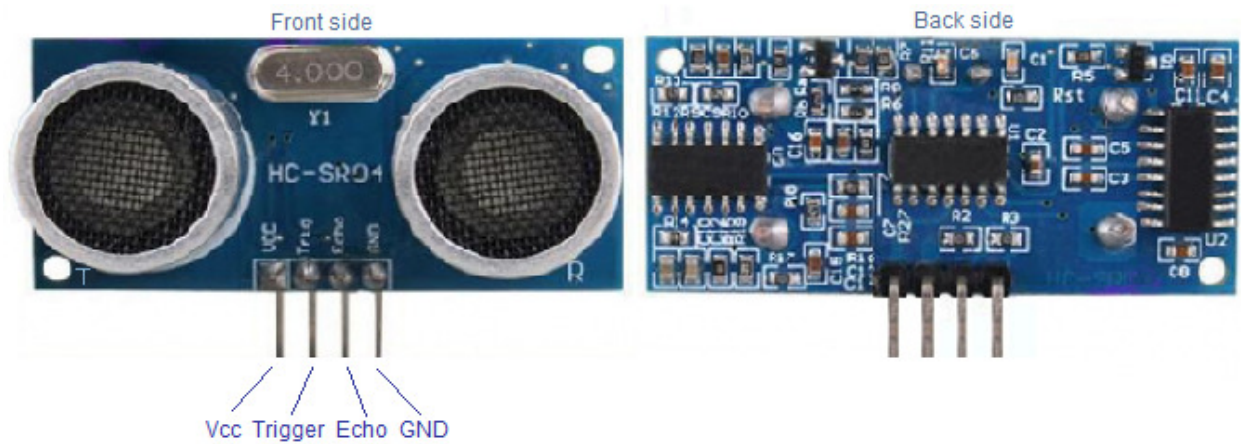


A simple ultrasonic range finder using 8051 microcontroller is presented in this article. This ultrasonic rangefinder can measure distances up to 2.5 meters at an accuracy of 1 centimeter. AT89s51 microcontroller and the ultrasonic transducer module HC-SR04 form the basis of this circuit. The ultrasonic module sends a signal to the object, then picks up its echo and outputs a wave form whose time period is proportional to the distance. The microcontroller accepts this signal, performs necessary processing and displays the corresponding distance on the 3 digit seven segment display. This circuit finds a lot of application in projects like automotive parking sensors, obstacle warning systems, terrain monitoring robots, industrial distance measurements etc.

HC-SR04 ultrasonic module.

HC-SR04 is an ultrasonic ranging module designed for embedded system projects like this. It has a resolution of 0.3cm and the ranging distance is from 2cm to 500cm. It operates from a 5V DC supply and the standby current is less than 2mA. The module transmits an ultrasonic signal, picks up its echo, measures the time elapsed between the two events and outputs a waveform whose high time is modulated by the measured time which is proportional to the distance. The photograph of an HC-SR04 module is shown below.

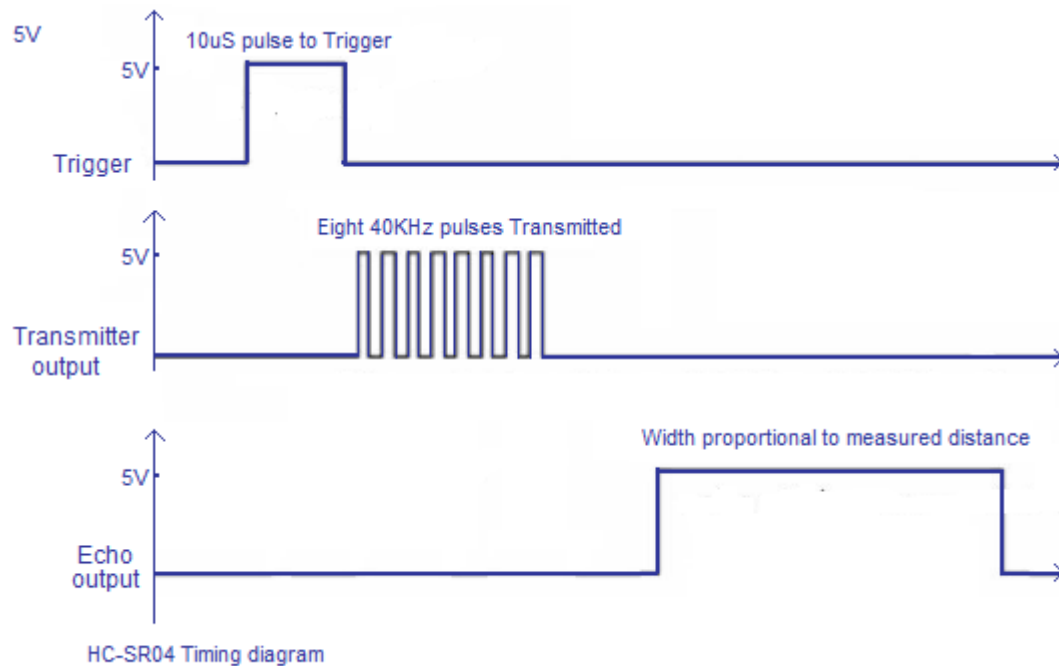


HC-SR04 ultrasonic ranging module (Fig1)

The supporting circuits fabricated on the module makes it almost stand alone and what the programmer need to do is to send a trigger signal to it for initiating transmission and receive the echo signal from it for distance calculation. The HR-SR04 has four pins namely Vcc, Trigger, Echo, GND and they are explained in detail below.

- 1) **VCC** : 5V DC supply voltage is connected to this pin.
- 2) **Trigger**: The trigger signal for starting the transmission is given to this pin. The trigger signal must be a pulse with 10uS high time. When the module receives a valid trigger signal it issues 8 pulses of 40KHz ultrasonic sound from the transmitter. The echo of this sound is picked by the receiver.
- 3) **Echo**: At this pin, the module outputs a waveform with high time proportional to the distance.
- 4) **GND**: Ground is connected to this pin.

HC-SR04 timing diagram.



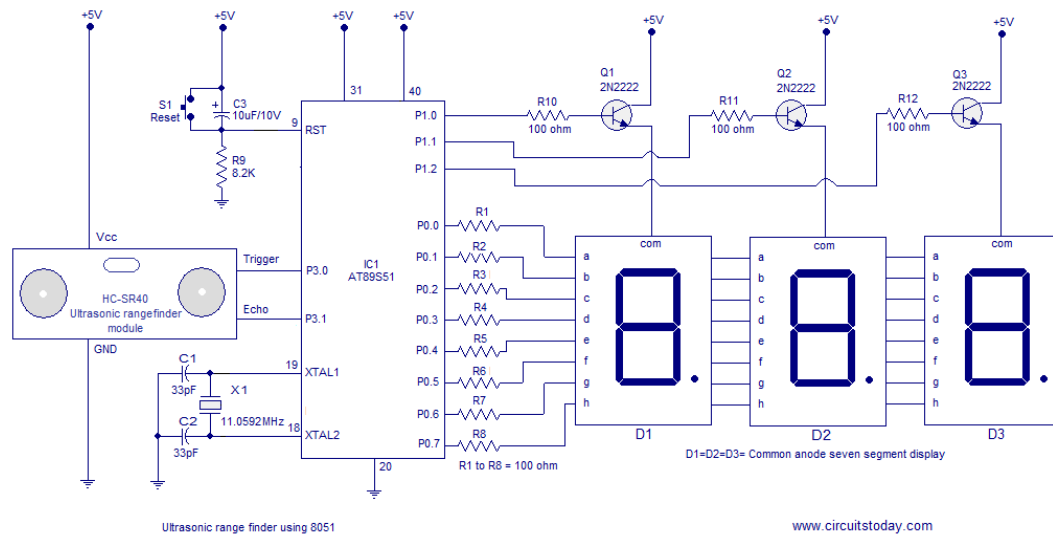
HC-SR04 Timing diagram

From the timing diagram, you can see that the 40KHz pulse train is transmitted just after the 10μs triggering pulse and the echo output is obtained after some more time. The next triggering pulse can be given only after the echo is faded away and this time period is called cycle period. The cycle period for HC-SR04 must not be below 50mS. According to datasheet, the distance can be calculated from the echo pulse width using the following equations.

Distance in cm = echo pulse width in μS/58

Distance in inch = echo pulse width in μS/148

Circuit diagram:

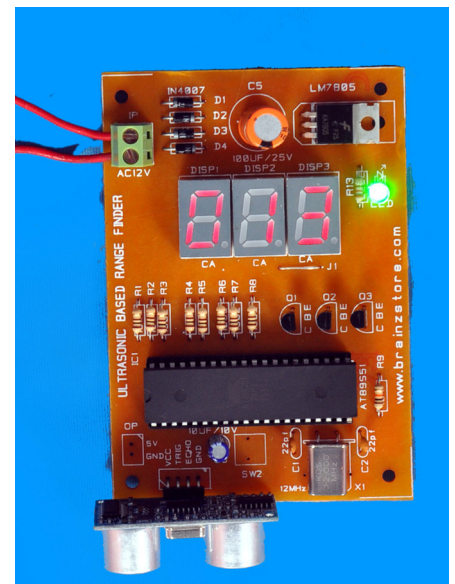


Ultrasonic range finder using Microcontroller:

The ultrasonic module is interfaced to the microcontroller through P3.0 and P3.1 pins. Port0 used for transmitting the 8 bit display data to the display and port pins P1.0, P1.1, P1.2 are used for transmitting display drive signals for the corresponding display units D1, D2, D3. Push button switch S1, capacitor C3 and resistor R9 forms a de-bouncing reset circuitry. Capacitors C1,C2 and crystal X1 are associated with the clock circuit.

Testing Circuit:

- Assemble PCB with appropriate components
- Insert preprogrammed Microcontroller IC
- Keep a obstacle in front of Ultrasonic Transducer
- Switch ON power supply
- Slightly vary the distance of obstacle
- Seven Segment display will display between obstacle and Transducer



******* Caution Apply 12 AC via 12V Step down transformer**