

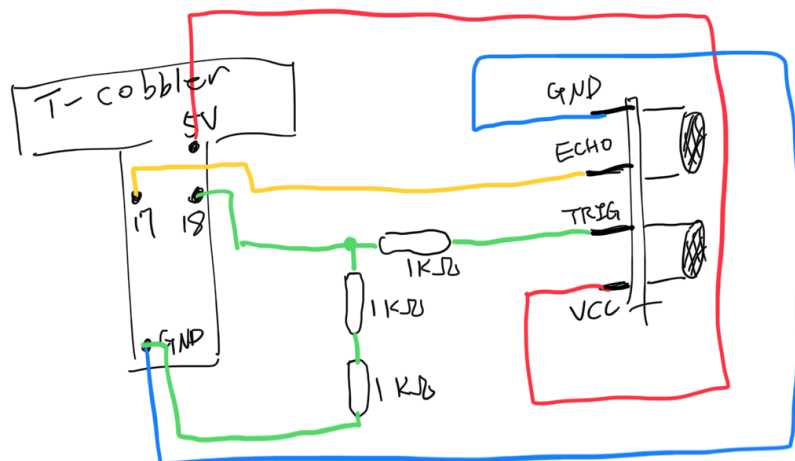
## Ultrasonic Sensor

0. Read the following datasheet for HC-SR04:

- <https://www.dropbox.com/s/tgzj3e9n6h1a8er/Ultrasonic%20Ranging%20Module%20HC%20-%20SR04.pdf?dl=0>
- Or, for HY-SRF05: <https://www.robot-electronics.co.uk/htm/srf05tech.htm>

1. Make a prototype for the below circuit.

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- For your reference, the following link explains how voltage divider works and why it is necessary for connection between RPi and the ultrasonic sensor using 5V signal level.

2. Run the below test code.

- `uss_test.py`

```
#!/usr/bin/env python

import RPi.GPIO as GPIO
import time

TRIG = 11
ECHO = 12

def setup():
    GPIO.setmode(GPIO.BOARD)
    GPIO.setup(TRIG, GPIO.OUT)
```

```

        GPIO.setup(ECHO, GPIO.IN)

def distance():
    GPIO.output(TRIG, 0)
    time.sleep(0.000002)

    GPIO.output(TRIG, 1)
    time.sleep(0.00001)
    GPIO.output(TRIG, 0)

    while GPIO.input(ECHO) == 0:
        a = 0
    time1 = time.time()
    while GPIO.input(ECHO) == 1:
        a = 1
    time2 = time.time()

    during = time2 - time1
    return during * 340 / 2 * 100

def loop():
    while True:
        dis = distance()
        print dis, 'cm'
        time.sleep(1)

def destroy():
    GPIO.cleanup()

if __name__ == "__main__":
    setup()
    try:
        loop()
    except KeyboardInterrupt:
        destroy()

```

- \$ python uss\_test.py
- \$ gcc -o test.out test.c -lwiringPi

<test.c>

```

/*****
*   Ultra Sonic Ranging module Pin VCC should
*   be connected to 5V power.
*****/
#include <wiringPi.h>
#include <stdio.h>
#include <sys/time.h>

#define Trig  0

```

```

#define Echo 1

void ultranIt(void)
{
    pinMode(Echo, INPUT);
    pinMode(Trig, OUTPUT);
}

float disMeasure(void)
{
    struct timeval tv1;
    struct timeval tv2;
    long time1, time2;
    float dis;

    digitalWrite(Trig, LOW);
    delayMicroseconds(2);

    digitalWrite(Trig, HIGH);
    delayMicroseconds(10);    //发出超声波脉冲
    digitalWrite(Trig, LOW);

    while(!(digitalRead(Echo) == 1));
    gettimeofday(&tv1, NULL);    //获取当前时间

    while(!(digitalRead(Echo) == 0));
    gettimeofday(&tv2, NULL);    //获取当前时间

    time1 = tv1.tv_sec * 1000000 + tv1.tv_usec; //微秒级的时间
    time2 = tv2.tv_sec * 1000000 + tv2.tv_usec;

    dis = (float)(time2 - time1) / 1000000 * 34000 / 2; //求出距离

    return dis;
}

int main(void)
{
    float dis;

    if(wiringPiSetup() == -1){ //when initialize wiring failed,print message to screen
        printf("setup wiringPi failed !");
        return 1;
    }

    ultranIt();

    while(1) {
        dis = disMeasure();
        printf("%.2f cm\n", dis);
    }
}

```

```
        delay(1000);  
    }  
    return 0;  
}
```

3. Modify the above code so that distance is measured at every 50ms.
4. For a given target distance, repeat measurement 100 times and evaluate how your measurements were successful. For example, aim at wall with 2m distance, and take 10 samples like: 2.0 1.9 **1.2 0.9 0.9** 2.0 1.9 1.9 2.0 1.9. If you set the threshold range 1.9 ~ 2.1m, the measurement success ratio becomes 70%.
5. Discuss the limit and fault of the above code.