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Ultrasonic Sensor HC-SR04 and Arduino Tutorial

👤 Dejan Nedelkovski   🕒 July 26, 2015   🗁 Arduino   💬 62

LATEST

In this Arduino Tutorial we will learn how the HC-SR04 Ultrasonic Sensor works and how to use it with the Arduino Board. You can watch the following video or read the written tutorial below.

Components needed for this tutorial

You can get these components from any of the sites below:

- Ultrasonic Sensor HC-SR04......... Amazon / Banggood /

GearBest / DealExtreme / ICStation

- Arduino Board……………………………… Amazon / Banggood / GearBest / DealExtreme / ICStation

- Breadboard and Jump Wires……. Amazon / Banggood / GearBest / DealExtreme / ICStation

Please note: These are affiliate links. I may make a commission if you buy the components through these links.
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How It Works - Ultrasonic Sensor

It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.
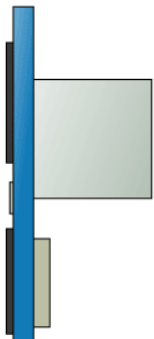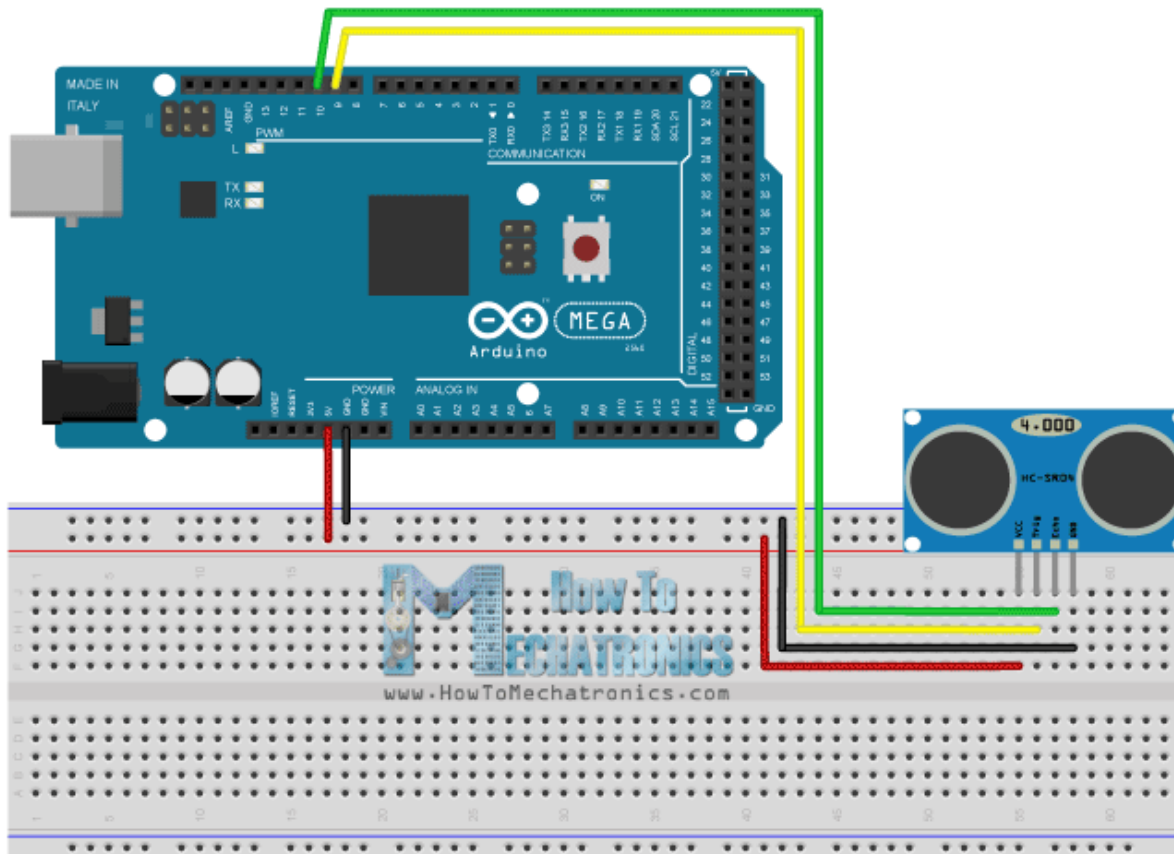
The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.
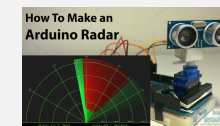
In order to generate the ultrasound you need to set the Trig on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo pin. The Echo pin will output the time in microseconds the sound wave traveled.
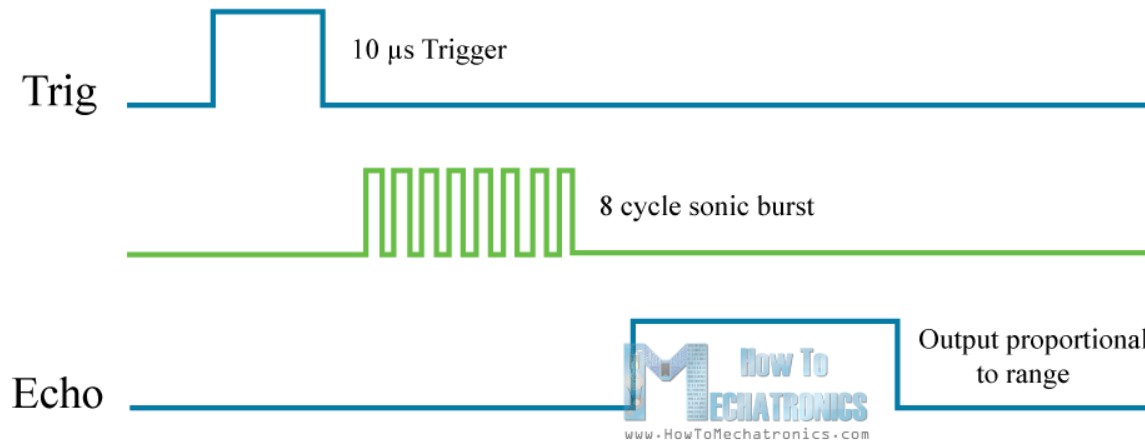
For example, if the object is 10 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/µs the sound wave will need to travel about 294 u seconds. But what you will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

speed of sound:

$$v = 340 \ m/s$$

$$v = 0,034 \ cm/\mu s$$

Time = distance / speed:

$$t = s / v = 10 / 0,034 = 294 \ \mu s$$

Distance:

$$s = t \cdot 0,034 / 2$$
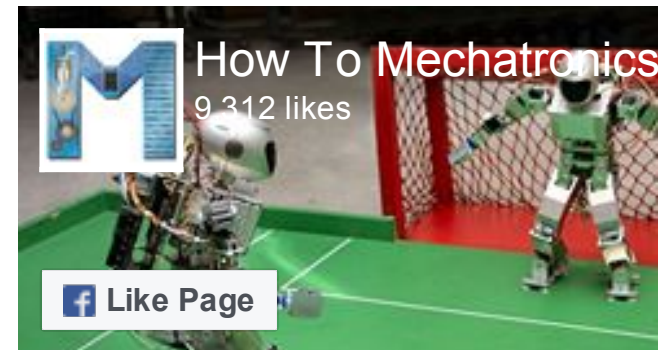
Source Codes

First you have to define the Trig and Echo pins. In this case they

are the pins number 9 and 10 on the Arduino Board and they are named trigPin and echoPin. Then you need a Long variable, named "duration" for the travel time that you will get from the sensor and an integer variable for the distance.

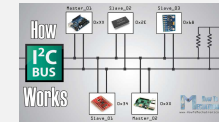In the setup you have to define the trigPin as an output and the echoPin as an Input and also start the serial communication for showing the results on the serial monitor.

In the loop first you have to make sure that the trigPin is clear so you have to set that pin on a LOW State for just 2 μs. Now for generating the Ultra sound wave we have to set the trigPin on HIGH State for 10 μs. Using the *pulseIn()* function you have to read the travel time and put that value into the variable "duration". This function has 2 parameters, the first one is the name of the echo pin and for the second one you can write either HIGH or LOW. In this case, HIGH means that the *pulsIn()* function will wait for the pin to go HIGH caused by the bounced sound wave and it will start timing, then it will wait for the pin to go LOW when the sound wave will end which will stop the timing. At the end the function will return the length of the pulse in microseconds. For getting the distance we will multiply the duration by 0.034 and divide it by 2 as we explained this equation previously. At the end we will print the value of the distance on the Serial Monitor.

```
1.    /*
2.     * Ultrasonic Sensor HC-SR04 and Arduino Tutorial
```

```
3.    *
4.    * Crated by Dejan Nedelkovski,
5.    * www.HowToMechatronics.com
6.    *
7.    */
8.
9.    // defines pins numbers
10.   const int trigPin = 9;
11.   const int echoPin = 10;
12.
13.   // defines variables
14.   long duration;
15.   int distance;
16.
17.   void setup() {
18.   pinMode(trigPin, OUTPUT); // Sets the trigPin as an
      Output
19.   pinMode(echoPin, INPUT); // Sets the echoPin as an
      Input
20.   Serial.begin(9600); // Starts the serial communication
21.   }
22.
23.   void loop() {
24.   // Clears the trigPin
25.   digitalWrite(trigPin, LOW);
26.   delayMicroseconds(2);
27.
28.   // Sets the trigPin on HIGH state for 10 micro seconds
29.   digitalWrite(trigPin, HIGH);
30.   delayMicroseconds(10);
31.   digitalWrite(trigPin, LOW);
32.
```

```
33.    // Reads the echoPin, returns the sound wave travel
       time in microseconds
34.    duration = pulseIn(echoPin, HIGH);
35.
36.    // Calculating the distance
37.    distance= duration*0.034/2;
38.
39.    // Prints the distance on the Serial Monitor
40.    Serial.print("Distance: ");
41.    Serial.println(distance);
42.    }
```

If you want to display the results from the HC-SR04 Ultrasonic Sensor on an LCD you can use the following source code:

```
1.    /*
2.     * Ultrasonic Sensor HC-SR04 and Arduino Tutorial
3.     *
4.     * Crated by Dejan Nedelkovski,
5.     * www.HowToMechatronics.com
6.     *
7.     */
8.
9.    #include <LiquidCrystal.h> // includes the
      LiquidCrystal Library
10.
11.   LiquidCrystal lcd(1, 2, 4, 5, 6, 7); // Creates an LCD
      object. Parameters: (rs, enable, d4, d5, d6, d7)
12.
```

```
13.    const int trigPin = 9;
14.    const int echoPin = 10;
15.
16.    long duration;
17.    int distanceCm, distanceInch;
18.
19.    void setup() {
20.    lcd.begin(16,2); // Initializes the interface to the
       LCD screen, and specifies the dimensions (width and
       height) of the display
21.
22.    pinMode(trigPin, OUTPUT);
23.    pinMode(echoPin, INPUT);
24.    }
25.
26.    void loop() {
27.    digitalWrite(trigPin, LOW);
28.    delayMicroseconds(2);
29.
30.    digitalWrite(trigPin, HIGH);
31.    delayMicroseconds(10);
32.    digitalWrite(trigPin, LOW);
33.
34.    duration = pulseIn(echoPin, HIGH);
35.    distanceCm= duration*0.034/2;
36.    distanceInch = duration*0.0133/2;
37.
38.    lcd.setCursor(0,0); // Sets the location at which
       subsequent text written to the LCD will be displayed
39.    lcd.print("Distance: "); // Prints string "Distance" on
       the LCD
40.    lcd.print(distanceCm); // Prints the distance value
```

```
         from the sensor
41.    lcd.print(" cm");
42.    delay(10);
43.    lcd.setCursor(0,1);
44.    lcd.print("Distance: ");
45.    lcd.print(distanceInch);
46.    lcd.print(" inch");
47.    delay(10);
48.    }
```

We highly recommend **EasyEDA** for circuit design and **low cost PCB order**

EasyEDA: A Powerful Free Circuit, Simulation & PCB Design Tool

Register now to use it for free. No Need to download. Lots of resources and Step by step tutorials

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| Tutorial |

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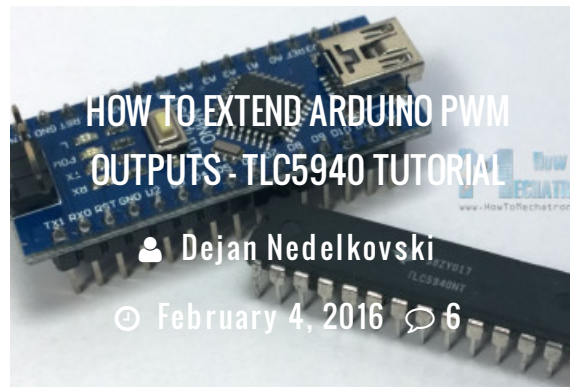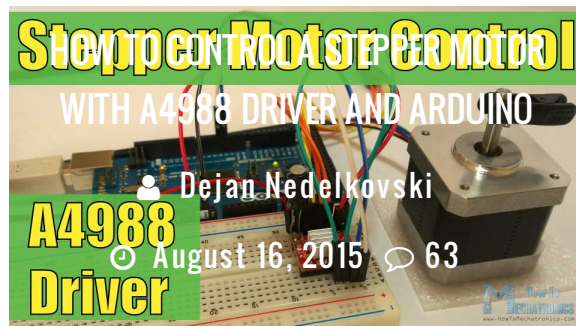
62 RESPONSES

S Looney

November 24, 2015

Please note the error in your fritzing wiring diagram that shows GND to VCC and VCC to echo.

Thanks

REPLY

Dejan Nedelkovski

November 25, 2015

Thanks for the remark. I will change the that one.

REPLY

pradeep

Are you a developer? Try out the HTML to PDF API

November 27, 2015

Can you please email me the updated
diagram of Ultrasonic Circuit sketch diagram ?

Thank you in advance,
Pradeep

Dejan Nedelkovski

November 27, 2015

It's already updated.

mujadidd

November 30, 2015

please give us the diagram of the ultra sonic with LCD

REPLY

Dejan Nedelkovski

November 30, 2015

Here you can find details how to connect and use the LCD:

http://howtomechatronics.com/tutorials/arduino/lcd-tutorial/

REPLY

Siddharth shetty

February 25, 2016

Can we use a led to indicate the distance????
If yes than can u pls email me the codes....
Thanks

Dejan Nedelkovski

February 25, 2016

Yes, you can, but I don't have such a code.

Tino

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

Hi,

Followed everything I guess.
Still I see that the distance will no be bigger than 1 cm:
0in, 0cm
0in, 0cm
0in, 0cm
0in, 0cm
0in, 1cm
0in, 0cm
0in, 0cm

I am using a Arduino DUE, for the rest anything is connected directly to the board.

Any ideas?

Best regards

REPLY

Dejan Nedelkovski

December 29, 2015

The problem might be that you are using Arduino DUE, which has 3.3V pins and the ultrasonic sensors is working with 5V. Try using an resistor at the echo pin, as the 3.3V are fine for the Trig pin, but the Echo pin of the sensor will output 5V to your Arduino DUI which might damage it.

REPLY

Rhydo

June 28, 2016

Make sure your trig and Echo pins are connected to digital pins 9 and 10 instead of 11 and 12.

REPLY

IAN

Unfortunately I get the same 0, 0, ... response for the ultrasonic sensor on the monitor as well using Mega 2560 using just the sensor code by itself???
Any other suggestions?
Cheers, Ian

REPLY

Dejan Nedelkovski

Sorry to hear that but I have just tried this code as well and it's working perfectly with my HC-SR04. You got to be doing something wrong, or your sensor is not working properly.

REPLY

amirul

what type of arduino should I use?

REPLY

Dejan Nedelkovski

January 1, 2016

Well you can do it with almost any model which operating voltage is 5V.

REPLY

extremeus

January 11, 2016

hi,you forgot to write liquidcrystal in the lcd code

REPLY

Dejan Nedelkovski

Are you a developer? Try out the HTML to PDF API

January 11, 2016

Yes thanks, it's fixed now.

REPLY

Haravey

January 23, 2016

Great video. Thanks. I'm trying to set this up to trigger a gate or relay at a predefined range to set off a light if something gets too close. Have you already developed a sketch for this scenario. I just can't seem to get it to work correctly myself. Thanks.

REPLY

Dejan Nedelkovski

January 24, 2016

Thanks! Well this is a tutorial that can help you understand the basic working principle of the sensor and the code to get it working with the

Arduino, but I don't have a specific code as what you have described. Every project is a unique and needs a unique code, but I don't make custom codes. I hope watching some of my other tutorials as well, will get your code writing knowledge good enough so you can make your own code for your project. Cheers!

REPLY

Thor

January 31, 2016

Hey, I got everything working and your tutorials are great! My display works, but it is just a blue screen. It is just blue and no numbers or anything on it, please help!

REPLY

Dejan Nedelkovski

January 31, 2016

Are you a developer? Try out the HTML to PDF API

Well the problem is the contrast of the display. Use a potentiometer to adjust the contrast (as shown in my Arduino LCD Tutorial) or make a voltage divider with two resistors.

REPLY

Harvey

February 6, 2016

Can u email me or update the diagram of this project by adding the connections for the 16×2 lcd green screen ty in advance this website was a real help to me as my first arduino project and I use arduino uno is that OK or I have to change something in ue given project waiting for a quick response:)

REPLY

Dejan Nedelkovski

February 7, 2016

Well combine the circuit schematics from my
Arduino LCD tutorial and this one.

REPLY

Sougata

February 9, 2016

Hey Can you please upload/ Mail me the code and the
diagram for measuring X-Axis And Y-Axis distance at the
same time… Thanks

REPLY

Dejan Nedelkovski

February 9, 2016

What do you mean, which example in this tutorial is
that?

REPLY

Are you a developer? Try out the [HTML to PDF API](#)

Sougata

February 10, 2016

Actually I wanna know that, if i wanna connect two ultrasonic at a same time and show output in the display,,,... then what will be the code??? thanks

sougata

February 11, 2016

Yea !!!!! I did it.... Anyway thanks.. 🙂

REPLY

terry schulz

February 25, 2016

hi i have been working on HC-SR04 Ultrasonic Module and was wondering if you could send me a schematic of the project with the lcd hook up thank

you for your time

REPLY

Aiden

June 12, 2016

Hi Sougata, Brilliant that you managed it! Could you give me the code? Thanks.

REPLY

Judy Kathryn

March 3, 2016

Is the source code for the sensor and LCD is under one sketch?? Or i need to use two arduino boards?? And if so, how can i connect the two then? 🙂

REPLY

Dejan Nedelkovski

March 3, 2016

It's one Arduino, one sketch. The ultrasonic sensor connection is as explained and for the LCD connection check my Arduino LCD Tutorial

REPLY

Gaurav Jagannath Alande

March 3, 2016

can you send me the code of interfacing arduino with HCSR-04 sensor -SG-90 servo motor n lcd with buzzer interfaing send me code plz

REPLY

Dejan Nedelkovski

March 3, 2016

Sorry, I don't have such a code.

vignesh

March 12, 2016

can i do the same with a pic controller? with an altered program

Dejan Nedelkovski

March 12, 2016

Yes, sure you can.

Anamul

March 21, 2016

Can i use this code for arduino UNO board

REPLY

Dejan Nedelkovski

March 21, 2016

Yes, you can.

REPLY

Ton

April 1, 2016

Dear Dejan, I am building a simple robot with this sensor. The problem is this: I want to avoid a collision at a distance of about 50 cm. How do I implement in code this value in the simple software I made. (the robot is programmed to drive an eight) with simple code as digitalWrite HIGH or LOW on two pins.

Regards, Ton.

REPLY

Dejan Nedelkovski

April 2, 2016

Well the sensor can detect objects at that distance so I guess using some "if" statements you could make a simple code for avoiding collisions.

REPLY

Pramod

April 17, 2016

Hi Dejan

Can I use HCSR 04 to send data to another HC SR04? I mean making one to act as transmitter and other as receiver? If yes how can I modify the code?

REPLY

Dejan Nedelkovski

April 18, 2016

Well I haven't tried something like that so I cannot say anything. You should try, it might be possible.

REPLY

rakan

April 18, 2016

Dear,
I have an idea to measure the amount of water in a water tank.
It has been seen on your video experiment to Motion Sensor.
Question: Is it possible to transfer centimeter change in the screen to a percentage, for example 40%, 50%.
Thank.
Rakan

REPLY

Dejan Nedelkovski

April 19, 2016

Sure you just have to implement the math into the code.

REPLY

rakan

April 21, 2016

can I get your email,we want contract with you for this adea please. thanks.

rakan

April 23, 2016

can I get your email,we want contract with you for this idea. thanks.

REPLY

William

May 20, 2016

Dear, it possible the ultrasonic can detect the water leakage on the water pipe? mean the ultrasonic can receive the frequency or other value to show that when the water pipe has leakage, the value will changing? thanks

REPLY

Dejan Nedelkovski

May 20, 2016

Well I'm not quite sure about this. I guess the ultrasonic wave could bounce when it would hit the water but I can't say whether it would work for your idea.

William

May 23, 2016

Sir, because i need use ultrasonic sensor to detect the water pipe leakage which is receive the frequency / pulse from the water pipe, it possible the ultrasonic sensor can receive the frequency/ pulse ?? since this is ultrasonic project, would u can take time explain the concept of the ultrasonic sound use in detect water pipe leakage, i very confuse, thanks for reply me....

asda

May 20, 2016

MY HC SR04 is always gives maximum output 24 cm .
what to do now >

REPLY

Dejan Nedelkovski

May 20, 2016

How come? Did you connect everything properly as presented in the tutorial, as well as, did you use the exactly same source code?

REPLY

SAYAN SETH

June 1, 2016

Which Software have you used to Draw this circuit design

REPLY

Dejan Nedelkovski

June 1, 2016

Fritzing.

REPLY

yoangel

August 13, 2016

hello, if I want the measurement is not displayed in cm, if not in liters or ml as should be the formula? since I want to use this sensor to measure the water level of a tank

REPLY

Dejan Nedelkovski

August 14, 2016

If you know the dimensions of the tank you can use and transform the unit "cm" to measure the "liters" of the tank.

REPLY

Anant

September 23, 2016

Hey Dejan, is it possible to add a sound in the output so that the distance can also be used by the blinds!!

REPLY

Dejan Nedelkovski

September 25, 2016

Sure it's possible.

REPLY

fatso

October 9, 2016

i connected the sensor to pic 16f877a and i wanted to measure the volume of water in a tank but i m getting false results what might be the problem

Dejan Nedelkovski

October 14, 2016

Sorry but I haven't tested this module with the particular microcontroller.

Malik

October 11, 2016

hi, i have checked this and many other codes but it is not giving accurate distance , only giving 2 inches. In addition I want to modify the range how I can do that?

Dejan Nedelkovski

October 14, 2016

The code is working 100%, so you either have a wrong connection or your sensor is faulty.

REPLY

Nicky Puff

October 20, 2016

Dude, your tutorials are fcking awesome !!!
I never find like this tutorial...
easy to understand, easty to implement... so yeah 😀

Do you have private contact ? i have final project in my colege and need new idea from you... Could you ? 😀

Thanks so much

REPLY

Dejan Nedelkovski

October 22, 2016

Thanks! Sorry but I don't work on private projects.

REPLY

LEAVE A REPLY

Your email address will not be published.

Comment

Name*

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Website

SUBMIT

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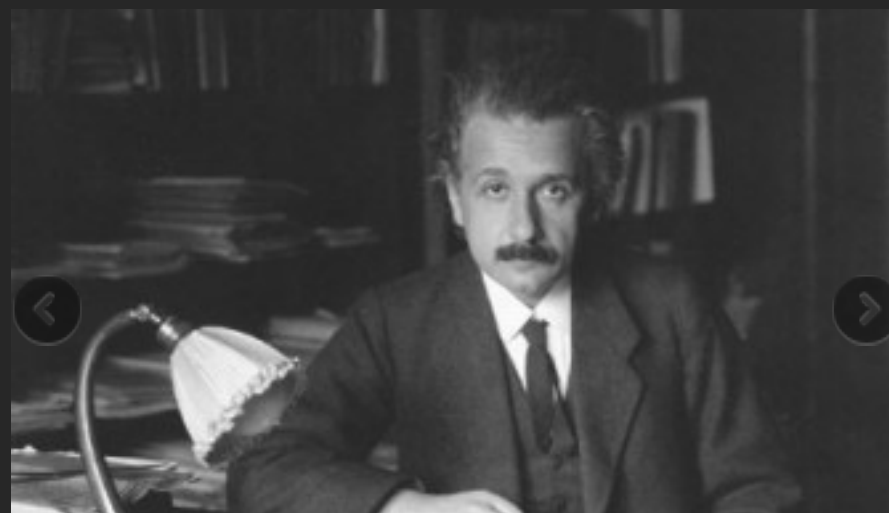
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