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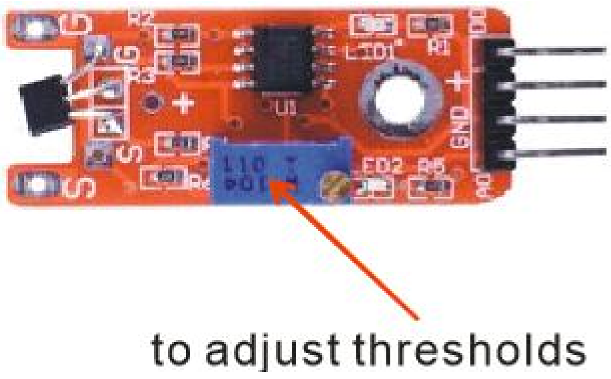
Hybrid Hall Sensor

(aka Linear Hall Sensor)



Overview

Hall effects are magnetic sensors, and vary their voltage output in relation to a detected magnetic field. They are used to detect proximity, position, speed, and current. Analog Hall sensors report a signal proportional to the magnetic field strength (an analog quantity) rather than act as a discrete (digital) switch indicating a magnet's "presence" or "absence." The module used in this experiment can provide both an analog reading of proximity and a digital "switch" value determining whether the reading exceeds some proximity threshold (set by the blue onboard potentiometer). This experiment uses the Raspberry Pi to measure both signals of the linear Hall sensor, and drives a blinking LED based on whether the captured analog signal exceeds a software-specified threshold. (Thus the sample code recreates, in software, the same decision logic mapping a sensed analog value to a switched effect that the onboard comparator and potentiometer accomplish in producing the digital signal in hardware.)
(The industry-standard conventional name for this module is "Linear Hall Switch," but since several types of Hall effect sensors report a linear measure of magnetic field strength, this document instead names the module by its design: "hybrid Hall Sensor.")

Experimental Materials

Raspberry Pi	x1
Breadboard	x1
Hybrid Hall sensor	x1
ADC0832	x1
LED (3 pin)	x1
Resistor (330Ω)	x1
Dupont jumper wires	
Any magnet	(you provide)

Experimental Procedure

1. If you have not done so already, prepare your development system by installing the Python interpreter, RPi.GPIO library, and wiringPi library as described in READ_ME_FIRST.TXT.

2. Install the ADC0832 analog/digital converter IC, hybrid Hall effect sensor, three-pin LED and resistor on your breadboard, and use Dupont jumper wires to connect them to each other and your Raspberry Pi as illustrated in the Wiring Diagram below. Note you will connect only two of the three pins on the LED.

3. Execute the sample stored in this experiment's subfolder.
   If using C, compile and execute the C code:

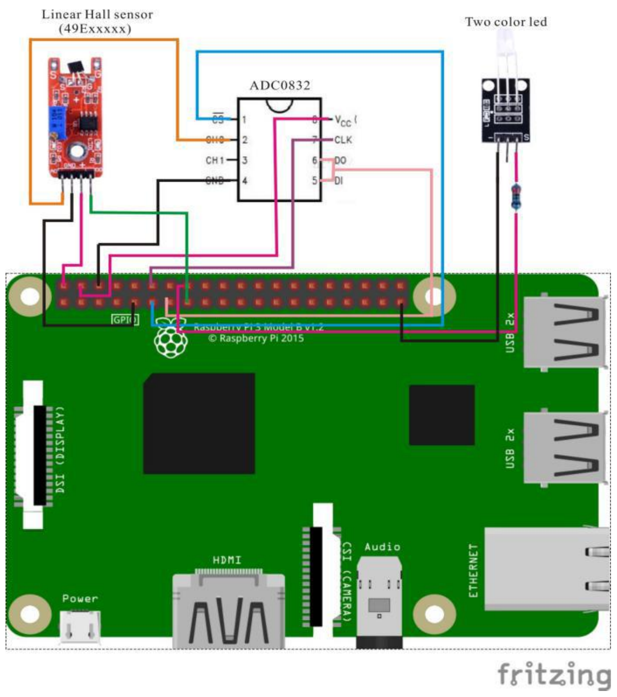
   ```
   cd Code/C
   gcc hybridHall.c -o hybridHall.out -lwiringPi
   ./hybridHall.out
   ```

   If using Python, launch the Python script:

   ```
   cd Code/Python
   python hybridHall.py
   ```

4. Make experimental observations.
   When you hold your magnet vertically close to the sensor, the Hall effect generates an (analog) voltage, which the ADC converts to a (digital) signal readable by the Raspberry Pi. The sample code then turns on the LED if that voltage exceeds a certain threshold.

Wiring Diagram



ADC0382 pin position:

CS	↔	Raspberry Pi Pin 11
CLK	↔	Raspberry Pi Pin 12
DI	↔	Raspberry Pi Pin 13
D0	↔	Raspberry Pi Pin 13
CH0	↔	Linear Hall Sensor Pin A0
VCC	↔	Raspberry Pi +5V
GND	↔	Raspberry Pi GND

Hybrid Hall pin position:

A0	↔	ADC0382 Pin CH0
D0	↔	Raspberry Pi Pin 15
GND	↔	Raspberry Pi GND
"+"	↔	Raspberry Pi +5V

LED pin position:

"S"	↔	Raspberry Pi Pin 16(through resistor)
"-"	↔	Raspberry Pi GND

Sample Code

Python Code

```
#!/usr/bin/env python
import RPi.GPIO as GPIO
import ADC0832
import time

Hall_DO_PIN = 15
LedPin = 16
thresholdVal = 100

def init():
   GPIO.setmode(GPIO.BOARD)
   GPIO.setup(Hall_DO_PIN,GPIO.IN,
pull_up_down=GPIO.PUD_UP)
   GPIO.setup(LedPin, GPIO.OUT)
   ADC0832.setup()
def loop():
    while True:
        global digitalVal
        digitalVal = GPIO.input(Hall_DO_PIN)
        if(digitalVal == 0):
          print 'DO is %d' % digitalVal
          analogVal = ADC0832.getResult(0)
          print 'Current analog value is %d'% analogVal
          if(analogVal > thresholdVal):
             GPIO.output(LedPin, GPIO.HIGH)
             time.sleep(0.2)
        else:
           GPIO.output(LedPin, GPIO.LOW)

if __name__ == '__main__':
   init()
   try:
      loop()
   except KeyboardInterrupt:
      ADC0832.destroy()
      print 'The end !'
```

C Code

```
#include <wiringPi.h>
#include <stdio.h>
#include <string.h>
#include <errno.h>
#include <stdlib.h>

#define     ADC_CS    0
#define     ADC_CLK   1
#define     ADC_DIO   2

#define  Hall_DO_Pin   3
#define  LedPin         4
#define thresholdVal 100

typedef unsigned char uchar;
typedef unsigned int uint;


uchar get_ADC_Result(void)
{
   uchar i;
   uchar dat1=0, dat2=0;

   digitalWrite(ADC_CS, 0);
   digitalWrite(ADC_CLK,0);
   digitalWrite(ADC_DIO,1);   delayMicroseconds(2);
   digitalWrite(ADC_CLK,1);   delayMicroseconds(2);

   digitalWrite(ADC_CLK,0);
   digitalWrite(ADC_DIO,1);    delayMicroseconds(2);
   digitalWrite(ADC_CLK,1);   delayMicroseconds(2);

   digitalWrite(ADC_CLK,0);
   digitalWrite(ADC_DIO,0);   delayMicroseconds(2);
   digitalWrite(ADC_CLK,1);
   digitalWrite(ADC_DIO,1);    delayMicroseconds(2);
   digitalWrite(ADC_CLK,0);
   digitalWrite(ADC_DIO,1);    delayMicroseconds(2);
```

```
    for(i=0;i<8;i++)
    {
        digitalWrite(ADC_CLK,1);   delayMicroseconds(2);
        digitalWrite(ADC_CLK,0);    delayMicroseconds(2);

        pinMode(ADC_DIO, INPUT);
        dat1=dat1<<1 | digitalRead(ADC_DIO);
    }

    for(i=0;i<8;i++)
    {
        dat2 = dat2 | ((uchar)(digitalRead(ADC_DIO))<<i);
        digitalWrite(ADC_CLK,1);   delayMicroseconds(2);
        digitalWrite(ADC_CLK,0);    delayMicroseconds(2);
    }

    digitalWrite(ADC_CS,1);
    pinMode(ADC_DIO, OUTPUT);
    return(dat1==dat2) ? dat1 : 0;
}

int main(void)
{
    uchar digitalVal = 1;
    uchar analogVal = 0;
    if(wiringPiSetup() == -1)
    {
        printf("setup wiringPi failed !\n");
        return -1;
    }


    pinMode(ADC_CS,  OUTPUT);
    pinMode(ADC_CLK, OUTPUT);
    pinMode(Hall_DO_Pin, INPUT);
    pullUpDnControl(Hall_DO_Pin, PUD_UP);
    pinMode(LedPin, OUTPUT);
    while(1)
    {
        if((digitalVal = digitalRead(Hall_DO_Pin)))
        {
            printf("Do is %d.\n", digitalVal);
            analogVal = get_ADC_Result();
            printf("Current analog value is %d.\n", analogVal);
            if(analogVal > thresholdVal)
            {
                digitalWrite(LedPin, HIGH);
            }
            delay(200);
        }
        else
        {
            digitalWrite(LedPin, LOW);
        }
    }

    return 0;
}
```