# Electronics
# Interrupts and Threading

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**Useful Technique:** *Interrupts* and multiple *threads* allow you to create programs which don't waste lots of time waiting for unpredictable *events*. **Events** include specific transitions on GPIO pins.

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The main program and the *interrupt service routine* are called different *threads* of execution.

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- Create flags to communicate between threads.
- Make interrupt routines as short as possible; have most processing done in the main thread.

## Example: Ultrasonic Sensor

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Here's an example of using interrupts with the SR-04 ultrasonic distance sensor.

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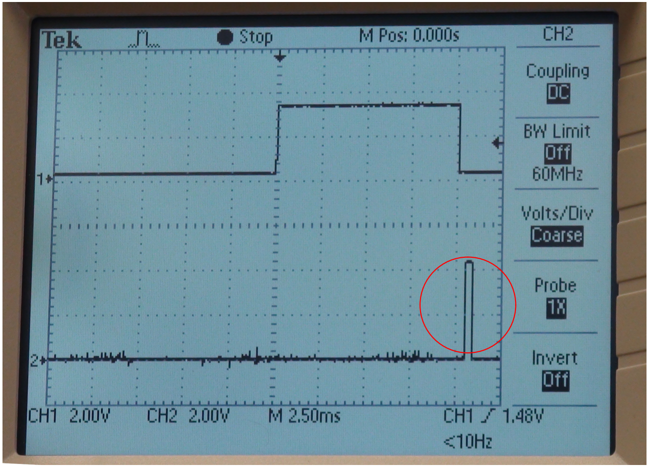
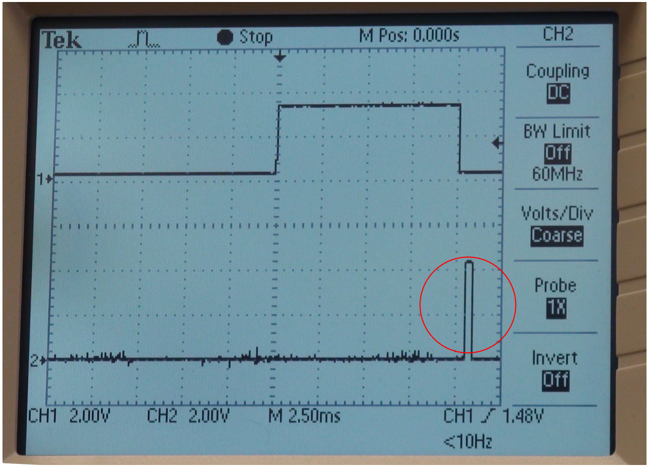
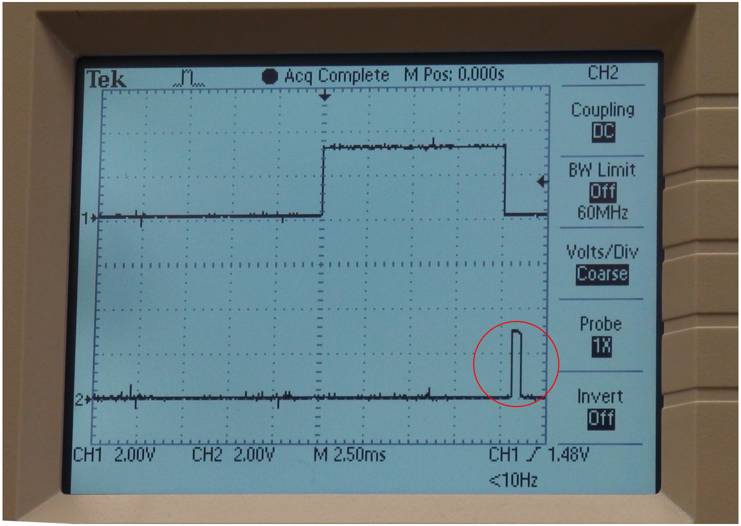
Optoisolating both signals takes care of both problems.


Tek
Stop
M Pos: 0.000s
CH2
Coupling
DC
BW Limit
Off
60MHz
Volts/Div
Coarse
Probe
1X
Invert
Off
CH1 2.00V
CH2 2.00V
M 2.50ms
CH1 ∕ 1.48V
<10Hz



Sensor side; 5V logic pulses


Tek
Acq Complete
M Pos: 0.000s
CH2
Coupling
DC
BW Limit
Off
60MHz
Volts/Div
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Off
1
2
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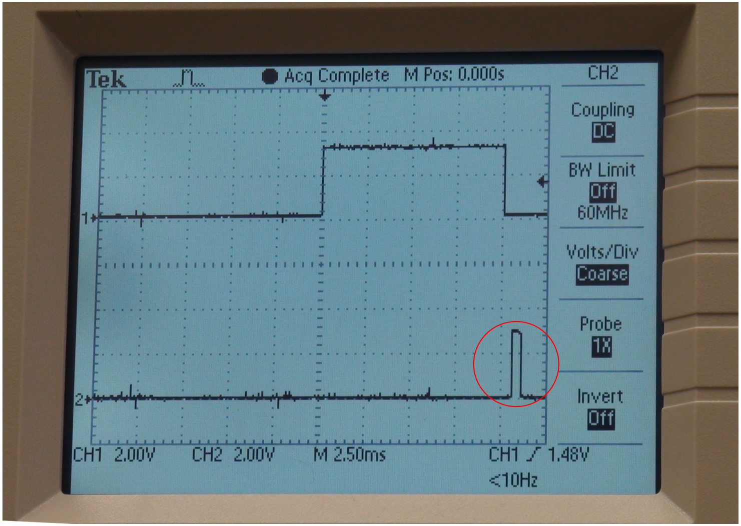

Raspberry Pi side; 3.3V pulses

## Interrupt sample code (1/4)

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```
 import RPi.GPIO as GPIO
 import datetime
 import time
#
#stuff omitted here
#
GPIO.setup(TRIGGER_PIN, GPIO.OUT)
GPIO.setup(ECHO_PIN, GPIO.IN)
#
#stuff omitted here
#
```

## Interrupt sample code (2/4)

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```
#
#stuff omitted here
#
def Ultrasonic_Send_Pulse():
    GPIO.output(TRIGGER_PIN,GPIO.HIGH)
    time.sleep(PULSE_TIME)
    GPIO.output(TRIGGER_PIN,GPIO.LOW)
    global trigger_time
    trigger_time=datetime.datetime.now()
```

## Interrupt sample code (3/4)

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```
def Ultrasonic_Pulse_Received(channel):
    echo_time=datetime.datetime.now()
    delta=echo_time-trigger_time
    flight_time=delta.total_seconds()
    print "Rising edge detected on ECHO_PIN."
    print flight_time*speed
```

## Interrupt sample code (4/4)

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```
GPIO.add_event_detect(ECHO_PIN, GPIO.FALLING,
            callback=Ultrasonic_Pulse_Received)

try:
        while True:
            Ultrasonic_Send_Pulse()
            print "Waiting..."
            time.sleep(5)
            print "Done waiting..."

except KeyboardInterrupt:
        GPIO.cleanup()        # CTRL+C exit
```

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  set up interrupt
- **ECHO_PIN**

  pin to monitor
- **GPIO.FALLING**

  transition (i.e. “event”) to watch for
- **callback=Ultrasonic_Pulse_Received**

  function to execute when event happens

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while True:
    Ultrasonic_Send_Pulse()
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    time.sleep(5)
    print "Done waiting..."
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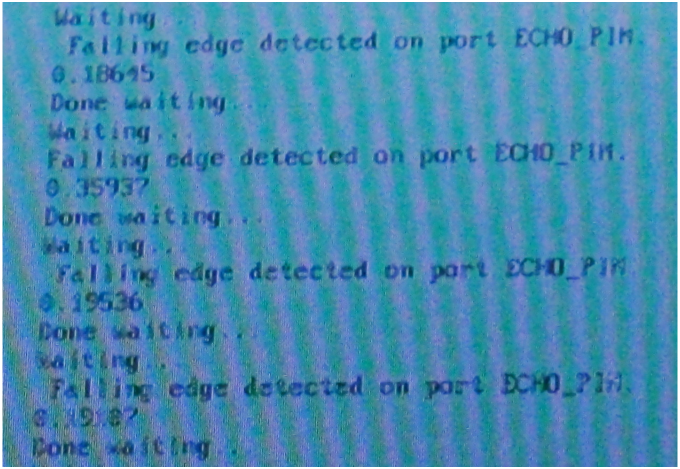
Note the *sleep* instruction after the pulse is sent.



```
Waiting...
 Falling edge detected on port ECHO_PIN.
0.18645
Done waiting...
Waiting...
Falling edge detected on port ECHO_PIN.
0.35937
Done waiting...
Waiting...
 Falling edge detected on port ECHO_PIN.
0.19536
Done waiting...
Waiting...
 Falling edge detected on port ECHO_PIN.
0.19187
Done waiting...
```

Transitions detected *during* sleep.

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No doubt there are many other possibilities as well.