Hc-sr04 schematic pdf

An ultrasonic distance sensor is a sensor that can measure distance from a fixed or physical object. The ultrasonic range finder does this through sound waves. It emits high-frequency sound waves and then waits for these sound waves to be listened to. If she heard these sound waves, it means that the sound waves bounced off the physical object and returned to the sensor, which means that a physical object is present in front of the sensor. If these sound waves do not sound, it means that no physical object has been detected. The ultrasonic sensor we use is a very inexpensive and popular HC-SR04 sensor. We integrate this sensor with arduino for a very good object detection system. We write a code so that if the sensor detects an object less than 3 inches away from it, the LED lights up and lights up. The ultrasonic range finder can detect objects anywhere from 2 cm (less than inches) to 400 cm (157 inches or 13 feet). In fact, there are 2 types of sensors that are widely used and very popular to measure distance from a physical object - these are infrared proximity sensor and ultrasonic range ejector. This sensor has a measuring angle of 15°. This means that the object must be between the 15° front of the sensors. If it is outside this range, it will not be found. Ultrasonic dryers, in general, have narrow measuring angles, but exist wider, so for your application always check the sensor data sheet. Components The necessary HC-SR04 ultrasonic distance sensor LED Arduino Hc-SR04 ultrasonic distance sensor is inexpensive, as has already been said. It can be getting on ebay or many different online retailers for just over $1. It runs on 5V dc power and requires 2 of Arduino digital pins for connection. The sensor datasheet can be found at the following link: HC-SR-4 Ultrasonic Distance Sensor Datasheet. The sensor has a total of 4 pins. 2 are the power pin and 2 are digital pin connections. Pinout for HC-SR04 is shown below. Power pins are VCC and GND. The ultrasonic range finder works at 5V power. This is associated with VCC. GND is attached to the ground. The trigger pin (trig) is the pin needed to start or start the sensor into range mode. To start the sensor, it is necessary to send a 10-micro-initial pulse to the trigger pulse. Without this impulse, and the sensor never went into range mode to detect objects. That's why it's a crucial pin. In order for the sensor to begin detecting objects, it is necessary to send a pulse of at least 10 microseconds. When it receives this pulse, it will send 840 KHz pulses to detect the object and wait for these audio pulses to be listened to. The Echo Pin is a pin that sends the result of the pulses sent. If the pulses have been taken back, this means that the pulses have bounced off the which means that an object has been detected. The Echo pin then returns a pulse representing the time it took for the pulses to get back. With this time, we can calculate the distance at which the object is from the sensor. If no object is detected, the pulses are not reassed, so the echo returns no pulse or value of 0. Ultrasonic distance sensor The ultrasonic distance sensor that we will use to measure the distance from the detected object is listed below. The circuit is very basic in connections. The power pin is connected to the +5V and grounding terminals of the arduina so that it can have sufficient power to operate. Then the trigger pin is connected to pin 8, while the echo pin is connected to pin 7. With this physical setting, all we need right now is the code below. Code The code For detecting objects that are a certain distance away, see below. const int signalPin = 7; const int triggerPin = 8; const int LEDPin = 13; long signal, inches, centimeters; invalid setting() { Serial.begin(9600), } invalid loop() { pinMode (signalPin, INPUT; pinMode (triggerPin, OUTPUT); pinMode (LEDPin, OUTPUT); //sends a trigger pulse to launch the sensor into digitalWrite range mode(triggerPin, LOW); delayMicroseconds(2); digitalWrite(triggerPin, HIGH); delayMicroseconds(10); digitalWrite(triggerPin, LOW); signal = pulseIn(signalPin, HIGH); //With HR-SRO4 sensor it takes 148 microseconds to reflect the signal back to the sensor //so we know it's a centimeter further = signal/148; centimeters = inches * 2.54; //if it's 2.54 cm in 1 inch Serial.print(ind); Serial printing (in,); Serial printing (centimeters); Serial printing (cm); Serial.println(); delay (500); the HC-SR04 sensor will check the distance to the object every half a second if (< 3 inches){ digitalWrite(LEDPin, HIGH); delay(10000); } } This code is very basic, but reaches a lot. The first block of code declares all the variables that the code uses. The first 3 variables on the first 3 lines declare the pin connections to the arduino plate. The signal pin, which is the pin that the ultrasonic range finder emits on the Arduino plate, connects to the pin 7 arduino. The trigger pin is connected to pin 8. The LED connects to pin 13 on the arduino. Other variables, declared for a long time, are signal (value in itself), inches in what far object, and centimeters, how far the object is gone. Another block of code, setup() creates a serial connection so that you can view a serial monitor that displays data in inches and centimeters in terms of how far the physical object the sensor detects is. Without this code, you wouldn't be able to see any print results. Another block of code, loop() is code that is executed over and over again. Here we make a signalPin entry. SignalPin transmits the output signal from the ultrasonic finder and enters it in the arduina. That is why it is declared an entry from the point of view of arduino. To start and run the range detecter to start scanning physical objects, a 10-microsecond TTL pulse must be sent to the startup pin. When this happens, the ultrasonic distance sensor enters range mode and begins to detect objects. The sensor emits sound wave pulses and waits for these pulses to sound. If so, it detected an object. If not, no object was detected. PulseIn() reads pulse. When set to high, it waits for the pin to go high, starts timing, and then waits until the pin is reduced. The function returns the pulse length in microseconds. Returns 0 if there is no pulse. It works pulses from 10 microseconds to 3 minutes. PulseIn() can also have a third parameter, a time-out parameter. It appears as follows: pulseIn(pin, value, timeout). With this time-out parameter, we can specify a value representing the numeric time at which, after the expiration of this time period that we entered, the pulse is surrendered and 0 returns. So it's good to know if you just want an ultrasonic range finder to look for for a while. If you do not care, it is not necessary and therefore we do not use this parameter in this code. Next, we calculate how far the physical object is, which the sensor detects in inches. Calculate according to the formula, inches = signal/148. This is because it takes 146 microseconds for an ultrasonic sensor to send the signal and read it back. In other words, if the ultrasonic sensor sends out a sound wave and gets it back 146 microseconds later, we know that the object is 1 inch away. If it returns a signal, for example, 700 microseconds later, then we know that the object is 700/148 = 4.73 inches. It really takes 73,746 microseconds for an ultrasonic sensor to send out and reach the object one inch away. But then the same signal has to bounce back and get to the sensor. So the total time to read the signal is about 148 microseconds. So you can see the essence of how ultrasonic sensors can measure distance. It's all about transmitting high-frequency sound waves and the time it takes for the sensor to read the sound wave. Thus, the amount of time directly correlates with the distance of the object it captures. Next, we change the value of inches to centimeters. This is only for those countries that use a metric system or are used in a metric system for distance values. Since the United States is one of the rare countries that uses many non-metric values, centimeters would be more popular in most of the world. Since there is 2.54 centimeters in 1 inch, then convert by taking the value of an inch and multiplying it by 2.54. Then we have a delay function that is largely suspended Sensor. In this case, we'll suspend him for 500 milliseconds, which is half a second. Then the sensor is restored. This is important depending on how often the sensor should test object detection. If you don't want to check or frequently, you may have a long delay() of, say, 60,000 milliseconds, which is a minute. But if you want frequent monitoring, 500 milliseconds is fine. Then, our last block of code is if the statement. It now acts as our warning or alarm system. If the object is detected within a certain range, then we can start the output, as in this case the red LED is turned on when the distance detected by the object is less than 3 inches. Again, it's completely customizable. All you can do is change the value. And that's how ultrasonic range detectors work. Works very easily and smoothly with arduino. Connections are easy. The code is simple. And it is very useful for many applications. Related sources How to create a dark activated switch Since my original findings, some more detailed analyses have revised my analysis and have not been affected by other people's analysis. Some parts have changed and you'll see a change. I had a dose of these plates to test at least one that was known to be faulty, so I did some work to get the tools to test and repair these boards, which led to these sites being followed by students and others. This section details with electronics such as previous site cover overview The first thing to understand is that the sequence of events is Micro sends the trigger pulse to the unit to start the measurement, which inside the unit sends an explosion of 8 x 40 kHz pulses through the ultrasonic sender sets the Echo output signal HIGH in the real world the sound wave is sent and bounces back from the objects and the first bounce back (echo) is behind the NEAREST object (after this, additional echoes of the RX sensor can be received and possibly TX but are ignored). The first echo echo oscillations will hopefully be at the end of the 8th and sensing the depths of the sea. Signals on HC-SR04 Image of signal timing range The left is a screenshot showing external and internal signals for this process, where - TRIG (Yellow) and ECHO (Magenta) are signals between the unit and micro, TX (Cyan) and TX- (green) are internal signals of the transmitted explosion. Back to the beginning measured timings on HC-SR04 This section divides the timing shown in the figure above to show how timings are formed, from images such as those below. Commission timing are displayed for object 9.5 cm away - Timing from osciloscope Start End Time µs Comment TRIG rising TRIG drops 12 Trigger pulse TRIG falling TX Start 248 Start of ultrasonic transmission TX Start TX End 200 Ultrasonic transmission width TX Start ECHO rises 202 Start of ultrasonic transmission to start measurement TRIG fall ECHO rising 450 Start waiting for RX Example Osciloscope Screen Shots The range of timing range from trigger pulse to burst Timing range for bursting to trigger echo pulse Back to the highest version of HC-SRO4 HC-SR04 is an inexpensive ultrasonic distance sensor available throughout the price very cheap and quite reliable, but its accuracy is +/- 3 mm. This accuracy means that, at worst, the proximity is estimated to be anything less than 1 cm. Revision of HC-SR04 since January 2017 Top View on HC-SR04 View of HC-SR04 Back to top Diagram of HC-SRO4 Circuit As mentioned above, since I had a dose of these sensors for testing and at least one had a faulty component, I certainly did some reverse engineering side by side comparisons between work units and failing units. Along with online searches that got me to circuit descriptions and circuit diagrams, but these were previous circuit revisions, but good starting points. The main pages that you should also look at alternative views are - Emils Projects the oldest revision boards found, but a detailed description. K.C . Lee's newer review, which is probably a review in front of the board I have Robert Clemenzi other pages with links to the other two and discussing issues with some units I believe, that now fixed application note CN0343 Analog devices document on sonication with more physics All examples of software use Arduino things such as built-in functions pulseIn() or libraries like Ping or NewPing, while you can use it for your software as described in betterecho, I found that they have too many overheads or problems. When I looked at circuit diagrams on these pages and reverse engineering, I developed a circuit in my CAD software and created much smaller file size diagrams that were easier for me to track and use. The circuit is shown below and a reference to the PDF version of the circuit. My version of the circuit scheme is available in pdf version here (size 22 KB) or it can be displayed on the screen under the HC-SR04 circuit scheme (click on magnification) Back to the upper circuit description HC-SRO4 The unit consists of three parts - microcontrolr, transmitter and receiver (with associated amplifiers). Use the circuit diagram above to refer to this description. The U1 microcontrolr The heart of the unit is elan's 8-bit em78P153 microprocessor (U1). It processes the interface to host (Trig and Echo pins) timing and sending antiphase rupture for ping send Squelch control where during threshold for incoming reciver is effectively disabled to prevent false echoes. This is as with the sending of vibrations from the TX probe, it shall be received through the PCB and through the air between the transduce on the RX probe. Receiving a processed signal from the Receiver as Interruption (Rising edge) section, it is actually a filtered and much amplified version of all received echoes. U3 transmitter In earlier revisions it was MAX232, while the pin out is very different, I'm not sure what the real device is like because the numbers have been erased. It seems to be some form of transistor array or buffer or ASIC. However, some of its features were found to be. Voltage drive to the TX converter from antiphase TX signals from micro (U1). Using antiphase signals, the differential voltage can be directed through the probe effectively +/-5V through the probe. The chip provides a higher current control than it can produce micro. I suspect that these outputs are actually some form of PIN controller or H-Bridge controller, for high current drive. The second part is two transistors with a common base, collectors are available on other pins. this transistat is part of the feedback on the last part of the receiver chain, to change the analog signal to a digital signal of type TTL and is basically a switch driven by the last phase to pull the signal to 0V and pulled up to 5V resistance (R17) receiver U2 Quadruple op-amp IC (U2) is LM324, which is a relatively old bandwidth device with low 1 MHz bandwidth, with a limited I/O range (outputs do not extend to rails). It is a ubiquitous and inexpensive device. Due to some of the profit levels used in stages, this means that 40 kHz signals pass through phases with a bandwidth of approximately 100 kHz. Large offset errors can also affect some stages when they have occurred. The receiver is a string of three op-amps as small signal stages all AC-né, which are used in the configuration of one rail, the final phase is a variable threshold hysteris comparator with output switch. Each of the first three stages is an inverting amplifier or filter with positive input to the central rail, which applies displacement for the operation of one electric railway. supply for medium rail is provided by R14, R15 and C6. C1, C3 and C4 provide alternating connections between stages. The first phase (U2D, R1 and R2) is an inverting signal amplifier of the RX probe with a gain of about 5.6 (allowing tolerances). The output is weakened with reference to the mean rail R3 and R4. The second stage (U2C, C2, C3 and R5) is a band filter with tolerances centered around 40 kHz of the frequency of pulses emitted. The third stage (U2B, R6 and R7) is another amplifier with a gain of approximately 10. The last op-amp is a variable threshold hysteria comparator with output switch, output witch is formed by transistor in U3 and pullup resistor R17. This output is part of the feedback on the R9 hysteria comparator. R10 (R10) R16 you are a potential splitter to obtain the correct base voltage for the transistor in U3. The variable threshold comes from R13 and R12 with separation and filtering of the ground path using C8 and R11. One end of R13 is bound to the middle rail for the normal threshold, while the Threshold signal from the micro through R12 pulls the threshold on pin 2 closer to the ground, forcing the output higher and the transistor in U3 to clamp the signal to the micro during the TX burst transmission. So avoid false echoes too soon. Unfortunately, I have found that problems in this area, such as open circuit R16 or bad (incorrect value) parts such as C8 can cause all sorts of problems with erratic values. personally it would be better with a proper Schmitt Trigger op-amp with hard threshold control without C8 better timed from micro from the beginning of the Trig pulse to the end of the TX burst (ECHO HIGH setting). Personally, instead of changing the threshold, it would be better to cede the input from the sensor using the FET through the sensor pins. Back to the top Known hardware faults on faulty units Flag First point to check Only able to detect large objects (e.g. A4 paper size) at approximately a minimum distance of 30 cm R16 on one drive that was found to be open circuit should be 3k9 0603 Size causes the input signal to the micro-contract to be clamped too long. , power connections good and TRIG pulse is valid, no echo Metal disc snoring inside TX or RX ultrasonic transducers (behind the grill) Replace the unit or probe on the unit Valid data when sampling at 1 second intervals, but random reading or many errors in sampling faster Readings scattered with many timeouts (time 0) Incoming shortly preceding pages cover interest in something similar contact sales. Sales.

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