hcsr04sensor Python Module

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1 HC-SR04 Ultrasonic Sensor on Raspberry Pi

`https://www.linuxnorth.org/hcsr04sensor/`

Calculate distance and depth measurements with a HCSR04 Ultrasonic Sound Sensor and a Raspberry Pi. Instructions assume that you are using Raspberry Pi OS/Raspbian Linux.
This module also works with the JSN-SR04T waterproof sound sensor.

2 Installation

Install PIP and RPi-GPIO

```
sudo apt install python3-pip python3-rpi.gpio
```

This will install the apt package RPi.GPIO v0.7.0 from the repository. On Raspberry Pi OS (Bullseye) you may prefer to install the latest version of RPi.GPIO 0.7.1 with Pip. If you prefer the later package run the following;

```
sudo apt remove python3-rpi.gpio  <--version 0.7.0
sudo pip3 install RPi.GPIO <--version 0.7.1
```

Install the hcsr04sensor package. This will also install prerequisite packages if required.

```
sudo pip3 install hcsr04sensor
```

3 Module Description

The module does the following;

- Returns an error corrected distance by using the median reading of a sorted sample. The default sample size is 11 readings.
- You can specify a different sample size by passing `sample_size=x` to `raw_distance`, where x is your desired number of readings. This is useful if you need to lower the sample size to take quicker readings. Beware that the probability of getting erroneous readings increases as sample size is reduced. For my purposes a sample of 11 readings gives a consistent value that I can trust and takes approximately 3 seconds to run with a 0.1 second wait time between individual samples.
- It is also possible to speed up the readings by passing a lower value to `sample_wait` in `raw_distance`.

- The lower the value the quicker the individual samples will be taken. A default of 0.1 is a safe wait time but this can be reduced further. CPU usage increases as faster readings are taken as well as the chance for errors.
- This module uses BCM pin values. See the Raspberry Pi pin layout documentation for your model.
- Uses BCM pin values by default. BOARD pin values are supported.
- Adjusts the reading based on temperature by adjusting the speed of sound.
- Allows measuring distance and depth in metric and imperial units. See - pydoc hcsr04sensor.sensor
- Raises an exception if a faulty cable or sensor prevents an echo pulse from being received.
- Calculate the volume of different types of containers. See recipes for examples.

4 Connecting the Sensor

The HC-SR04 sensor has four pins.

- 5V VCC which connects to a 5V pin on the Raspberry Pi
- Trig Pin which connects to a valid GPIO pin. Diagram uses GPIO pin 17.
- Echo Pin which connects to a valid GPIO pin. Diagram uses GPIO pin 27.
- Ground which connects to any valid ground pin on the Raspberry Pi

GPIO pins are rated for 3.3V so you must insert a voltage divider as the power pin on the PI is 5V. In the above diagram a 470 Ohm resistor is soldered on the echo wire. A 1000 Ohm resistor is soldered between the echo and ground wires. This reduces voltage to GPIO pin 27 to 3.4V which is within a tolerable level. Failure to do this can damage your board.

Voltage divider calculator - courtesy ohmslawcalculator.com

Soldering tutorial -courtesy Xrobots James Bruton

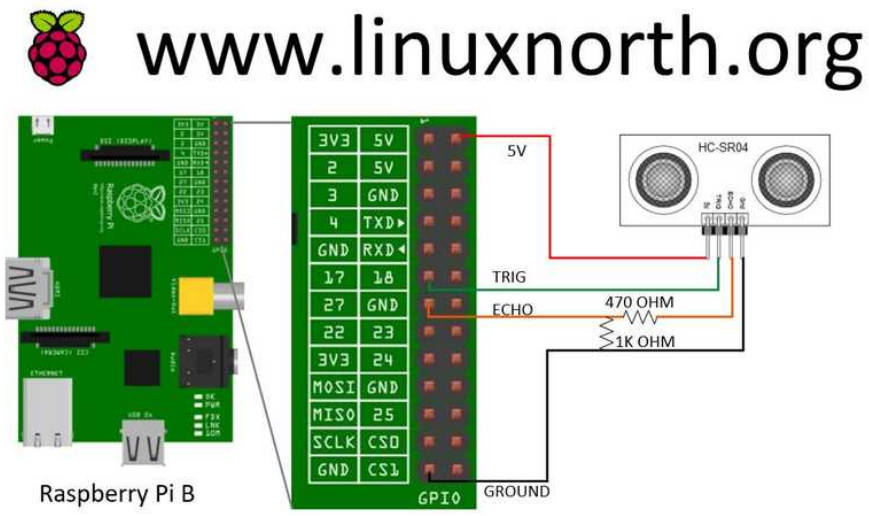

Figure 1: HCSR04 Wiring Diagram

5 Accuracy of Readings

If you need highly accurate readings then this module would not be suitable for your project. In that case you should probably use an Arduino instead of a Raspberry Pi.

Linux is not a Real Time OS so you can expect to get a small variance on each reading, usually within a half cm of the actual value. I say ”usually” because every once in a while you can get a reading that is way out of range. This is due to the OS executing other tasks before getting your distance reading. It is why I use a sample of readings. I can always trust that the median of my sample of 11 readings is good.

Highly accurate readings are not required for some applications. For example I use this module in an application I wrote for a sump pump monitor. I am not worried about millimeter accuracy for that application. 1 cm variance on a meter deep pit is close enough to alert me to problems.

Another example would be to calculate the water volume of a drinking water well (standing cylinder shape). It would not matter if you are a gallon off on a 1000 gallon reading.

6 Distance Limitations

The HCSR04 sensor is suited for short distance readings. The specification manual says it is suitable up to 13 feet. I have tested it to go further than that, but anything over 12 feet starts having periodic strange readings. This module is not suitable for long distances.

7 Usage

See example scripts in `https://github.com/alaudet/hcsr04sensor/tree/master/recipes`

8 Testing the Module

Run the **/usr/local/bin/hcsr04.py**. This utility does not presently support BOARD pin values. Use BCM pin values.

8.1 Usage

```
usage: hcsr04.py [-h] -t TRIG -e ECHO [-sp SPEED] [-ss SAMPLES]

Script tests the HCSR04 sensor under different configurations

optional arguments:
-h, --help            show this help message and exit
-t TRIG, --trig TRIG  Trig Pin (Required - must be an integer, must use
BCM pin values)
-e ECHO, --echo ECHO  Echo Pin (Required - must be an integer, must use
BCM pin values)
-sp SPEED, --speed SPEED
Time between individual reading samples (Optional -
must be a float, default is 0.1 seconds)
-ss SAMPLES, --samples SAMPLES
Reading Sample Size (Optional - must be an integer, default is
11)
```

8.2 Sample Output

```
pi@raspberry:~ $ hcsr04.py -t 17 -e 27
trig pin = gpio 17
echo pin = gpio 27
```

```
speed = 0.1
samples = 11

The imperial distance is 12.3 inches.
The metric distance is 31.2 centimetres.
```

9 Contributing

The python hcsr04sensor module source code is available on GitHub `https://github.com/alaudet/hcsr04sensor`.

Your contributions are welcome.

10 Resources

- Available on GitHub - `https://github.com/alaudet/hcsr04sensor`
- hcsr04sensor Home Page - `https://www.linuxnorth.org/hcsr04sensor/`
- Script recipes - `https://github.com/alaudet/hcsr04sensor/tree/master/recipes`
- HC-SRO4 Specification Manual - `https://www.linuxnorth.org/raspi-sump/HC-SR04Users_Manual.pdf`
- JSN-SR04T Specification Manual - `https://www.linuxnorth.org/raspi-sump/jsn-sr04t.pdf`

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