

ANKARA UNIVERSITY ELECTRICAL AND ELECTRONICS ENGINEERING



FINAL REPORT Digitalmeter using HC-SR04 Range Sensor

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DIGITAL METER

INTRODUCTION

The HC-SR04 is an affordable and easy to use distance measuring sensor which has a range from 2cm to 400cm (about an inch to 13 feet).

The sensor is composed of two ultrasonic transducers. One is the transmitter which outputs ultrasonic sound pulses and the other is the receiver which listens for reflected waves. It's basically a SONAR, which is used in submarines for detecting underwater objects.

The sensor has 4 pins. VCC and GND go to 5V and GND pins on the Arduino, and the Trig and Echo go to any digital Arduino pin. Using the Trig pin we send the ultrasound wave from the transmitter, and with the Echo pin we listen for the reflected signal.

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.

In order to generate the ultrasound we need to set the Trig pin on a High State for 10 μ s. That will send out an 8 cycle ultrasonic burst which will travel at the speed of sound The Echo pins goes high right away after that 8 cycle ultrasonic burst is sent, and it starts listening or waiting for that wave to be reflected from an object.

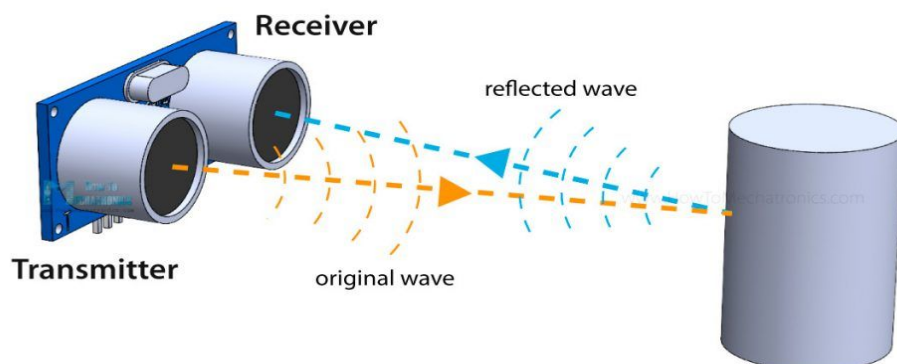
If there is no object or reflected pulse, the Echo pin will time-out after 38ms and get back to low state.

If we receive a reflected pulse, the Echo pin will go down sooner than those 38ms. According to the amount of time the Echo pin was HIGH, we can determine the distance the sound wave travelled, thus the distance from the sensor to the object.

For that purpose we are using the following basic formula for calculating distance:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

We actually know both the speed and the time values. The time is the amount of time the Echo pin was HIGH, and the speed is the speed of sound which is 340m/s. There's one additional step we need to do, and that's divide the end result by 2. and that's because we are measuring the duration the sound wave needs to travel to the object and bounce back.



DISCUSSION

Components

LCD Screen



**16x2 Karakter LCD Ekran -
Mavi - 1602**

LCD is an abbreviation for (Liquid Crystal Display). It is basically an imaging unit that uses liquid crystals to create an image. The designation of the screen as 16×2 means that the LCD has 2 lines and can display 16 characters per line. In other words, the screen can display 32 characters at the same time.

An Erkek Pin Header is integrated for making connections via breadboard.

Technical Features

Ekran	16 sütun 2 satır
Arka ışık	Mavi
Besleme voltajı	5V

Arduino Nano



**Arduino Nano Klon - USB
Kablo Hediye**

The Arduino Nano with soldered headers is a small, complete, breadboard-friendly sign based on the ATmega328. This board uses the same chip as the UNO, but comes in a different package. This board has no DC power jack, and is controlled with a Mini-USB cable.

Technical Features

Model:	Arduino Nano Klon (CH340 Çipli)
Mikrokontrolcü:	Atmega328P
Çalışma Gerilimi:	5V
Dijital Pin:	14
Analog Pin:	8
PWM Çıkış Sayısı	6
Flash Hafıza:	32 kb (8 kb bootloader yüklü)
EEPROM	1 KB
DC Current per I/O Pins	40 mA (I/O Pins)
Clock Frekansı:	16 Mhz
Boyut:	45x18mm

HC-SR04 ultrasonic Range Sensor



HC-SR04 Ultrasonik Mesafe Sensörü

It is one of the most used sensors for distance measuring processes. It measures distance by broadcasting ultrasonic sound waves. It can be easily used in development boards such as Arduino.

The HC-SR04 Ultrasonic Range Sensor Features:

- Çalışma Voltajı: 3V - 5.5V
- Çalışma Akımı: 2.2mA
- Ölçüm Mesafesi: 2cm - 450cm
- Çalışma Sıcaklığı: -10°C - +70°C
- Arduino geliştirme kartlarıyla rahatlıkla kullanılabilir.
- Engelden kaçan robot, mesafe ölçen robot, park sensörü vb. robotik projelerde kullanıma uygundur.

Breadboard Power Supply Module



Breadboard Güç Modülü Kartı -
3.3V/5V

It allows one to use 3.3V and 5V outputs easily by attaching to the breadboard.

Technical Properties

- Model: MB102 Breadboard Güç Modülü
- Giriş/Besleme Gerilimi: 6.5V - 12V (Jack) ve 5V USB girişi
- Çıkış Gerilimi: 3.3V ve 5V
- Çıkış Akımı: 700mA (Maks.)
- 2.1mm Jack ve USB A besleme Girişi
- Kart Boyutu: 35x55mm

Pil Soketi



9V Pil Soketi - Yuvası

It is a battery socket with a connector compatible with 9V batteries. It has a connector structure compatible with Arduino development boards.

Battery

A 9V battery is used to produce a DC source for the system.

Jumper Cables

Cables are used to connect the arduino Nano, LCD and the other components.








Potentiometer

A variable resistor is used to set the brightness of the LCD screen.

Breadboard

The components are integrated on the breadboard.

Cost

	40lı Ayrılabilen Dişli-Erkek Jumper Kablo - 20cm - Arduino Uyumlu	1	18	14,61 TL
	Arduino Nano Klon - USB Kablo Hediye	1	18	112,12 TL
	16x2 Karakter LCD Ekran - Mavi - 1602	1	18	49,43 TL
	HC-SR04 Ultrasonik Mesafe Sensörü	1	18	19,10 TL
	40 Pin 2.54 mm Tek Sıra Erkek Header - Siyah	1	18	2,25 TL
	Breadboard Güç Modülü Kartı - 3.3V/5V	1	18	17,98 TL
	9V Pil Soketi - Yuvası	1	18	3,37 TL

The Total Cost was 218.86 TL.

Accuracy

The accuracy of the is quite compared to the cost of the device. The device is observed with the help of a measuring tape. According to the measurements, the system senses 49 cm for 50 cm and 99 cm for 100 cm. **The accuracy is quite close to %100.** The system with this sensor provides high accuracy with low cost. The sensor can observe 450 cm which is written on the datasheet. However; the system makes sense up to 200 cm.

Code

The code is written in Arduino compiler and uploaded to the Arduino Nano using a PC.

```
#include <LiquidCrystal.h> //LCD kütüphanemizi başlatıyoruz.
LiquidCrystal lcd(12, 11, 5, 4, 3, 2); //LCD'nin pin bağlantılarını ayarlıyoruz.
const int trig = 9;
const int echo = 8;
int mesafe;
int sure;

void setup() {
  pinMode(trig , OUTPUT);
  pinMode(echo , INPUT);
  lcd.begin(16, 2); //LCD ekranımızın en-boy oranını ayarlıyoruz.
  lcd.print("Hello World!");
  delay(2000);
}

void loop() {
  digitalWrite(trig, HIGH);
  delay(1);
  digitalWrite(trig, LOW);
  sure = pulseIn(echo, HIGH);
  mesafe = (sure/2)/28.5;
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Distance");
  lcd.setCursor(0, 1);
  lcd.print(mesafe);
  lcd.print("cm");
  delay(250);
}
```


CONCLUSION

In conclusion, HC-SR04 Ultrasonic sensor with Arduino is a great sensor use for many DIY electronics projects where we need a non-contact distance measuring, detection of presence or objects, level or position of something etc.

REFERENCES

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- <https://maker.robotistan.com/elektronik-metre-yapimi/>