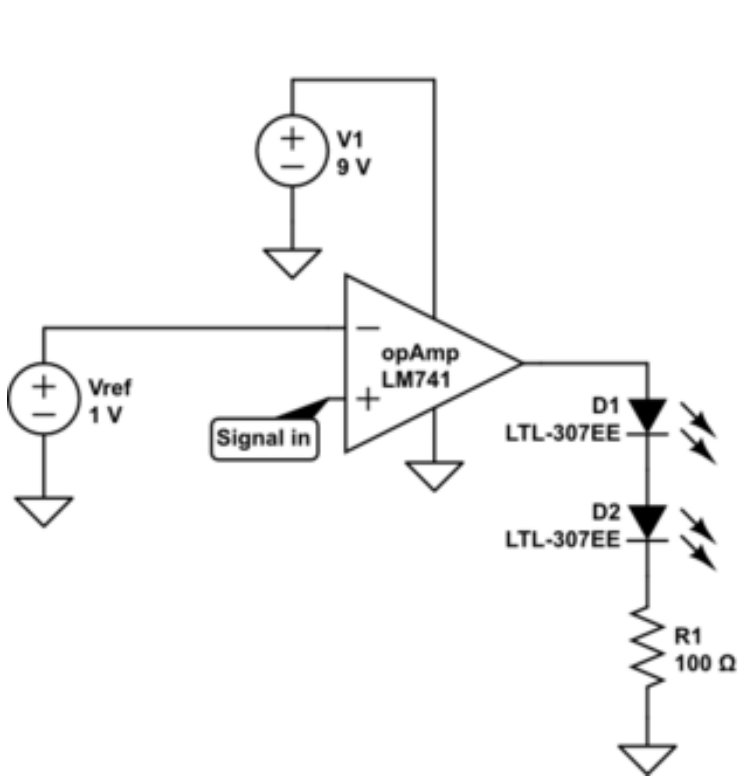
- Photodiode + resistor (voltage divider)
- Comparator (op- amp 393)
- Logic state

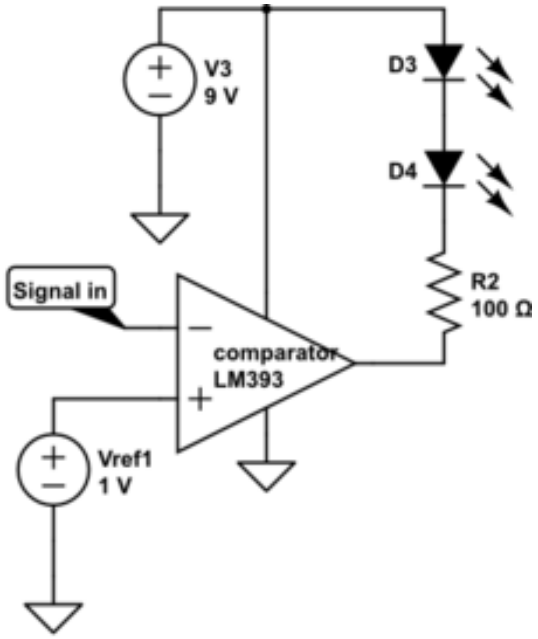

VCC
VCC
VCC
VCC
R4
10K
LED1
U1A
LM393AD
R1
R2
100
22K
R3
3
2
8
4
1
VCC
JP1
1
2
3
10K
C1
0.1UF

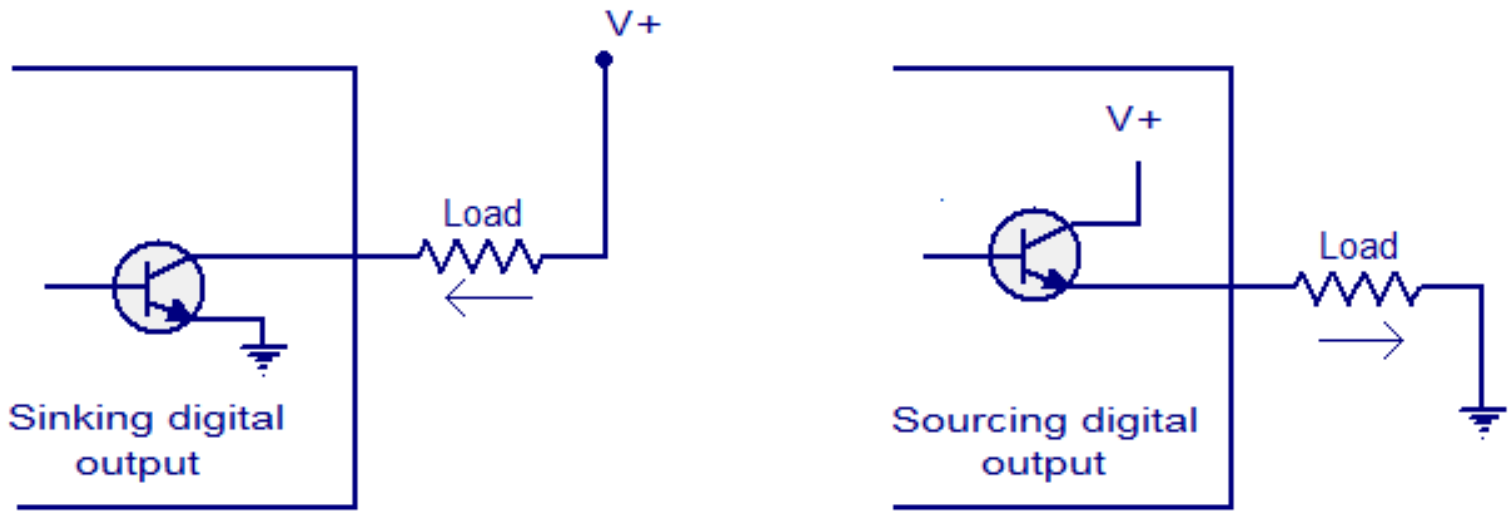


https://www.tinkercad.com/things/iShbiYFnLUZ-photodiode-module-schematic

Two kind of comparator

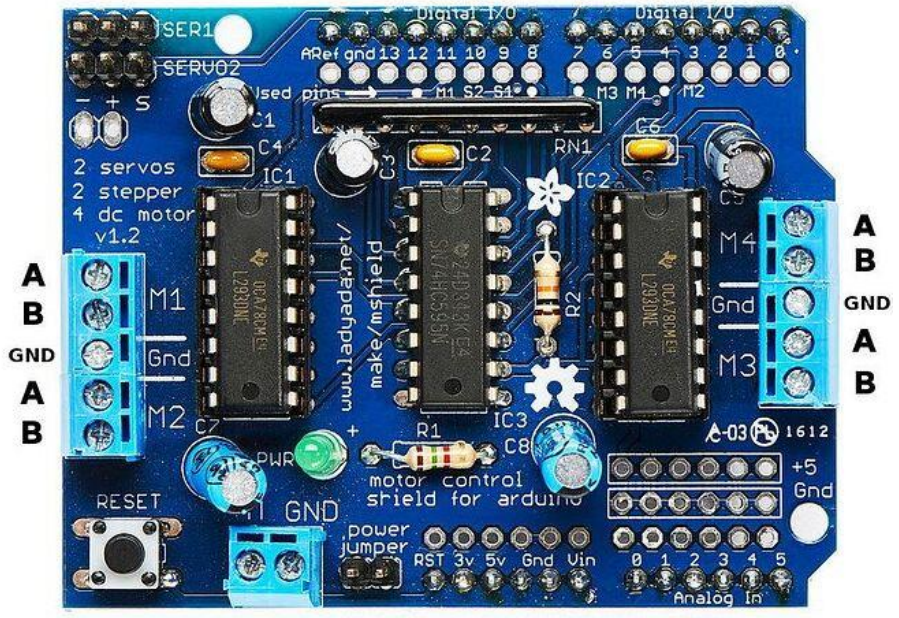





V+
Load
Sinking digital output
V+
Load
Sourcing digital output

3. Think about output component

- Two motors with driver



4. Think about process component

- Truth table

no	left sensor	right sensor	left motor	right motor
1	black	black	off	off
2	black	white	off	on
3	white	black	on	off
4	white	white	on	on

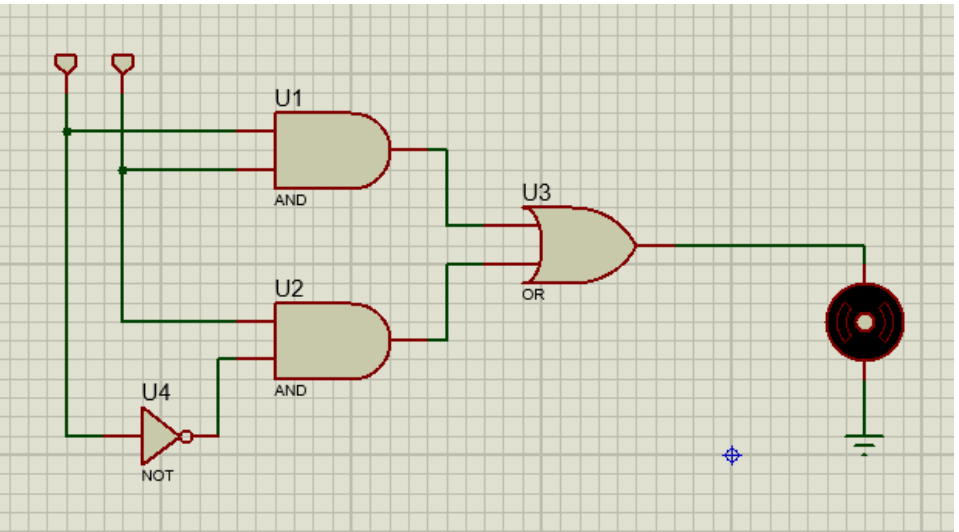
- Digital circuit ?

no	left sensor	right sensor	left motor
1	black	black	off
2	black	white	off
3	white	black	on
4	white	white	on

no	left sensor	right sensor	right motor
1	black	black	off
2	black	white	on
3	white	black	off
4	white	white	on

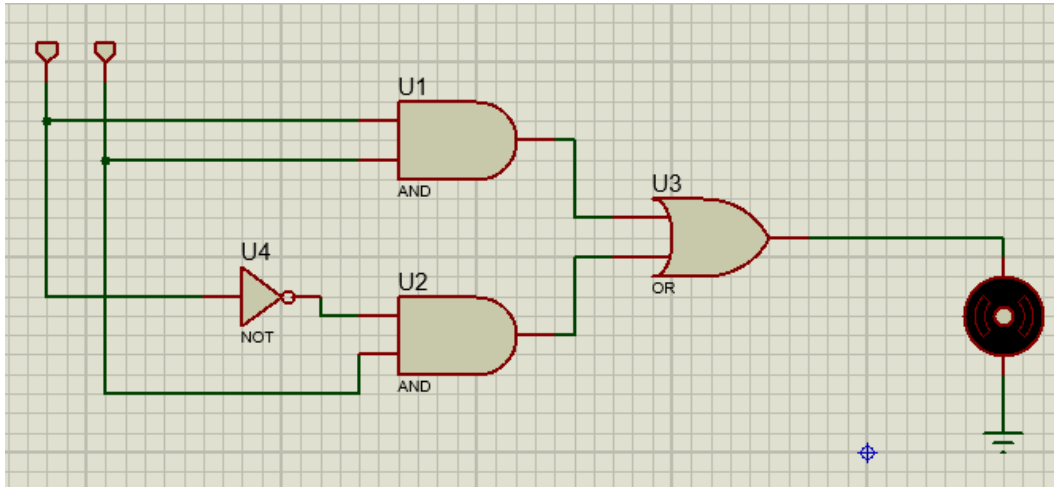
no	left sensor (A)	right sensor (B)	left motor (y1)
1	0	0	0
2	0	1	0
3	1	0	1
4	1	1	1

Y1 = AB’ + AB



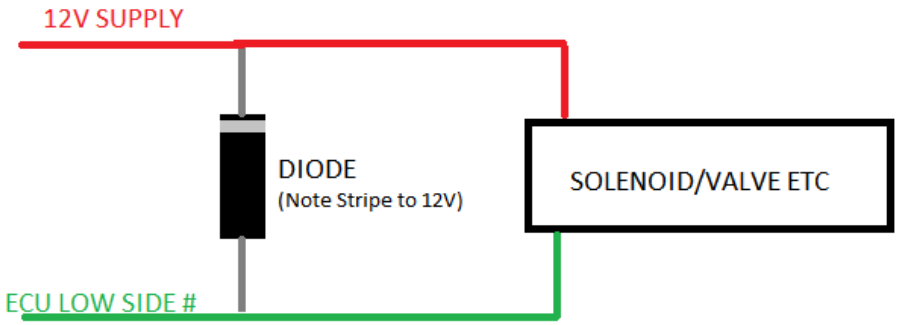
no	left sensor (A)	right sensor (B)	right motor (y2)
1	0	0	0
2	0	1	1
3	1	0	0
4	1	1	1

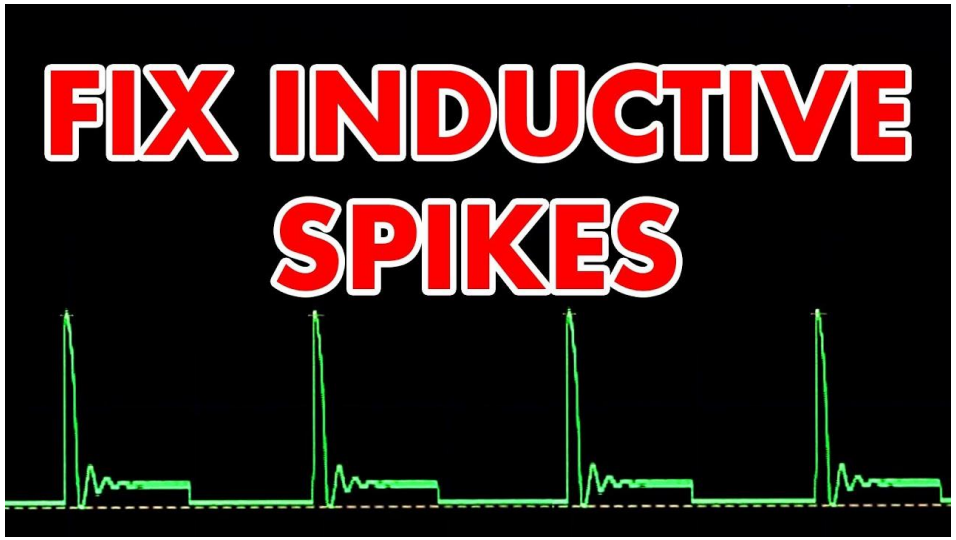
Y2 = A’B + AB



5. Safety component (optional)

- Flyback diode





$$v = L\frac{di}{dt}$$

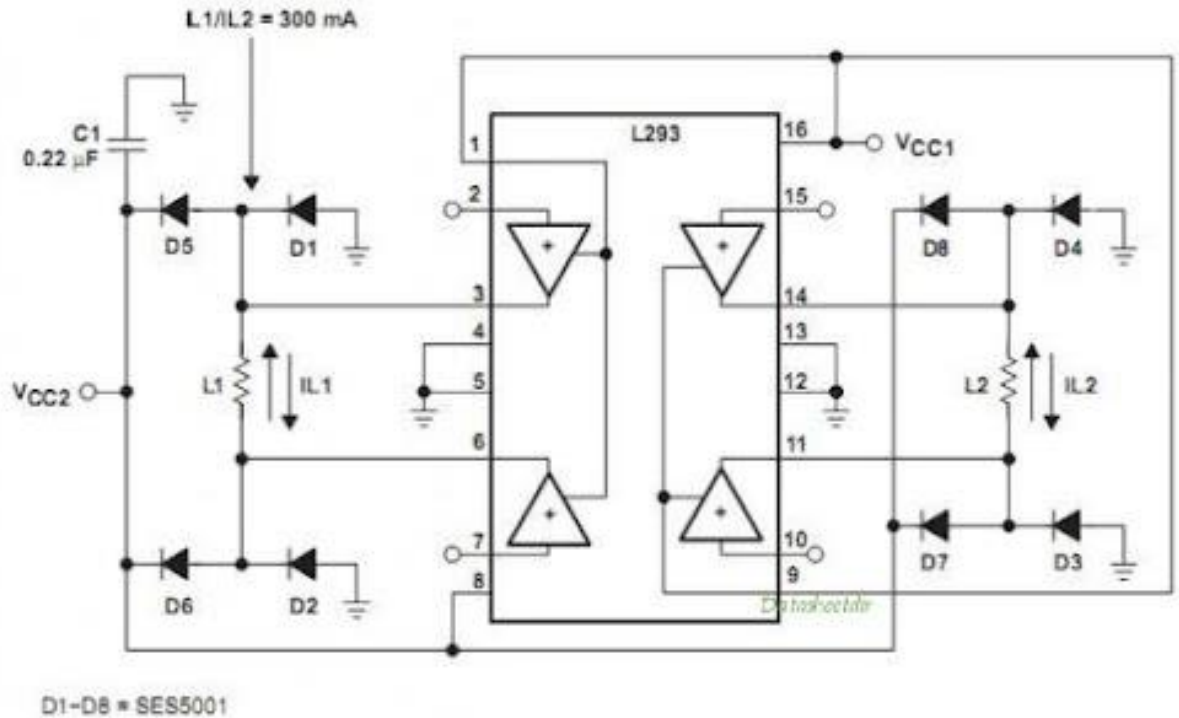
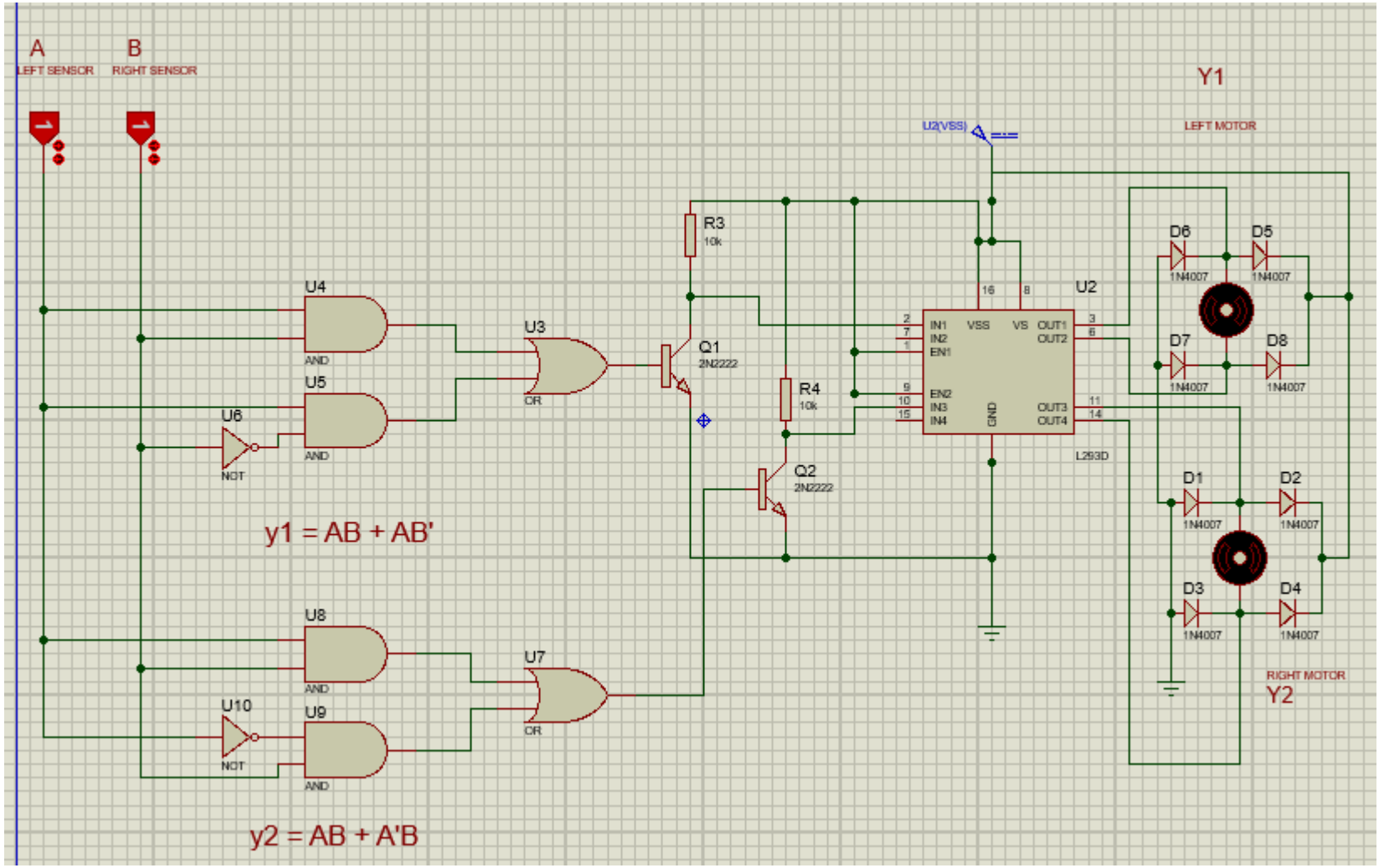
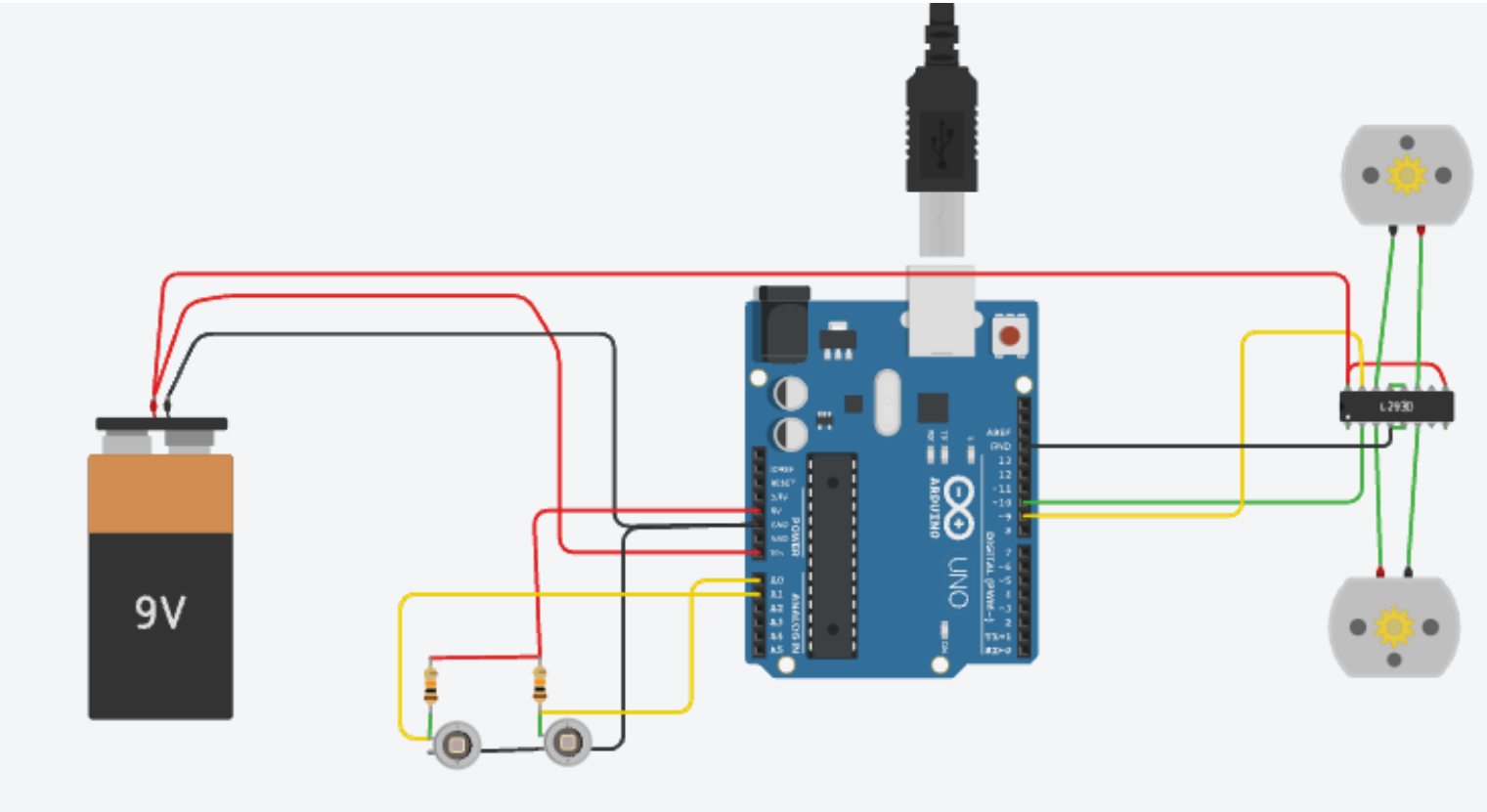


Figure 6. Bipolar Stepping-Motor Control

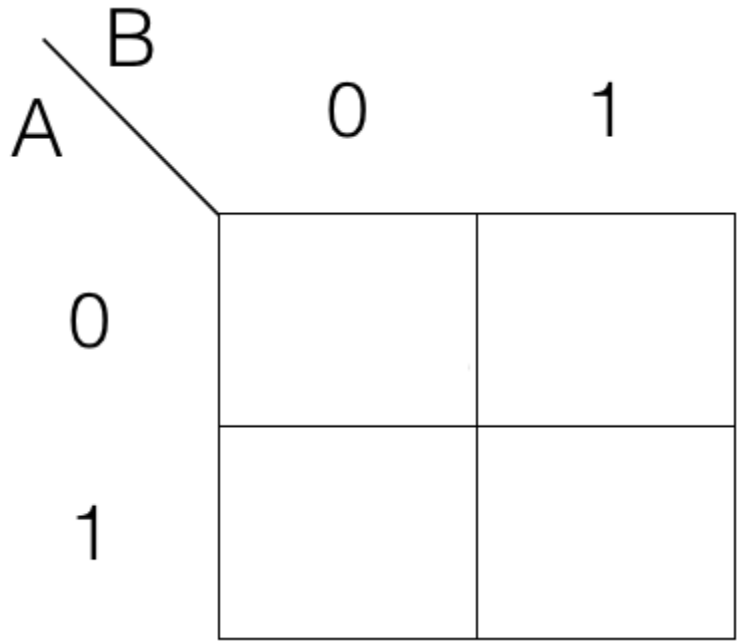
cheatsheet


A
LEFT SENSOR
B
RIGHT SENSOR
Y1
LEFT MOTOR
U2(VSS)
R3
10k
U4
AND
U5
AND
U6
NOT
U3
OR
Q1
2N2222
R4
10k
Q2
2N2222
U2
IN1
IN2
EN1
EN2
IN3
IN4
VSS
VS
GND
OUT1
OUT2
OUT3
OUT4
L293D
D6
D5
D7
D8
D1
D2
D3
D4
1N4007
y1 = AB + AB'
U8
AND
U10
NOT
U9
AND
U7
OR
y2 = AB + A'B
RIGHT MOTOR
Y2

Lets do that using microcontroller

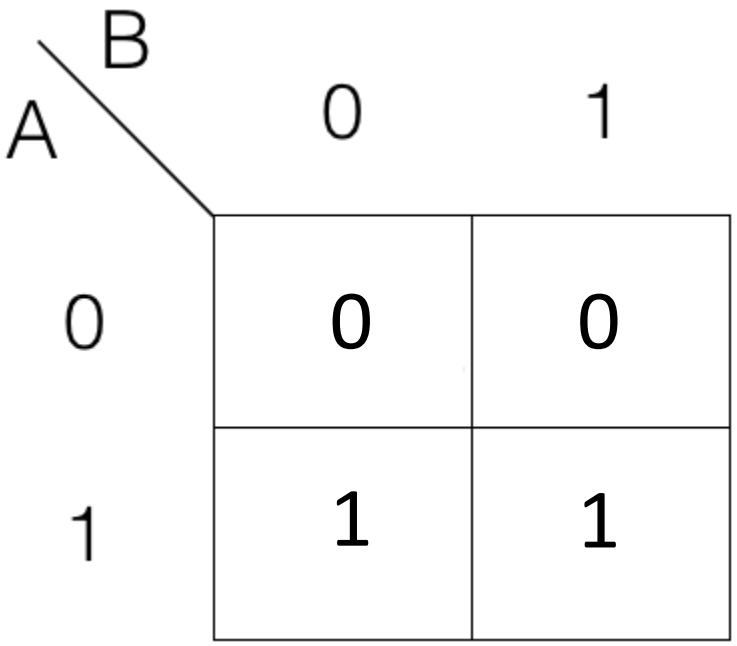


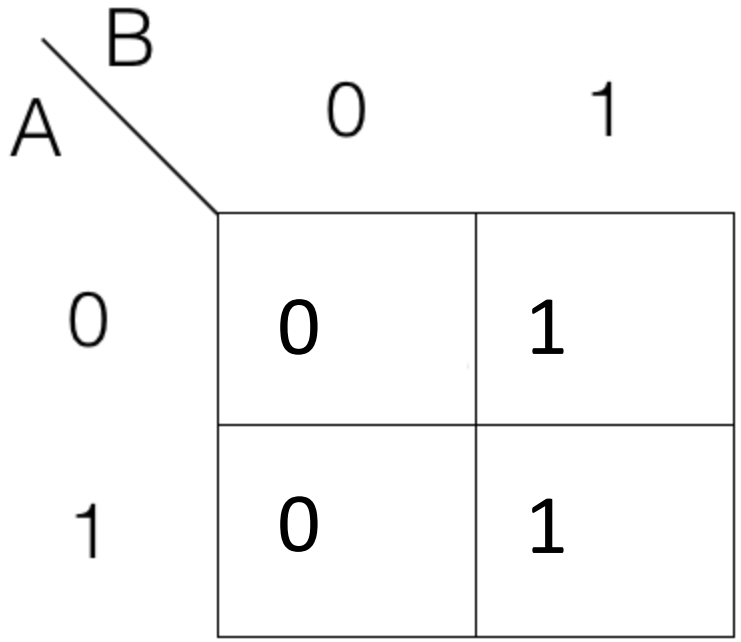
Wow so complicated ☺. This circuit can be simplified using karnough map. But how ?



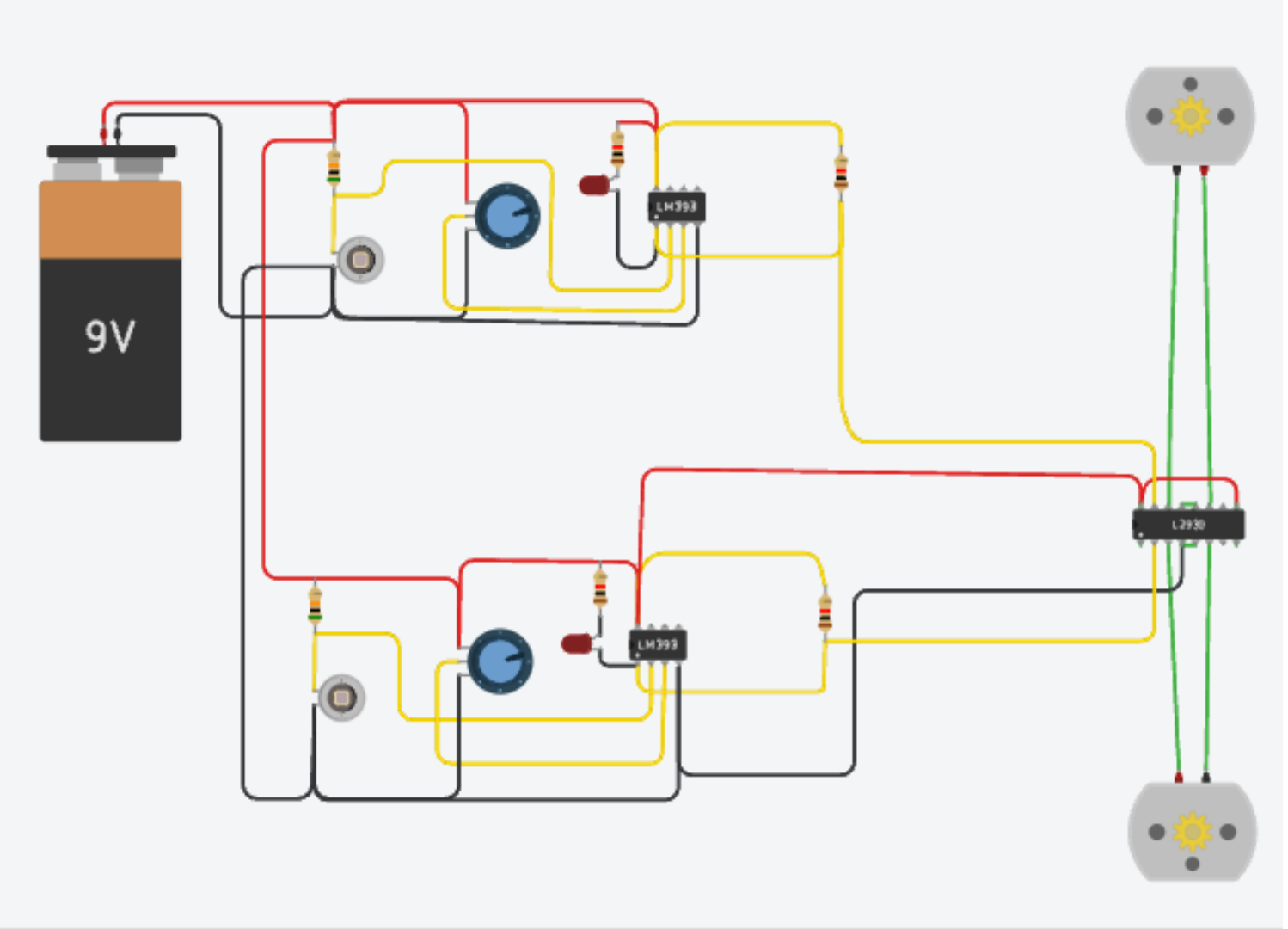
no	left sensor (A)	right sensor (B)	left motor (y1)
1	0	0	0
2	0	1	0
3	1	0	1
4	1	1	1

no	left sensor (A)	right sensor (B)	right motor (y2)
1	0	0	0
2	0	1	1
3	1	0	0
4	1	1	1

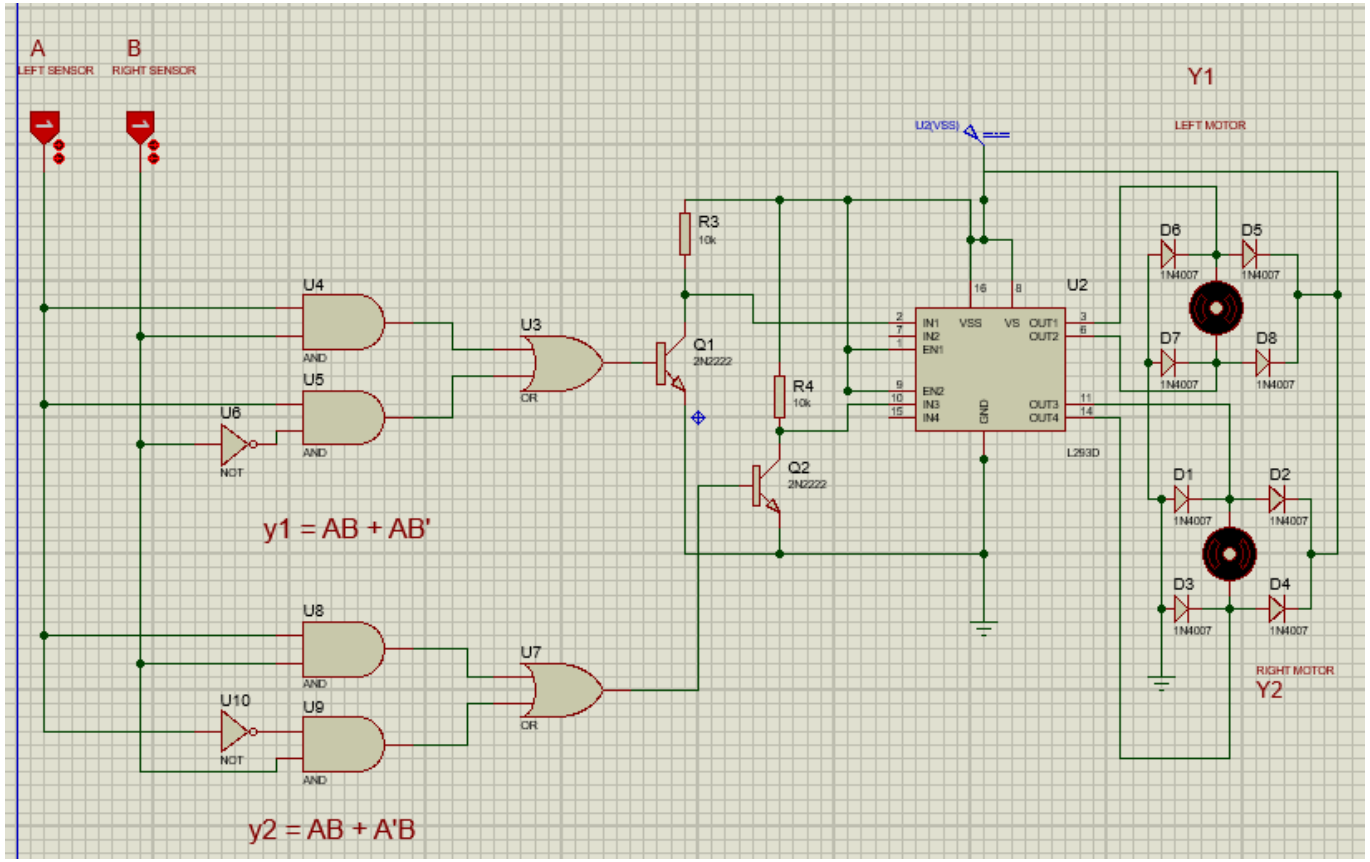




tadaa

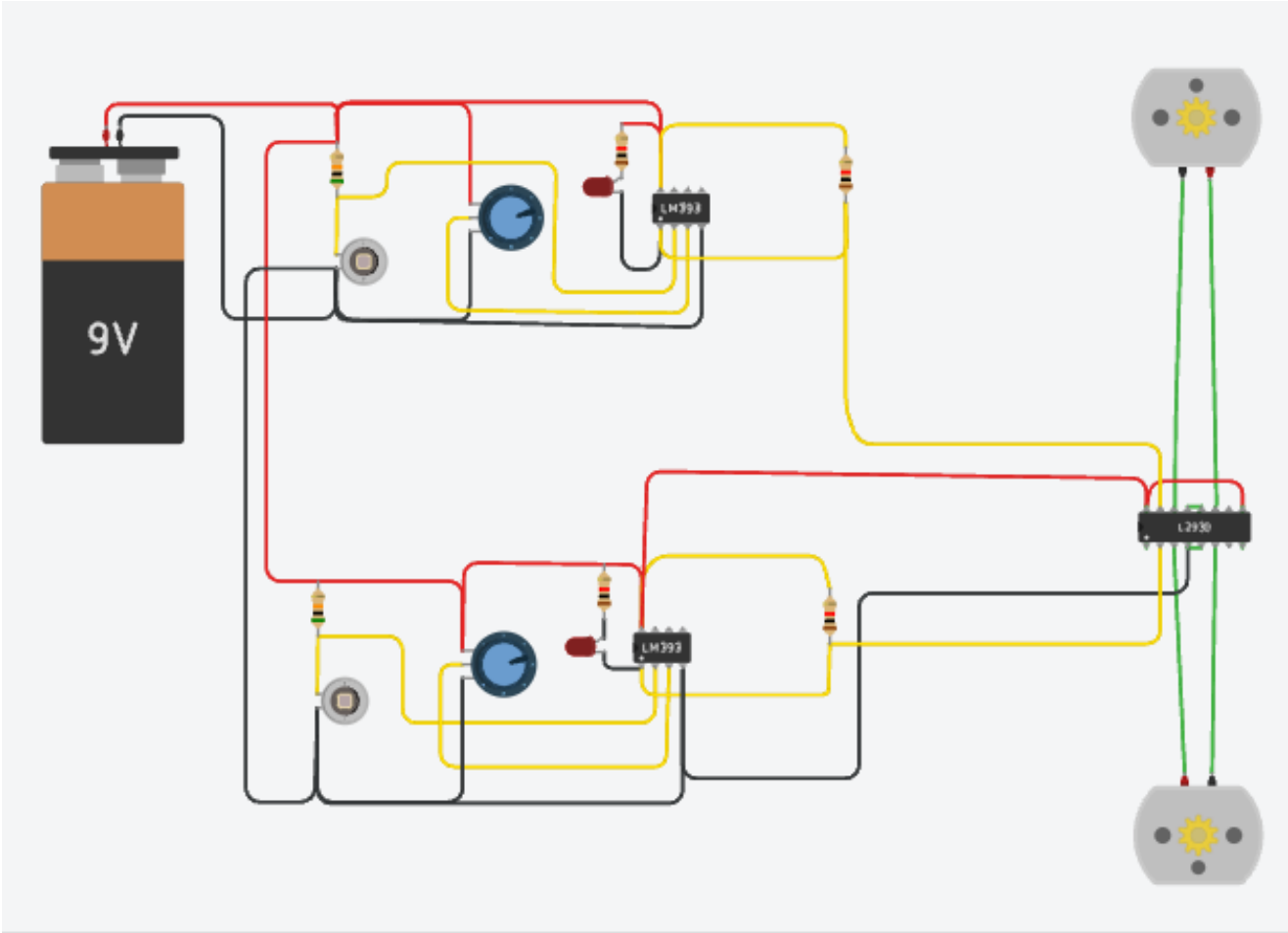


before

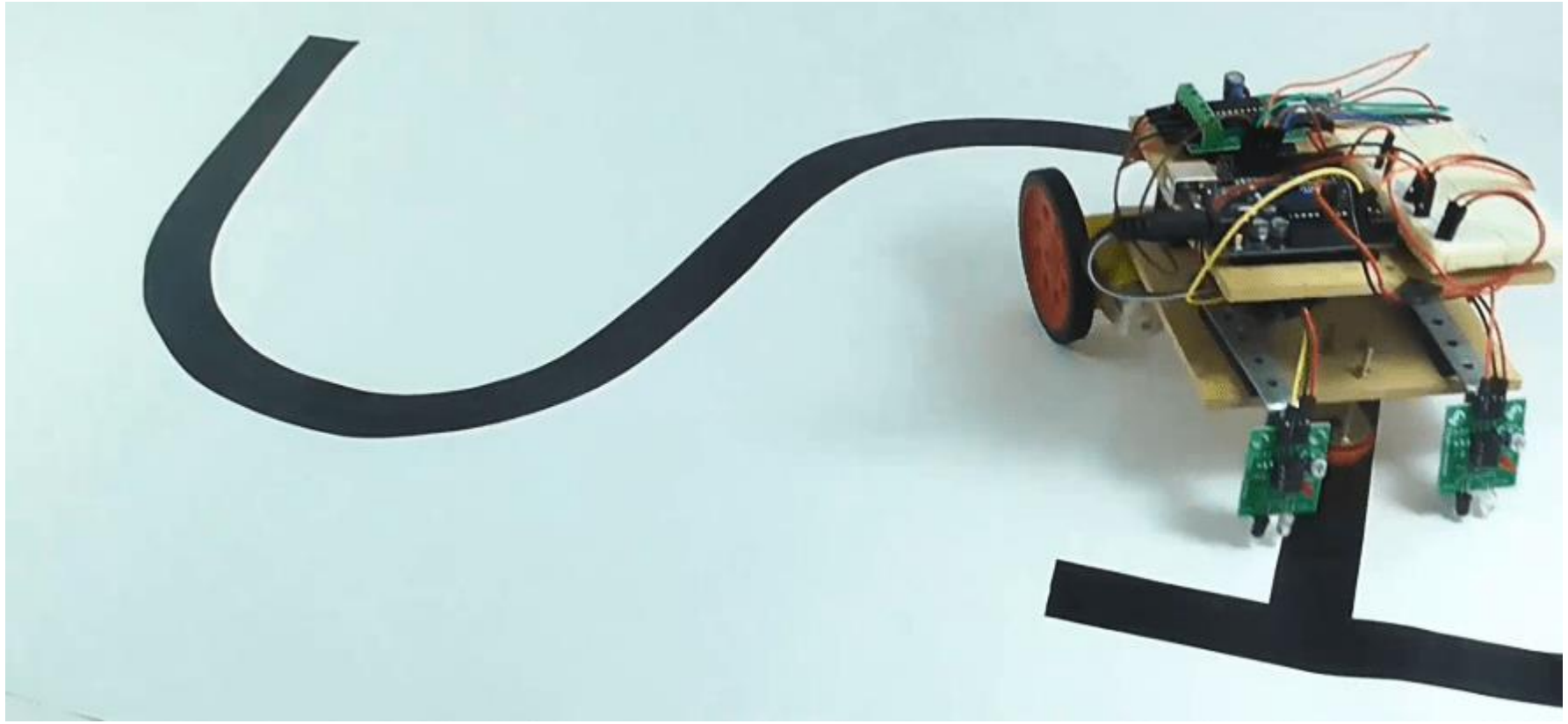

A
LEFT SENSOR
B
RIGHT SENSOR
Y1
LEFT MOTOR
U2(VSS)
R3
10k
U4
AND
U5
AND
U6
NOT
U3
OR
Q1
2N2222
R4
10k
Q2
2N2222
U2
IN1
IN2
EN1
VSS
VS
OUT1
OUT2
EN2
IN3
IN4
GND
OUT3
OUT4
L293D
D6
D5
D7
D8
D1
D2
D3
D4
1N4007
y1 = AB + AB'
U8
AND
U9
AND
U10
NOT
U7
OR
RIGHT MOTOR
Y2
y2 = AB + A'B

A \ B	0	1
0		
1		

after



More feature ! Line follower level 2 (+ speed control)



https://van.physics.illinois.edu › listing › t=variable-speed-...

Q & A: Variable speed DC motors - Physics Van

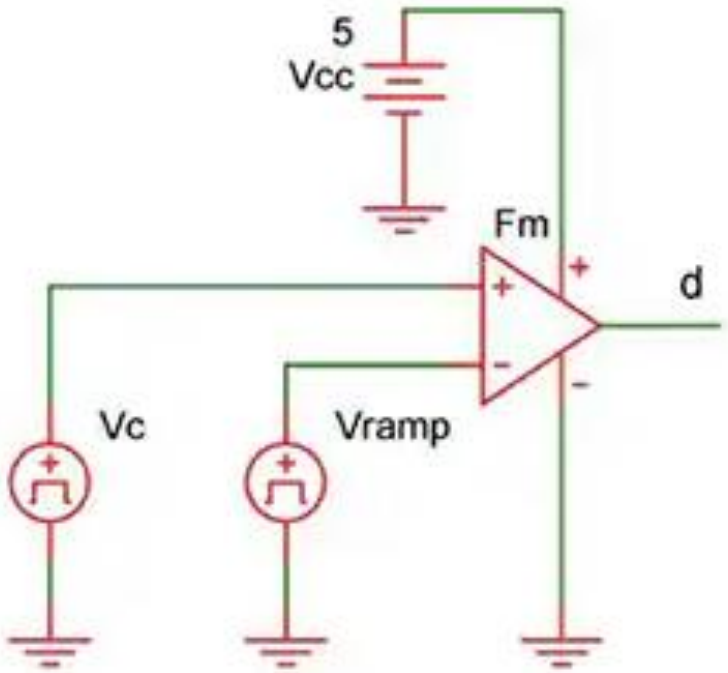
Search for: Can any DC motor be variable speed?

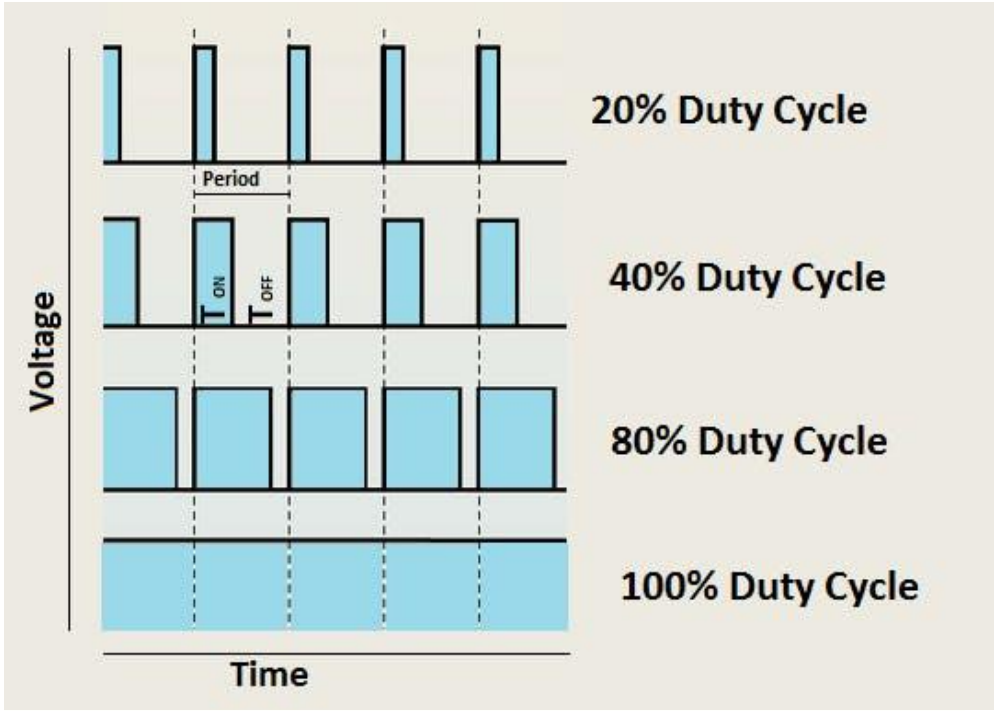
How do you increase the speed of a DC motor?

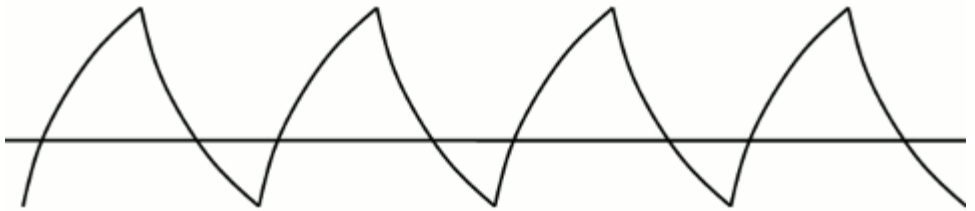
Thus, the speed of a DC motor can be controlled in three ways:

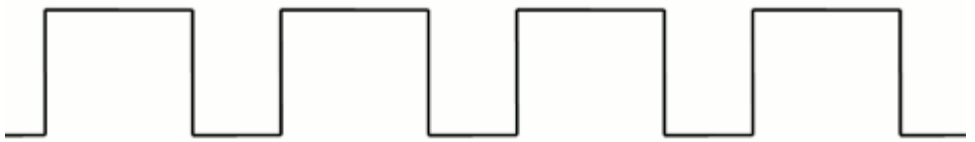
1. By varying the supply voltage.
2. By varying the flux, and by varying the current through the field winding.
3. By varying the armature voltage, and by varying the armature resistance.

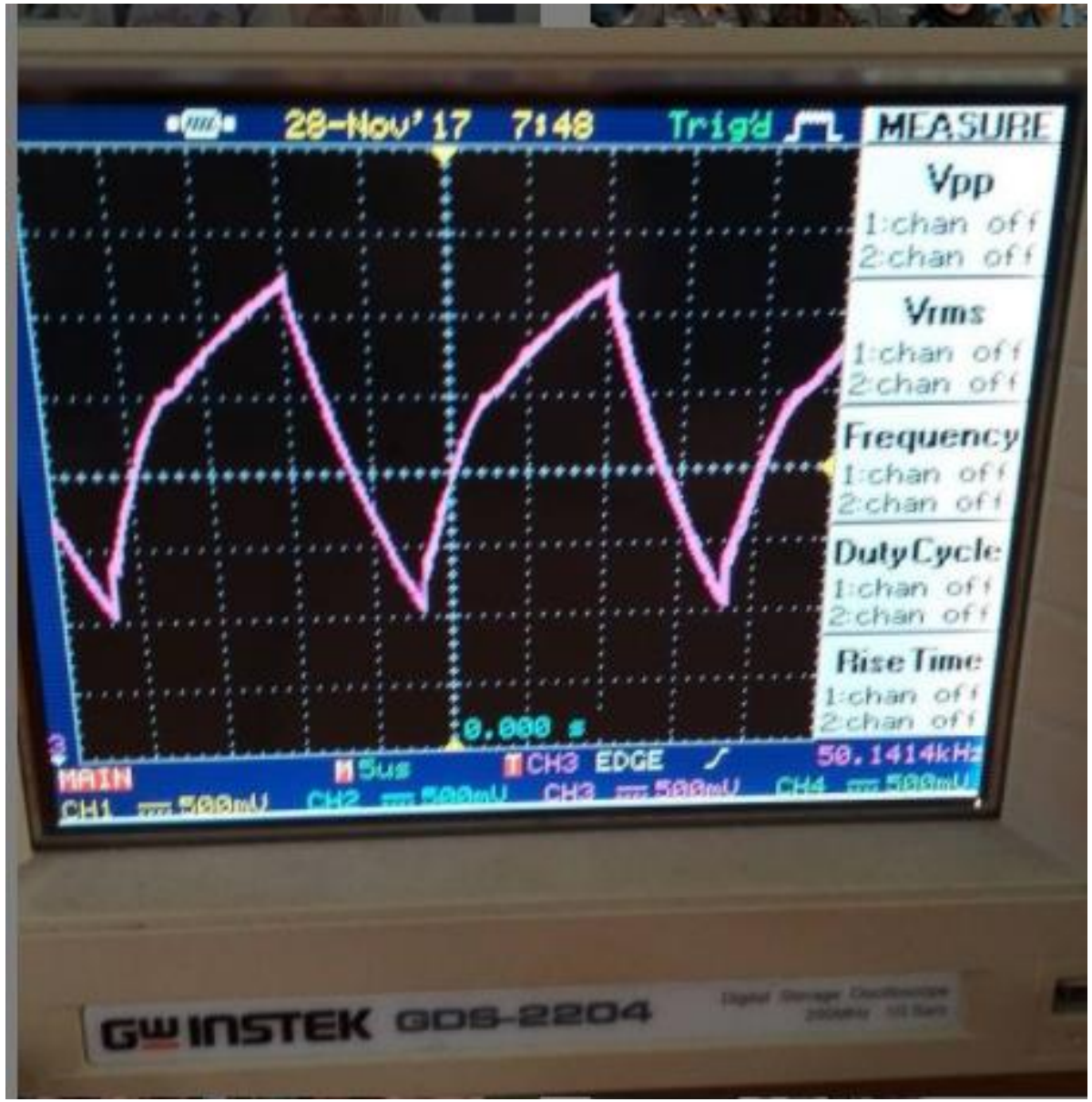
Pulse width modulation



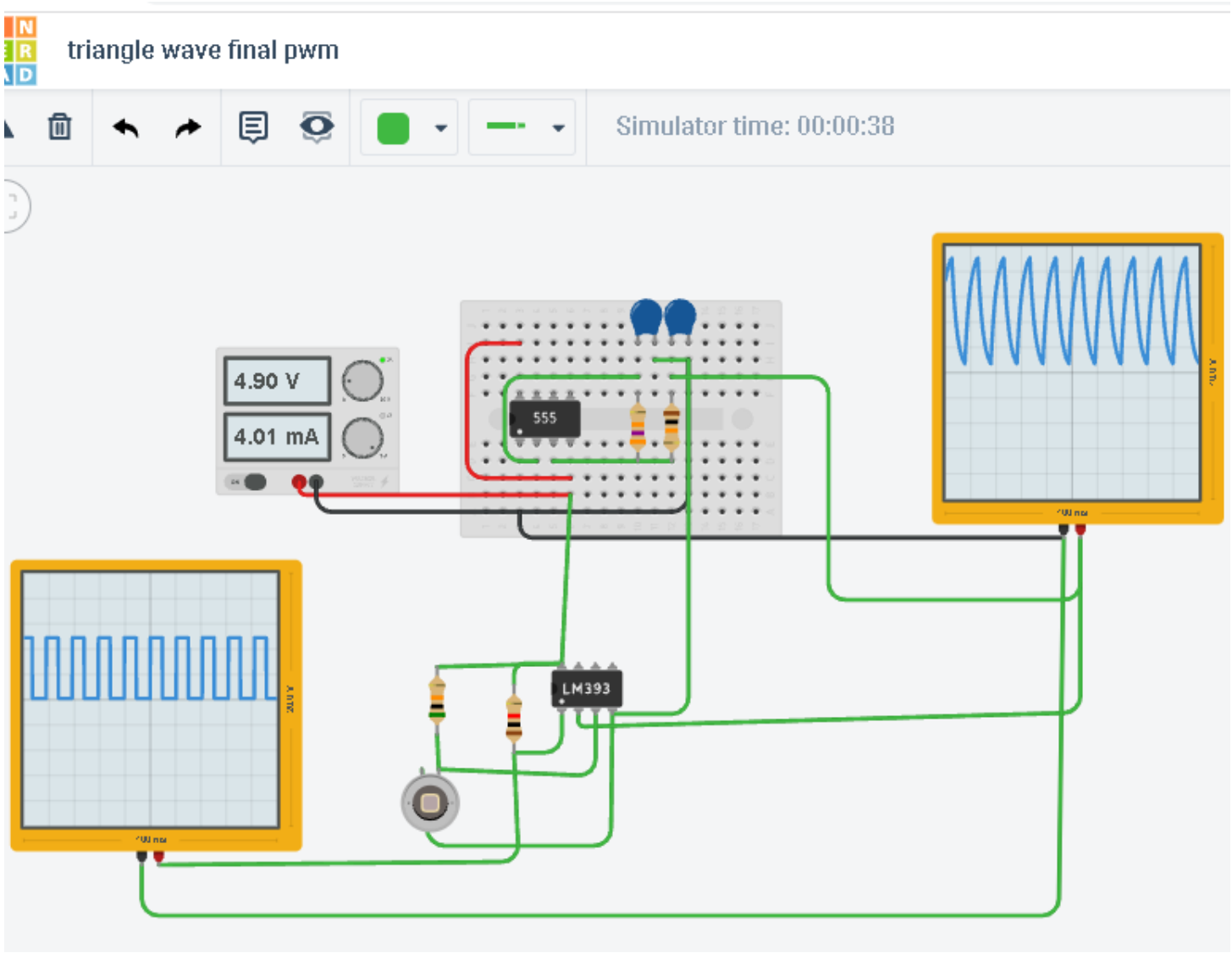




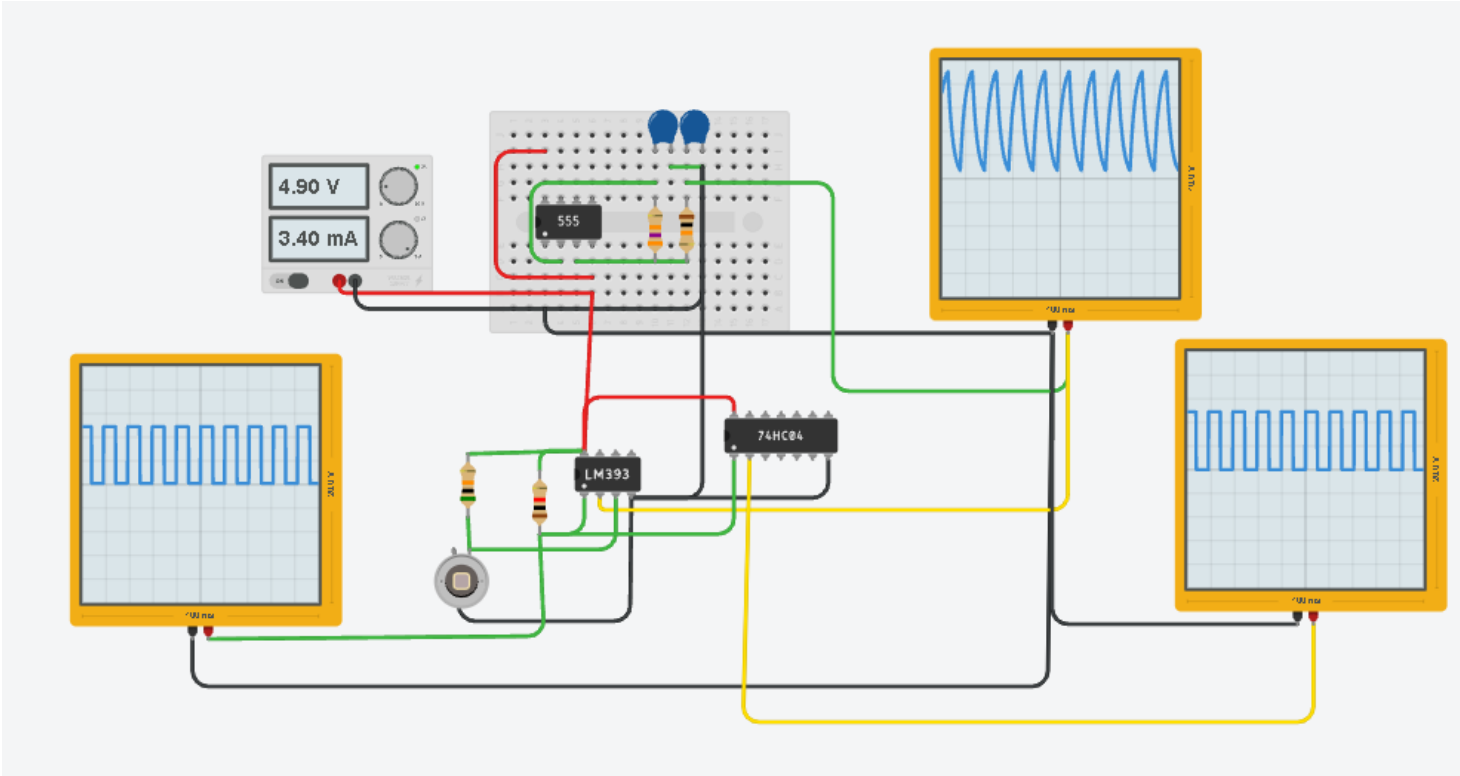



28-Nov'17 7:48 Trig'd
MEASURE
Vpp
1:chan off
2:chan off
Vrms
1:chan off
2:chan off
Frequency
1:chan off
2:chan off
Duty Cycle
1:chan off
2:chan off
Rise Time
1:chan off
2:chan off
0.000 s
MAIN
5us
CH3 EDGE
50.1414kHz
CH1 500mV
CH2 500mV
CH3 500mV
CH4 500mV
GW INSTEK GDS-2204

Without microcontroller



Without microcontroller



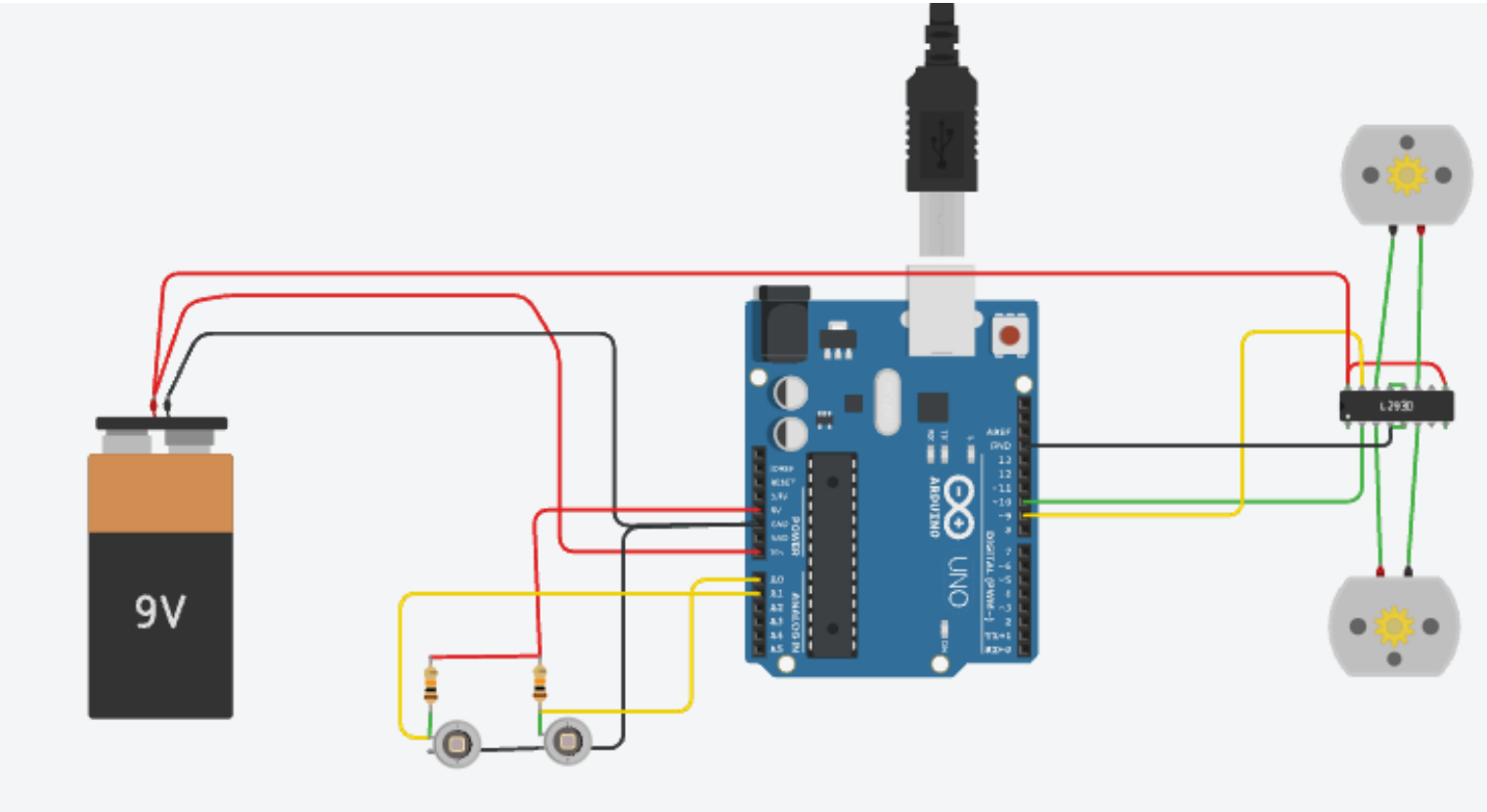
https://www.tinkercad.com/things/a7kNW9M3kSS-triangle-wave-final-pwm-2

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
	Supply voltage	V_{CC1}	4.5		7	V
		V_{CC2}	V_{CC1}		36	
V_{IH}	High-level input voltage	$V_{CC1} \leq 7$ V	2.3		V_{CC1}	V
		$V_{CC1} \geq 7$ V	2.3		7	V
V_{IL}	Low-level output voltage		–0.3 (1)		1.5	V
T_A	Operating free-air temperature		0		70	°C

With microcontroller



analogWrite(left_motor_pin, left_motor_speed);

analogWrite(pwm_pin, duty_cycle);

Next level of microcontroller project

$$X_1 = R \cdot \cos(\phi_1) \cdot \cos(\theta_1) \tag{6a}$$
$$X_2 = R \cdot \cos(\phi_2) \cdot \cos(\theta_2) \tag{6b}$$
$$Y_1 = R \cdot \sin(\theta_1) + H_1 \tag{6c}$$
$$Y_2 = R \cdot \sin(\theta_2) + H_2 \tag{6d}$$
$$Z_1 = R \cdot \sin(\phi_1) \tag{6e}$$
$$Z_2 = R \cdot \sin(\phi_2) \tag{6f}$$

The dx and dz are estimated as :

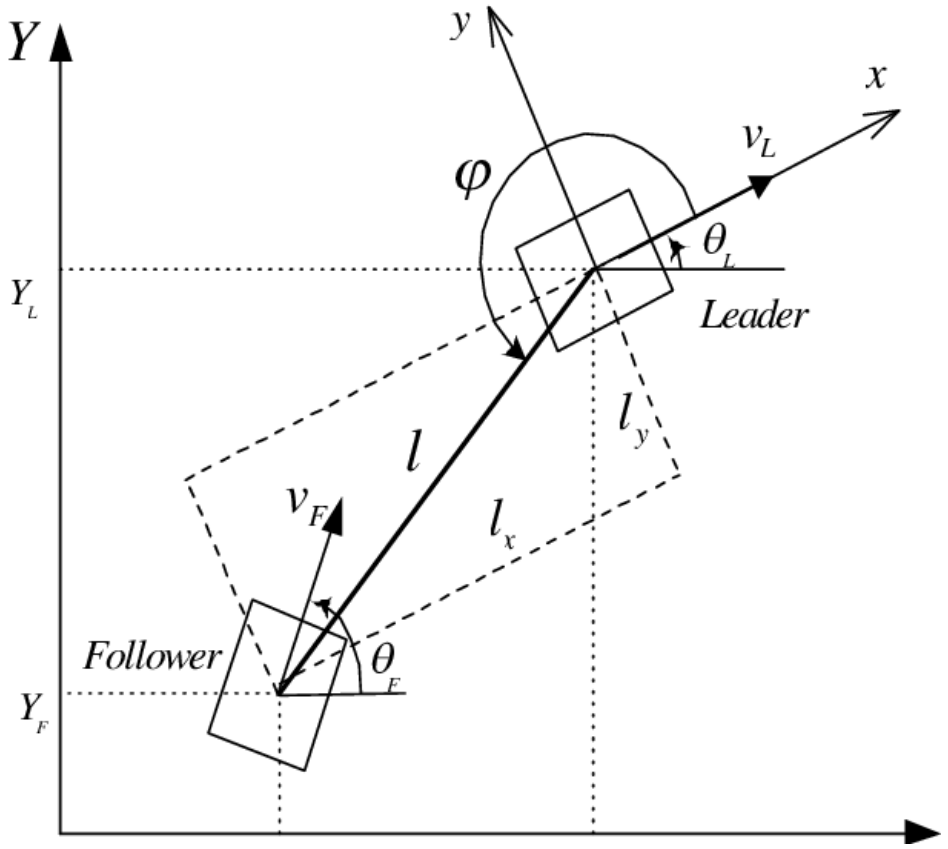
$$dx = X_2 - X_1$$
$$\Rightarrow dx = R \cdot [\cos(\phi_2) \cdot \cos(\theta_2) - \cos(\phi_1) \cdot \cos(\theta_1)] \tag{7a}$$
$$dz = Z_2 - Z_1$$
$$\Rightarrow dz = R \cdot [\sin(\phi_2) - \sin(\phi_2)] \tag{7b}$$

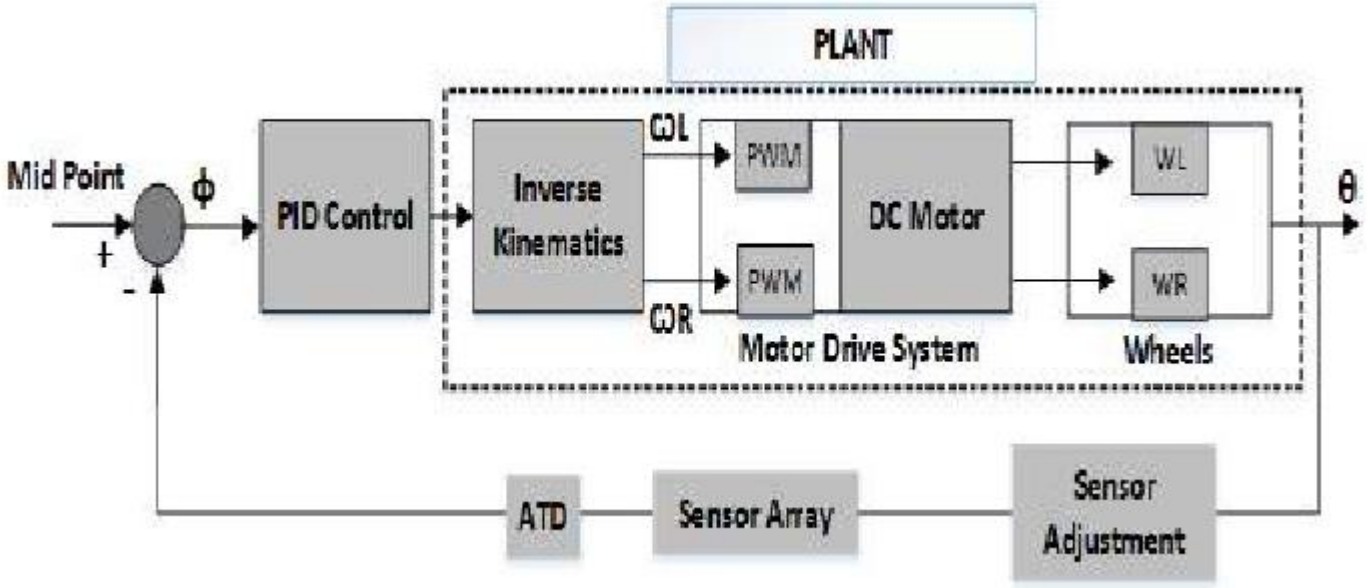
The relation between the dy and dy' is :

$$dy = Y_2 - Y_1$$
$$\Rightarrow dy = R \cdot [\sin(\theta_2) - \sin(\theta_2)] + dy' \tag{7c}$$

The differential factors dx, dy, dz and dt are used to find velocities $v_x = dx/dt$, $v_y = dy/dt$ and $v_z = dz/dt$ of the shuttlecock and further used to solve the trajectory equations (4a), (3a) and (3c).

Next level of microcontroller project





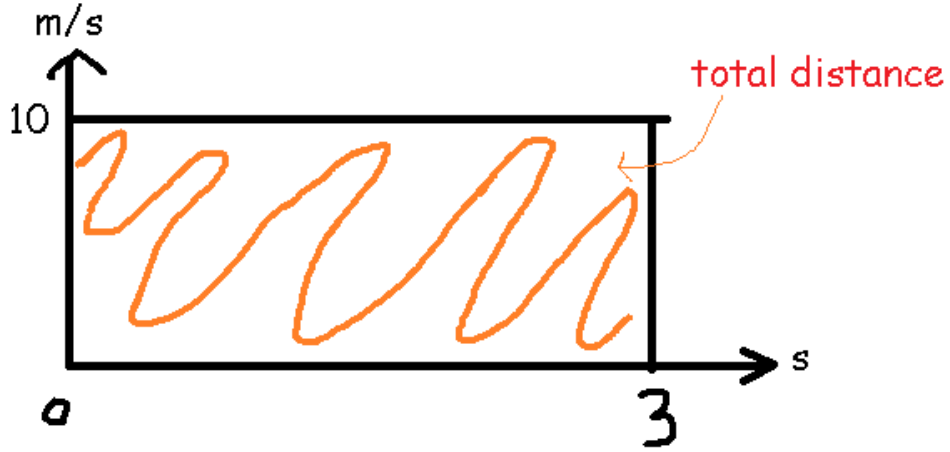
Count total distance

m 50

m 0

	Derivative Form	Integral Form
Position	$r(t)$	$r(t) = r_0 + \int_0^t v dt'$

Two ways to calculate total distance



Speed = 10

Way 2:

$$pos = \int_0^3 speed \ dt$$

Way 1:
(luas persegi Panjang)
pos = 3s x 10m/s = 30m

$$pos = \int_0^3 10 \ dt$$

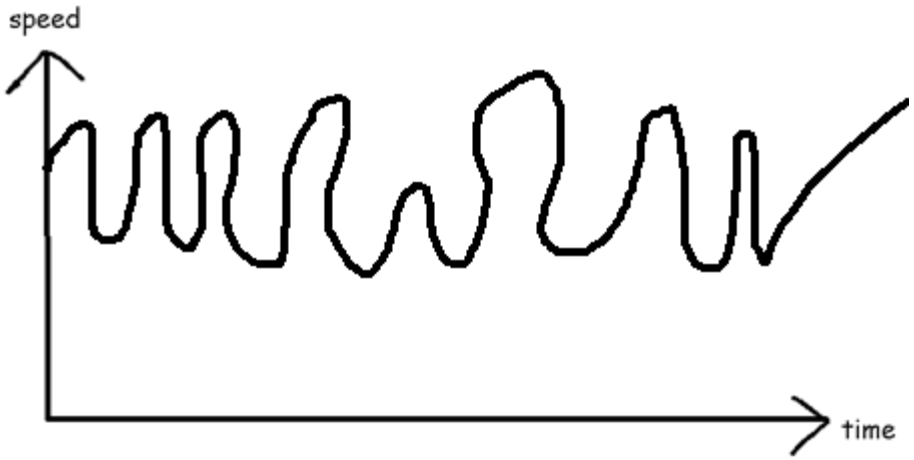
$$pos = 10t$$

Total distance

$$pos = 10 \, x \, 3$$

$$pos = 30$$

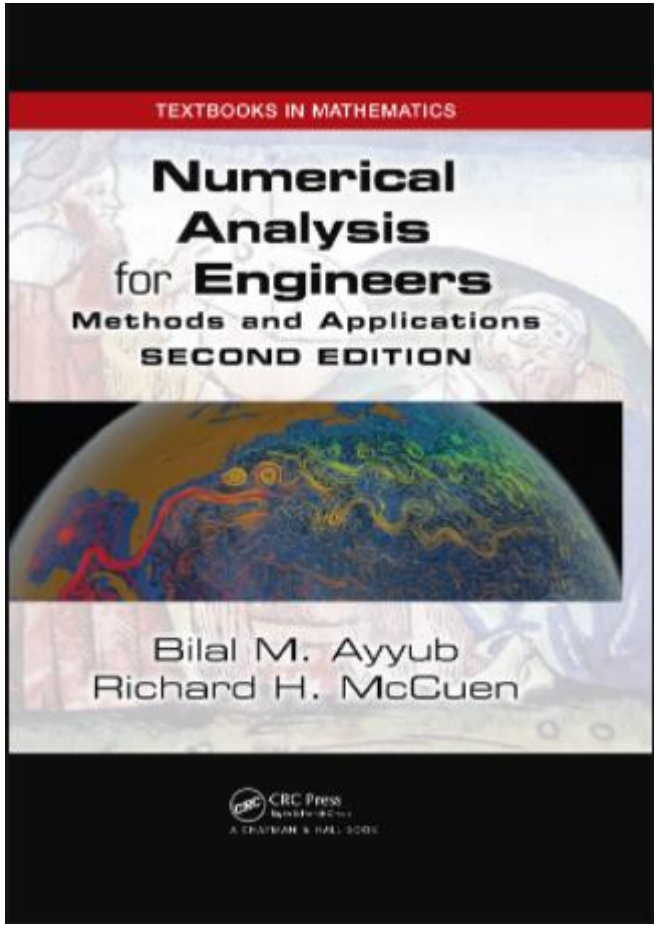
???????

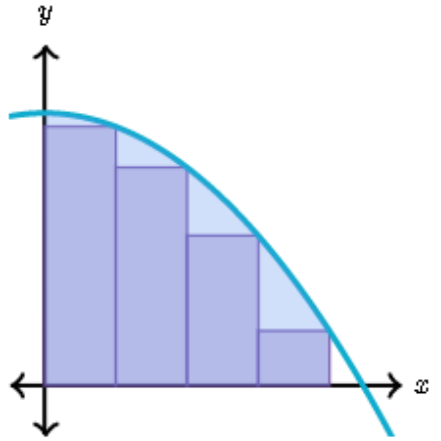


$$pos = \int_0^3 speed \; dt$$

	Derivative Form	Integral Form
Position	$r(t)$	$r(t) = r_0 + \int_0^t v dt'$

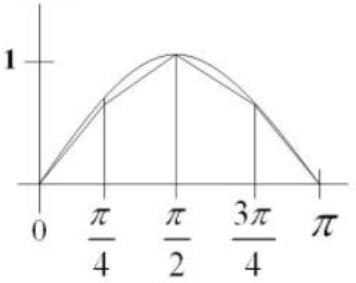
How to convert integral to code





Use the Trapezoidal Rule to approximate

$$\int_0^{\pi} \sin x\,dx \qquad Let \quad n = 4$$



$$h = \frac{b-a}{n} = \frac{\pi - 0}{4}$$

$$Area = \frac{\pi}{(2)4}\left(f(0) + 2f\left(\frac{\pi}{4}\right) + 2f\left(\frac{\pi}{2}\right) + 2f\left(\frac{3\pi}{4}\right) + f(\pi) \right)$$

$$= \frac{\pi}{8}\left(0 + 2\left(\frac{\sqrt{2}}{2}\right) + 2(1) + 2\left(\frac{\sqrt{2}}{2}\right) + 0 \right) \approx 1.896$$

Google

riemann sum

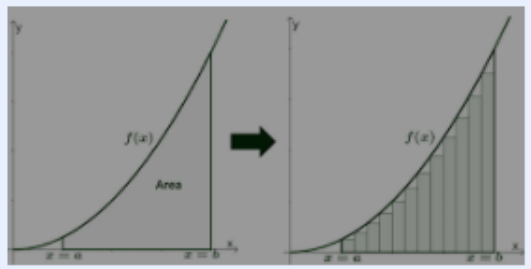
$$S = \sum_{i=1}^{n} f(x_i^*)(x_i - x_{i-1}) \qquad x_{i-1} \le x_i^* \le x_i$$

Left Riemann sum: $x_i^* = x_{i-1}$ for all i

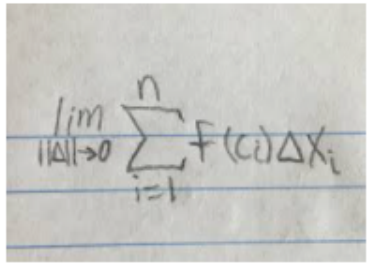
Right Riemann sum: $x_i^* = x_i$ for all i

Middle Riemann sum: $x_i^* = \frac{1}{2}(x_i + x_{i-1})$ for all i

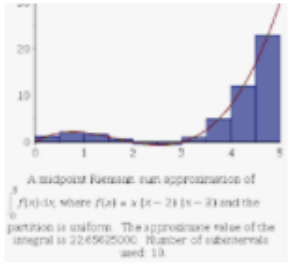
Riemann Sums
sites.google.com



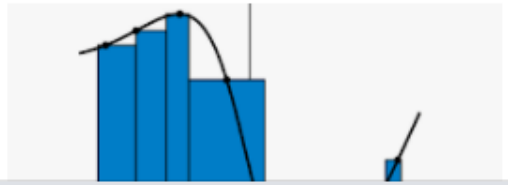
Riemann Sum – Two Rules, Approximations, a...
storyofmathematics.com

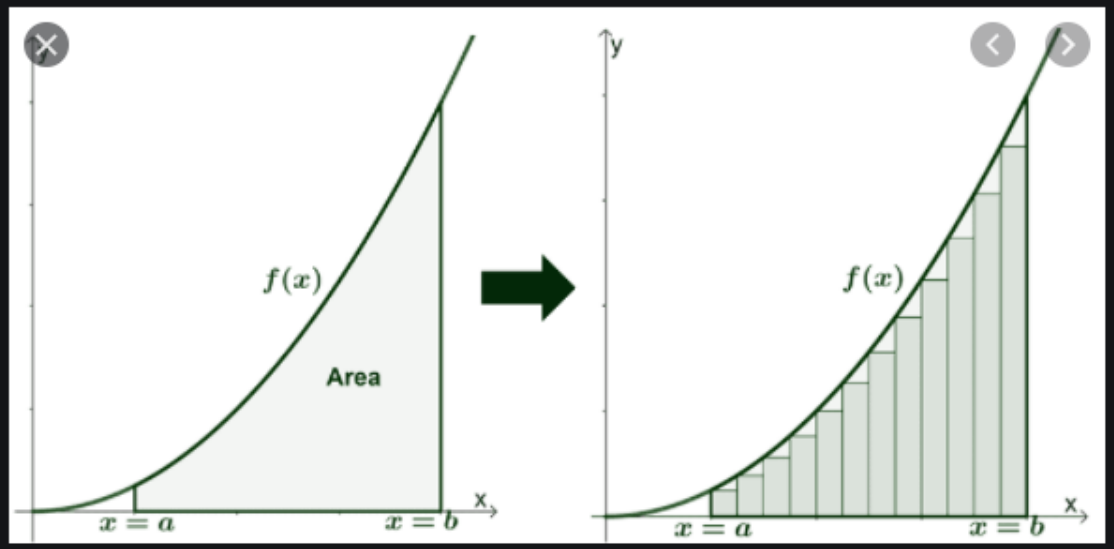


Definite integral as a limit of a ...
reddit.com



Midpoint Riemann Sum ...
de.maplesoft.com



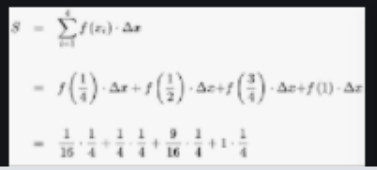


The Story of Mathematics

Riemann Sum – Two Rules, Approximations, and Examples

Gambar bisa saja memiliki hak cipta. Pelajari Lebih Lanjut

Gambar yang terkait



Test drive soal SMA

$$V(t) = \int_0^3 (t^2 + 2t)\, dt$$

$$v(t) = \int (t^2+2t)dt$$

$$= \frac{1}{3}t^3 + t^2 + c \qquad \rightarrow \text{karna } v(0) = 0, \text{ maka}$$

$$\frac{1}{3}(0)^3 + 0^2 + c = 0$$

$$c = 0$$

kecepatan partikel setelan 3 sekon,

$$v(t) = \frac{1}{3}t^3 + t^2$$

$$v(3) = \frac{1}{3}.3^3 + 3^2 = 18 \text{ m/s}$$

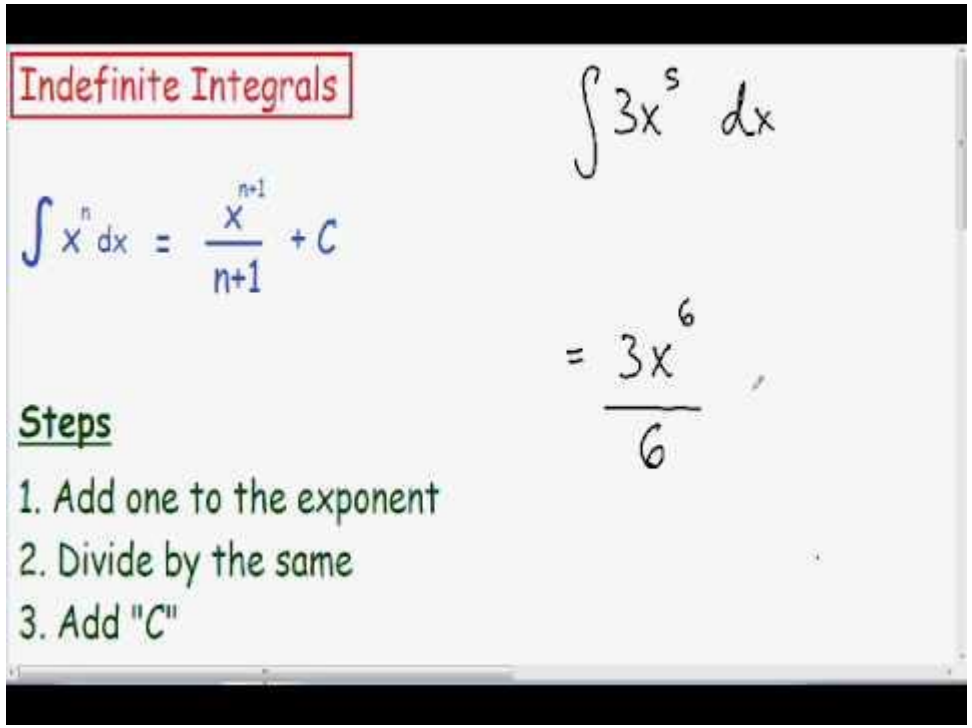
```
12  void loop() {
13   if (t < stop_time){
14     x_dot = (pow(t,2)+2*t);
15
16     x = x+ x_dot*dt;
17      Serial.print("t : ");
18      Serial.print(t);
19     Serial.print(" x_dot  : ");
```

Serial Monitor

```
t : 2.97 x_dot  : 14.753 x  : 17.577 dt  : 0.005
t : 2.97 x_dot  : 14.793 x  : 17.651 dt  : 0.005
t : 2.98 x_dot  : 14.833 x  : 17.725 dt  : 0.005
t : 2.98 x_dot  : 14.872 x  : 17.814 dt  : 0.006
t : 2.99 x_dot  : 14.920 x  : 17.874 dt  : 0.004
t : 2.99 x_dot  : 14.952 x  : 17.949 dt  : 0.005
t : 3.00 x_dot  : 14.992 x  : 18.024 dt  : 0.005
t : 3.00 x_dot  : 14.992 x : 18.02376
```


I WANT TO PLAY A GAME
quickmeme.com

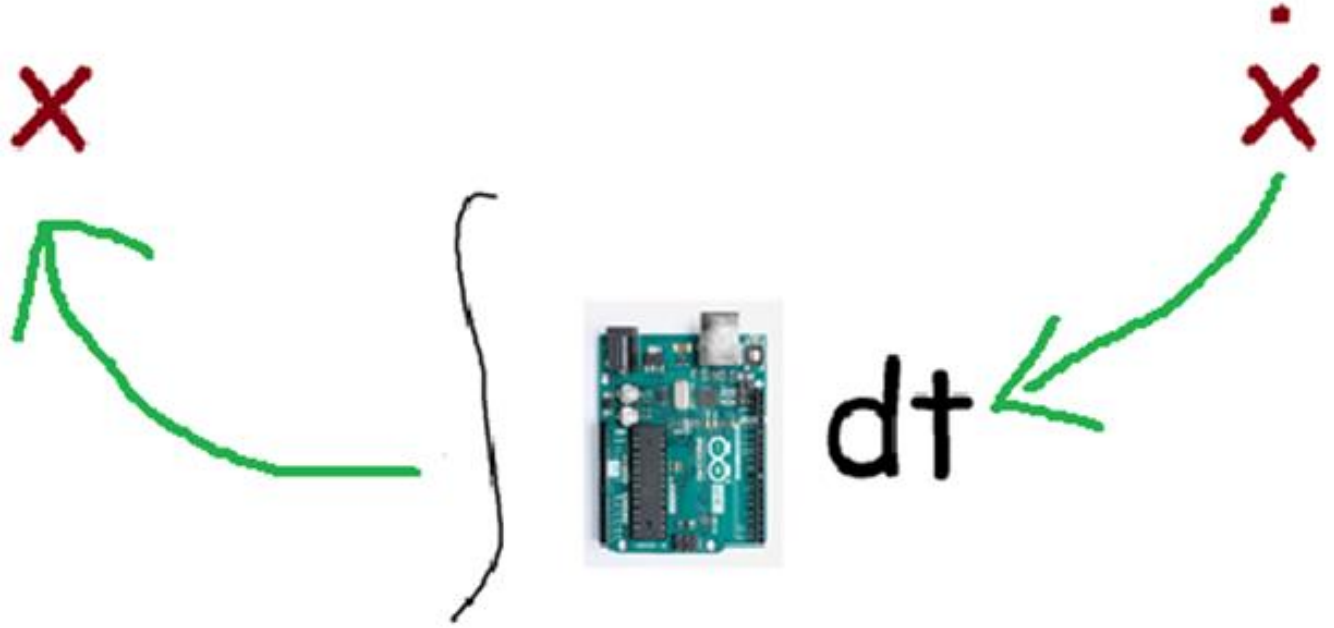
Fill the box challenge. Use traditional way

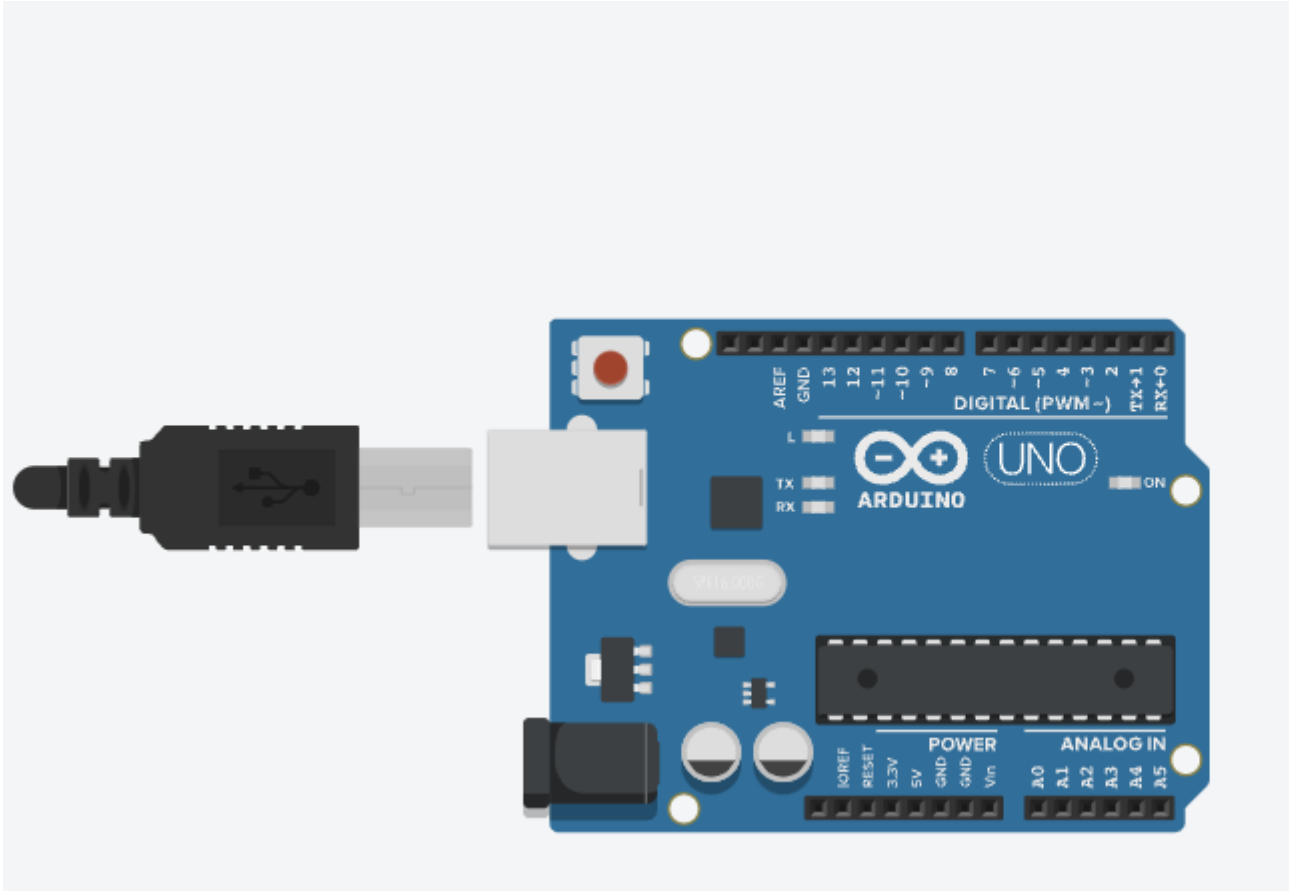


$$\int_{0}^{\square} \square\, t^{\square}\, dt = \frac{\square}{\square}\, t^{\square}\Big|_{0}^{\square}$$

$$= \square$$

Lets solve that problem using arduino





Text

```
4  float timePrev;
5  float Time;
6  float stop_time = 3;
7  float x_dot;
8  void setup() {
9    Serial.begin(115200);
10 }
11
12 void loop() {
13  if (t < stop_time){
14    x_dot = (pow(t,2)+2*t);
15
16    x = x+ x_dot*dt;
17     Serial.print("t : ");
18     Serial.print(t);
19    Serial.print(" x_dot  : ");
```

Serial Monitor

```
t : 2.97 x_dot  : 14.753 x  : 17.577 dt  : 0.005
t : 2.97 x_dot  : 14.793 x  : 17.651 dt  : 0.005
t : 2.98 x_dot  : 14.833 x  : 17.725 dt  : 0.005
t : 2.98 x_dot  : 14.872 x  : 17.814 dt  : 0.006
t : 2.99 x_dot  : 14.920 x  : 17.874 dt  : 0.004
t : 2.99 x_dot  : 14.952 x  : 17.949 dt  : 0.005
t : 3.00 x_dot  : 14.992 x  : 18.024 dt  : 0.005
t : 3.00 x_dot  : 14.992 x : 18.02376
```

https://www.tinkercad.com/things/jyouWc7HNkb-integral-riemann-sum


ENGINEERING ACADEMY
Free Class
Integral Diferensial
Untuk Project
Microcontroller
With
Muhammad Husni Muttaqin
Electronics and Control System Engineer
Jumat, 11 Juni 2021 | 19.30 - 21.30
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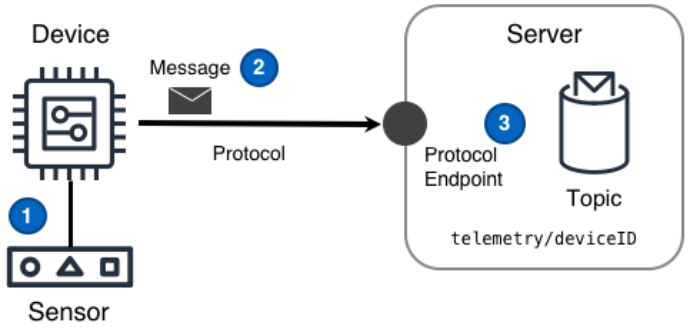
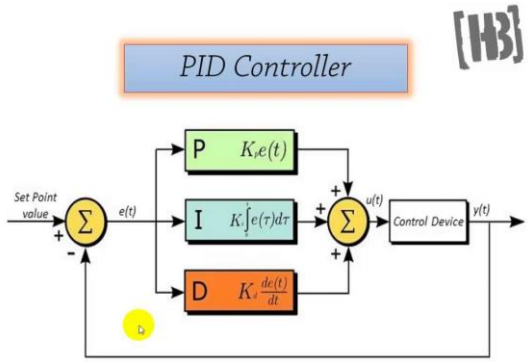
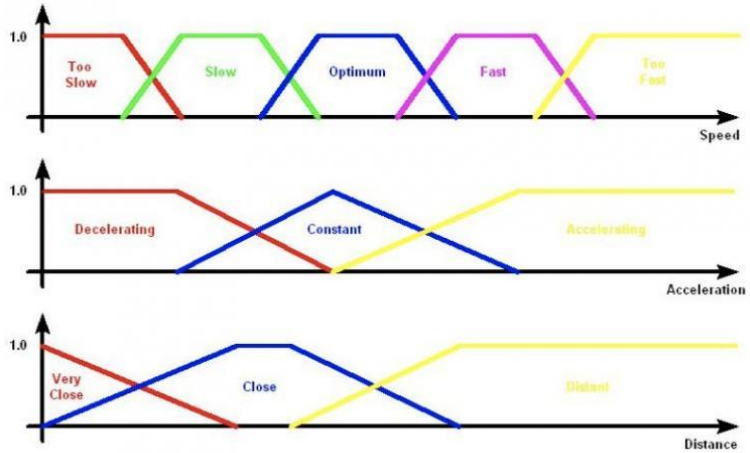
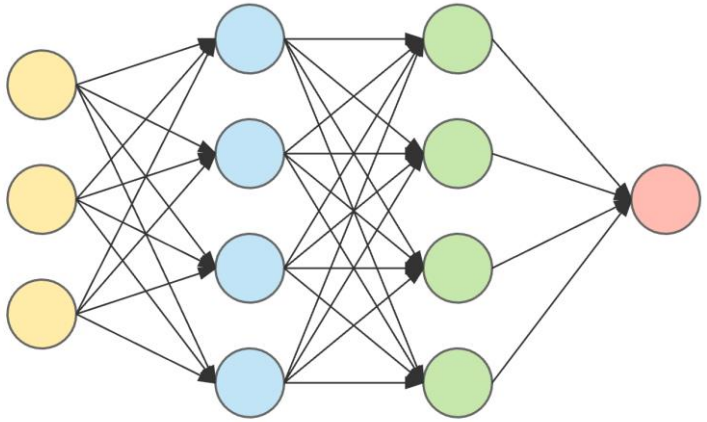
More and more, so you must use microcontroller

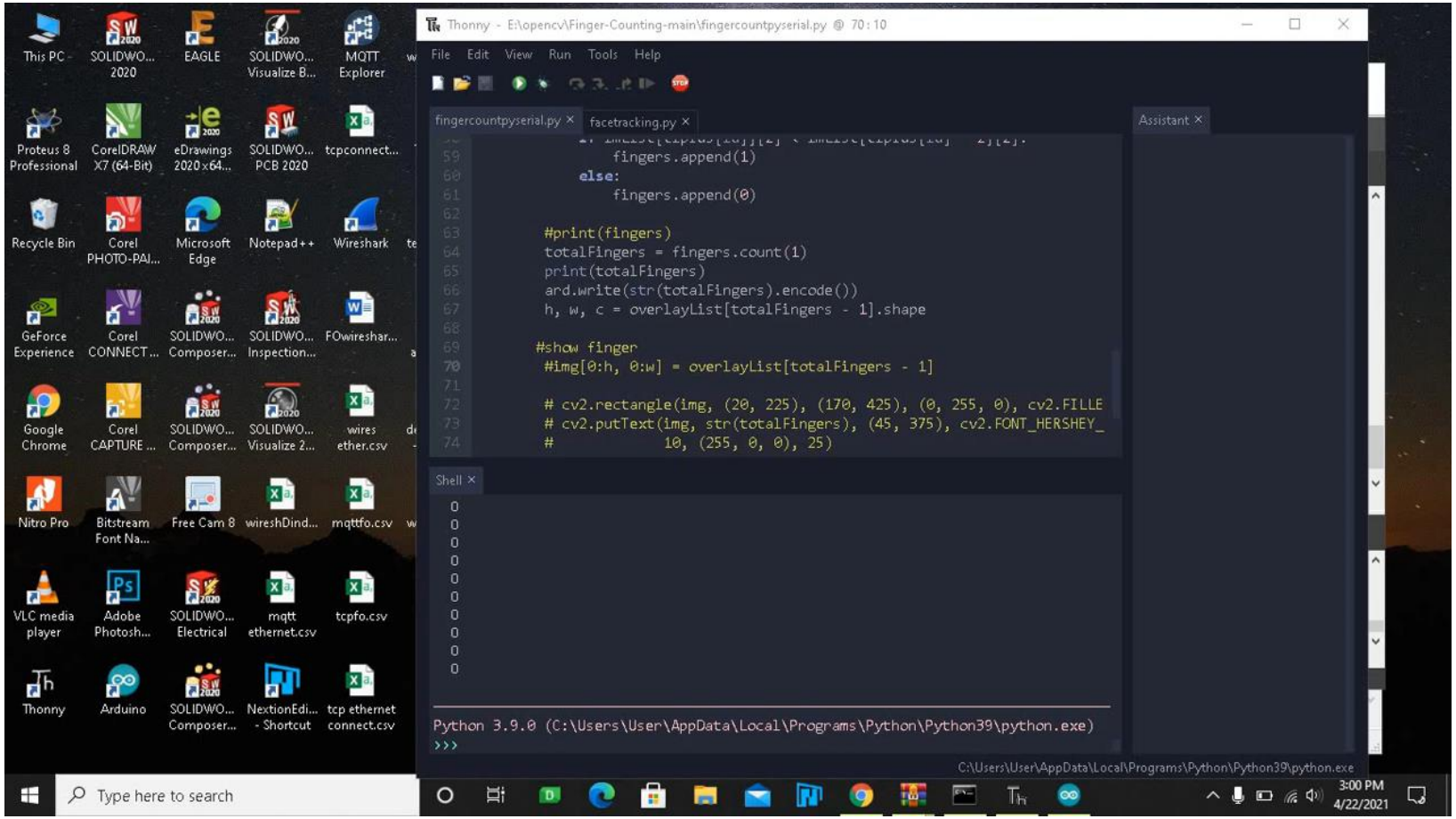








Example :


Thonny - E:\opencv\Finger-Counting-main\fingercountpyserial.py @ 70 : 10
File Edit View Run Tools Help
fingercountpyserial.py ×
facetracking.py ×
Assistant ×
fingers.append(1)
else:
fingers.append(0)
#print(fingers)
totalFingers = fingers.count(1)
print(totalFingers)
ard.write(str(totalFingers).encode())
h, w, c = overlayList[totalFingers - 1].shape
#show finger
#img[0:h, 0:w] = overlayList[totalFingers - 1]
cv2.rectangle(img, (20, 225), (170, 425), (0, 255, 0), cv2.FILLE
cv2.putText(img, str(totalFingers), (45, 375), cv2.FONT_HERSHEY_
10, (255, 0, 0), 25)
Shell ×
0
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Python 3.9.0 (C:\Users\User\AppData\Local\Programs\Python\Python39\python.exe)
>>>
C:\Users\User\AppData\Local\Programs\Python\Python39\python.exe
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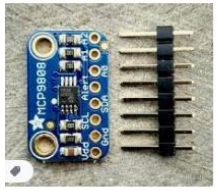
SOLIDWO... Inspection...
FOwireshar...
Google Chrome
Corel CAPTURE ...
SOLIDWO... Composer...
SOLIDWO... Visualize 2...
wires ether.csv
Nitro Pro
Bitstream Font Na...
Free Cam 8
wireshDind...
mqttfo.csv
VLC media player
Adobe Photosh...
SOLIDWO... Electrical
mqtt ethernet.csv
tcpfo.csv
Thonny
Arduino
SOLIDWO... Composer...
NextionEdi... - Shortcut
tcp ethernet connect.csv
Type here to search
3:00 PM
4/22/2021

Not only that. So many sensors that you must use microcontroller



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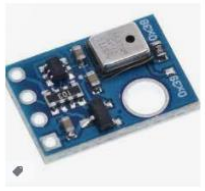
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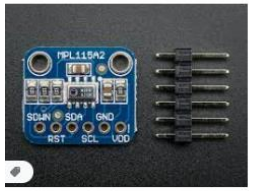

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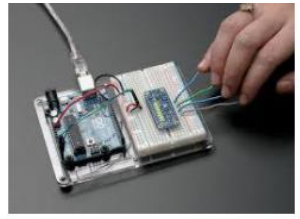
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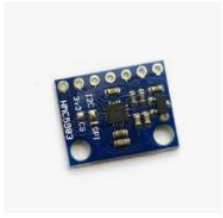
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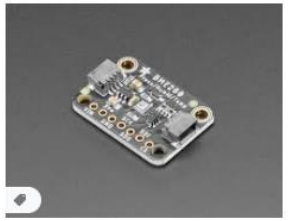
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conclusion

1.Choose what tools/ system that you will make

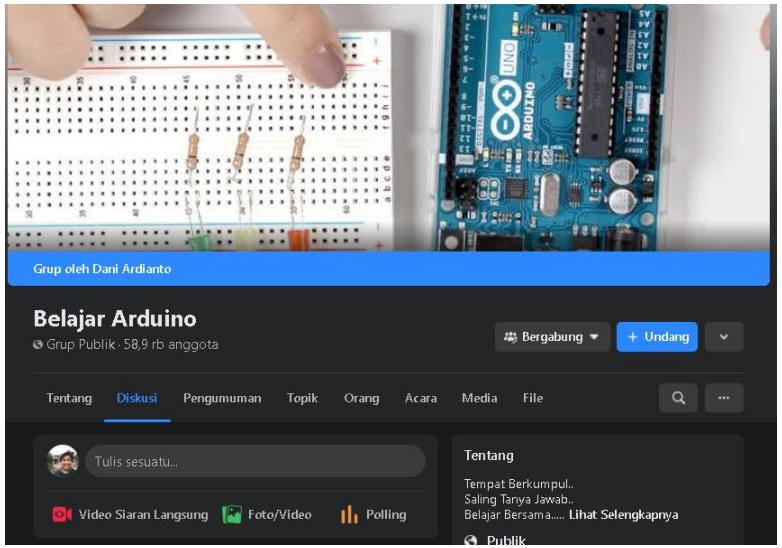
2.Think about input components

3.Think about output components

4.Think about process

5.Think about safety for the system

Join us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Undang
Tentang
Diskusi
Pengumuman
Topik
Orang
Acara
Media
File
Tulis sesuatu...
Video Siaran Langsung
Foto/Video
Polling
Tentang
Tempat Berkumpul..
Saling Tanya Jawab..
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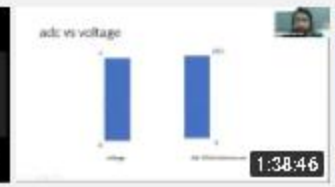

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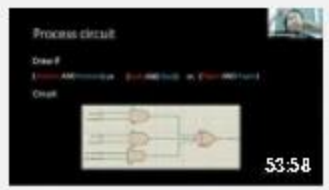

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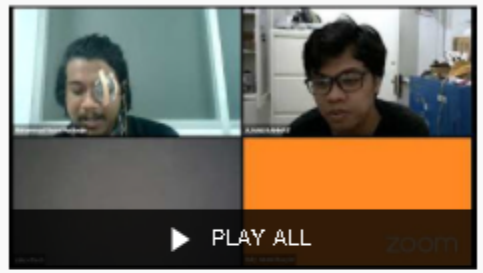

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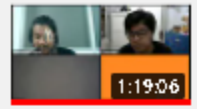
1 

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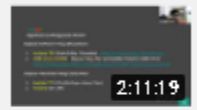
2 

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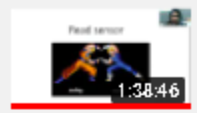
5 

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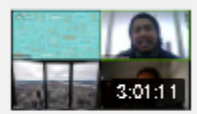
6 

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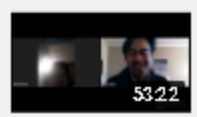
8 

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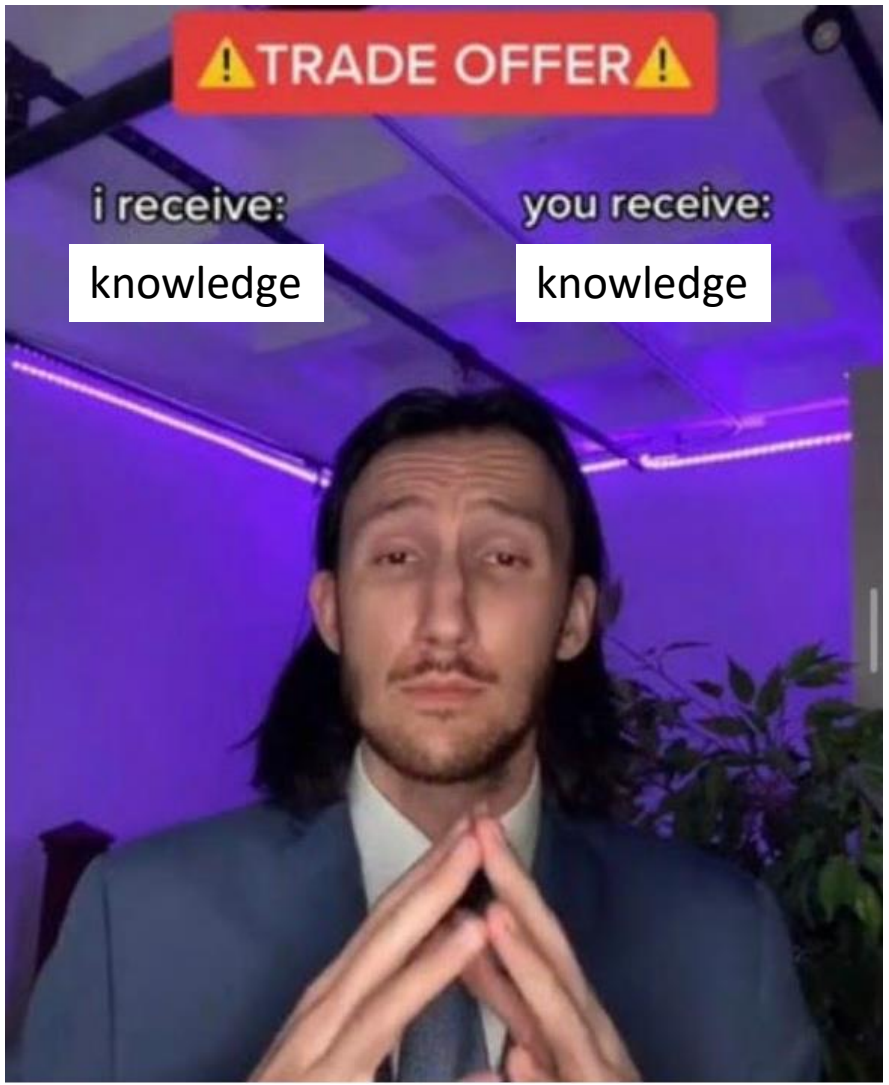
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