How to set Up and Wire a 3x3 Matrix of Hall Effect Sensors to a BeagleBoneGreen

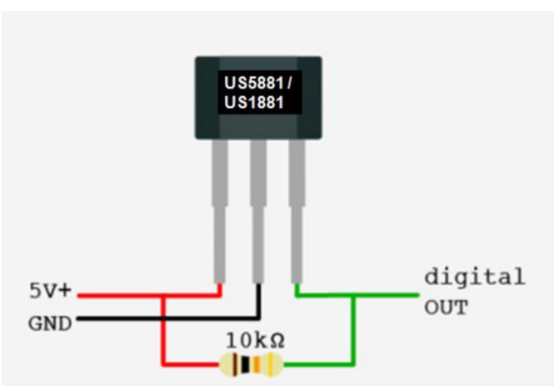
This guide covers the basics of how a hall effect sensor works, how to wire one, and how to create a 3x3 matrix of sensors interfaced to the BeagleBone Green.

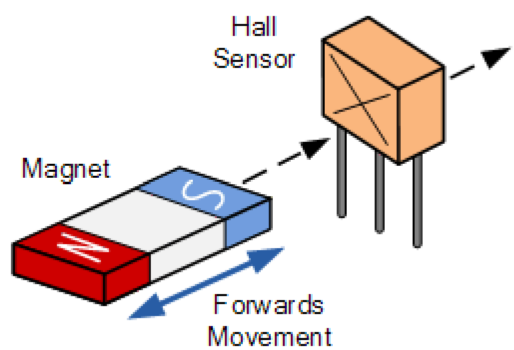
<u>Hall Effect Sensor Basics</u>

Hall effect sensors are switches that close when a magnetic field is detected. They have prongs for VCC, GND and Vout. They also require a pull up resistor connected across VCC and Vout in order to reduce noise and to prevent floating states from corrupting data. In typical hall effect sensors, the curved or rounded side is often referred to as the "sensitive side" or "sensing face."

Another important aspect of the hall effect sensor is its polarity. If the wrong magnet polarity is placed on the wrong side of the hall effect sensor, the sensor will not detect a change. The standard is that the south pole of your magnet will trigger the sensing face whereas the north pole of a magnet will trigger the non-sensing face.

The wiring for a single hall effect sensor along with its correct magnet placement is shown below.



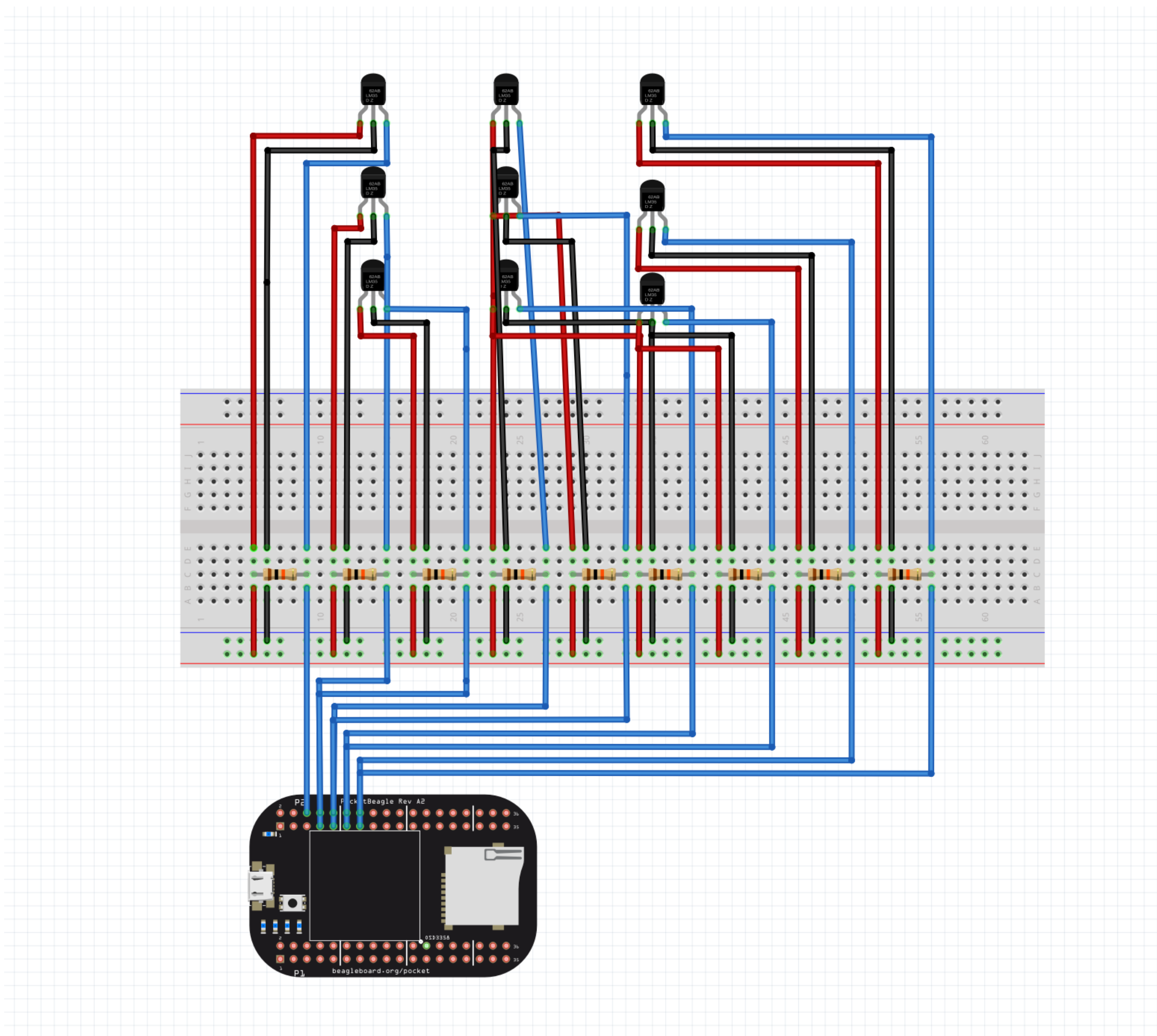


Note: The “x” on the hall effect sensor on the rightmost image indicates that it is the sensitive side.

The last feature to note is that standard hall effect sensors are active low. This means that when the switch is closed and current flows through the sensor, it will output a 0. Whereas, when the switch is open and no current flows, it will output a 1.

Matrix Basics

A 3x3 matrix of hall effect sensors can be wired in an array of pull up networks and 9 GPIO pins on the BeagleBone.



Each sensor will have its power and ground pins connected to 3.3V and GND respectively as well as the output pin connected to a GPIO pin on the BeagleBone. In addition, every sensor will have a 10k ohm resistor between the power and output pins in order to pull the GPIO value high when no magnet is in range.

BeagleBone Basics

The BeagleBone has GPIO pins we are going to be using to read the values of the switches. In order to use the GPIOs, you need to configure, export, then set the direction of every pin used. Lastly you will also set the pins to active low. As mentioned above the hall effect sensors will output a 0 when the switch is closed and a 1 when it's open. Setting the pin to active low will make the BeagleBone flip this logic resulting in a 1 when the switch is closed and a 0 when it's open. This simply makes interpreting the data more intuitive.

Another thing to note is that when configuring GPIOs, the actual GPIO directory number is different from the pin numbering on the physical board. For example p.8.26 is GPIO61/ not GPIO26/.

Steps

1. Wire the hall effect sensor matrix according to the schematic under the Matrix Basics section of this guide.

2. We now need to configure the GPIO pins on the BeagleBone. In this guide we will be using GPIOs p8.6 to and including p8.14. Set up the 9 GPIOs using the following BeagleBone Commands.

Note: You will have to run this set of code 9 times each with a different GPIO number. The first two iterations are given.

The GPIO mapping:

Pin Number	GPIO Directory Number
8.6	GPIO35
8.7	GPIO66
8.8	GPIO67
8.9	GPIO68
8.10	GPIO69
8.11	GPIO45
8.12	GPIO44
8.13	GPIO23

8.14	GPIO26

```
## iteration 1
$ config-pin p.8.6 gpio ## configure pin
$ cd /sys/class/gpio
$ echo 35 > export  ## export pin
$ cd /sys/class/gpio/gpio35
$ echo in > direction  ## set direction to input
$ echo 1 > active_low  ## set active low to be true

## iteration 2
$ config-pin p.8.7 gpio ## configure pin
$ cd /sys/class/gpio
$ echo 66 > export  ## export pin
$ cd /sys/class/gpio/gpio66
$ echo in > direction  ## set direction to input
$ echo 1 > active_low  ## set active low to be true
```

3. After the GPIOs are successfully configured, you can now place magnets on any of the 9 sensors, and observe the values the switches are reading using the following commands.

Note: change the gpio directory when trying different switches.

```
$ cd /sys/class/gpio/gpio61
$ cat value
```