2.8 Ultrasonic sensor

The ultrasonic sensor (or transducer) works on the same principles as a radar system. An ultrasonic sensor can convert electrical energy into acoustic waves and vice versa. The acoustic wave signal is an ultrasonic wave traveling at a frequency above 18kHz. The famous HC SR04 ultrasonic sensor generates ultrasonic waves at 40kHz frequency.



Figure 2.8 Ultrasonic sensor

**Features of the Ultrasonic Distance Sensor:**

1. Supply voltage: 5V (DC).
2. Supply current: 15mA.
3. Modulation frequency: 40Hz.
4. Output: 0 – 5V (Output high when obstacle detected in range).
5. Beam Angle: Max 15 degrees.
6. Distance: 2cm – 400cm.
7. Accuracy: 0.3cm.
8. Communication: Positive TTL pulse.

### 2.8.1 Ultrasonic sensor work principle

### 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

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## Figure 2.8.1 Ultrasonic sensor work principle

## 2.8.2 Operating principle and technology of ultrasonic sensor:

Ultrasonic sensors operate with a piezoelectric transducer as the sound emitter and receiver. A patented de-coupling layer in special material is used to decouple the ultrasonic to the air - an acoustically thin medium. This ultrasonic transducer is embedded, watertight, into the sensor housing, in polyurethane foam The transducer transmits a packet of sonic pulses and converts the echo pulse into a voltage. The integrated controller computes the distance from the echo time and the velocity of sound. The transmitted pulse duration .t and the decay time of the sonic transducer result in an unusable area in which the ultrasonic sensor cannot detect an object. The ultrasonic frequency lies between 65 kHz and 400 kHz, depending on the sensor type; the pulse repetition frequency is between 14 Hz and 140 Hz The active range of the ultrasonic sensor is referred to as the sensing range. This range is bounded by the lowest and highest sensing distances; whose values depend on the characteristics of the transducer. The highest sensing distance is given in the type code.

The ultrasonic sensor detects objects within its sensing range, regardless of whether these objects approach the sensor axially or move through the sound cone laterally. Ultrasonic sensors are available with switching outputs and/or analogue outputs; various output functions are available ac-cording to type.

## How to select the correct sensor

The range of ultrasonic sensor products is a large one due to their wide range of deployment. Important selection criteria are described in detail on the next five pages to assist you in selecting the correct sensor type for your specific applications:

1. Sensor principle
2. Output Function
3. Series
4. Electrical connections
5. Parameterization