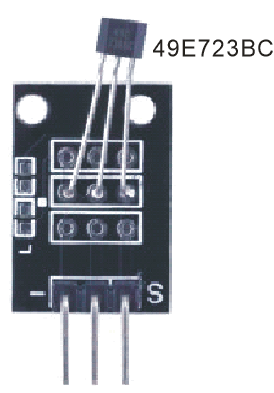
Analog Hall Sensor



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. This experiment uses the Raspberry Pi to measure the signal of an analog Hall sensor and drive a blinking LED based on the captured signal.

Experimental Materials

RaspberryPi x1

Breadboard x1

Analog Hall sensor x1

ADC0832 x1

LED (3-pin) x1

Dupont jumper wires  
 any magnet x1 (you provide)

Experimental Procedure

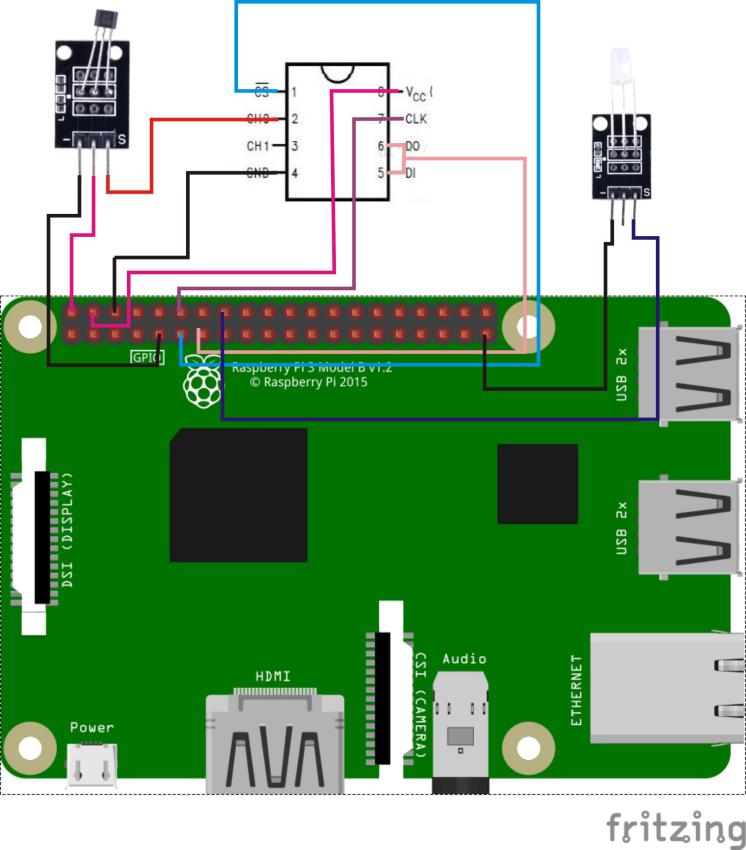
1. If you have not done so already, prepare your development system by installing the Python interpreter, RPi.GIO library, and wiringPi library as described in READ\_ME.TXT.
2. Install the ADC0832 analog/digital converter IC, analog Hall effect sensor, and three-pin LED on your breadboard, and use Dupont jumper wires to connect them to each other and your Raspberry Pi as illustrated in the Wiring Diagram below. (The three-pin LED provided in this kit includes onboard series resistors, so no additional resistors are needed.)
3. Execute the sample stored in this experiment’s subfolder.

If using C, compile and execute the C code:  
cd Code/C  
gcc analogHall.c -o analogHall.out –lwiringPi  
analogHall.out

If using Python, launch the Python script:  
cd Code/Python  
python analogHall.py

1. 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 RaspberryPi. The sample code then turns on the LED if that voltage exceeds a certain threshold.  
     
   Depending on the location of magnet and sensor, Hall effects can be useful in many applications. When the magnet is mounted on a door and the sensor on the doorframe, they can be used in burglar alarms to answer “is the door open?” When the magnet is mounted on a rotating wheel and the sensor on a fixed point next to the wheel, they can be used in speedometers and odometers to answer “has the wheel made a complete revolution?”

Wiring Diagram



ADC0382 pin position:

CS ↔ Raspberry Pi Pin 11

CLK ↔ Raspberry Pi Pin 12

DIO ↔ Raspberry Pi Pin 13

CH0 ↔ Analog Hall Sensor Pin "S"

VCC ↔ Raspberry Pi +5V

GND ↔ Raspberry Pi GND

Analog Hall pin position:

"S" ↔ ADC0382 CH0

"+" ↔ Raspberry Pi +5V

"-" ↔ Raspberry Pi GND

LED Pin position:

"S" ↔ Raspberry Pi Pin 16

"-" ↔ Raspberry Pi GND

Technical Background

When there is current at both ends of a semiconductor sheet and a uniform magnetic field with a magnetic induction strength is applied in the vertical direction of the sheet, a Hall effect with a potential difference of UH will be generated in the direction perpendicular to the current and the magnetic field. Hall elements— semiconductor components sensitive to the Hall effect—have many advantages as mechanical sensors (sensitivity to magnetic field, simple structure, small volume, wide frequency response, large output voltage change, long service life, etc.) and have been widely used in measurement, automation, computer and information technology. A voltage difference is generated when the Hall element and the magnet meet in the forward direction, and there is no voltage difference when the Hall element and the magnet meet in the forward direction, so that you can obtain the voltage change by the Raspberry Pi, and then judge the proximity of the magnet, and you can also control the LED light on and off according to the signal. For more information, see https://en.wikipedia.org/wiki/Hall\_effect\_sensor.

Sample Code

(These are listings of the files in this experiment’s Code subfolder.)

1. Python code

#!/usr/bin/env python

import ADC0832

import time

import RPi.GPIO as GPIO

LedPin = 16

thresholdVal = 150

def init():

ADC0832.setup()

GPIO.setup(LedPin, GPIO.OUT)

def loop():

while True:

analogVal = ADC0832.getResult(0)

print 'analog value is %d' % analogVal

if(analogVal < thresholdVal):

GPIO.output(LedPin, GPIO.HIGH)

else:

GPIO.output(LedPin, GPIO.LOW)

time.sleep(0.2)

if \_\_name\_\_ == '\_\_main\_\_':

init()

try:

loop()

except KeyboardInterrupt:

ADC0832.destroy()

print 'The end !'

1. 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 LedPin 4

#define thresholdVal 150

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 analogVal;

if(wiringPiSetup() == -1)

{

printf("setup wiringPi failed !");

return -1;

}

pinMode(ADC\_CS, OUTPUT);

pinMode(ADC\_CLK, OUTPUT);

pinMode(LedPin, OUTPUT);

while(1)

{

analogVal = get\_ADC\_Result();

printf("Current analog : %d\n", analogVal);

if(analogVal < thresholdVal)

{

digitalWrite(LedPin, HIGH);

}

else

{

digitalWrite(LedPin, LOW);

}

delay(200);

}

return 0;

}

<<\*\*\* EDITORIAL COMMENTS FROM NICK TO KUMAN/EMILY

* There in one thing that would improve this piece tremendously: A good quality photograph of the breadboard with the circuit assembled as in the wiring diagram. If your user has never used a breadboard before, the instructions above are NOT enough to go on (they don’t know how to interpret the wiring diagram with an actual breadboard). However, if you give them a good photo of it, immediately after the wiring diagram, a smart beginner or an unconfident intermediate user can figure out how to put the pieces together. Because I don’t have this kit, I can’t take this photo. If you can, include it after the fritzing Wiring Diagram illustration, in that same section.
* Am I right that Kuman does not provide “the magnet” in your kit? I’ve added it to the list of Materials, but is there anything more that could be added to the description to be helpful? Will ANY magnet work? If I was a new user, I would worry “wait – can I use the magnet on my fridge? Or do I need a ‘special magnet?’”
* Above the original says “A voltage difference is generated when the Hall element and the magnet meet in the forward direction, and there is no voltage difference when the Hall element and the magnet meet in the forward direction.” This is contradictory—is there voltage, or not, in the forward direction?? I think maybe one time you mean “backward” and the other time “forward” but can’t quickly decide which one is which! Please correct.
* It would be great in the Fritzing diagram if you could LABEL the “Analog Hall sensor,” the “ADC0382” and the “LED (3-pin)” with exactly the same names (words) that appear in the Experimental Materials.

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