

Grove Finger-clip Heart Rate Sensor on Beagle Bone Guide

By Aidan and the Asians

Introduction

Heart rate is the speed at which your heart beats, measured in beats per minute (bpm). A normal resting heart rate for adults is between 60 and 100 bpm. Your heart rate can give an indication of your fitness or help medical professionals in diagnoses. People in better shape usually have a lower resting heart rate. This guide will cover the use of a Grove finger-clip heart rate sensor on the beagle bone through both command line and C code. There exist other guides for interfacing with the grove finger clip heart rate sensor but none go into depth with its usage on the BeagleBone Green through C code.

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Required Parts

In order to follow this guide, the following parts are needed as well as a BeagleBone Green:

- 1 x Finger-clip Heart Rate Sensor
- 1 x 26AWG Grove Cable



Figure 1, Finger-clip Heart Rate Sensor (Left), 26 AWG Grove Cable(Right)

You may find these parts on http://wiki.seeed.cc/Grove-Finger-clip_Heart_Rate_Sensor/

Connecting Parts

To connect the Heart Rate Sensor, take the 26AWG Grove Cable and connect one end to the Heart Rate Sensor and the other to the I2C Grove interface on the BeagleBone Green. There are two similar looking ports on the BeagleBone Green, be sure not to confuse the two. The left one is the I2C Grove Interface while the right one is the Uart Grove Interface.

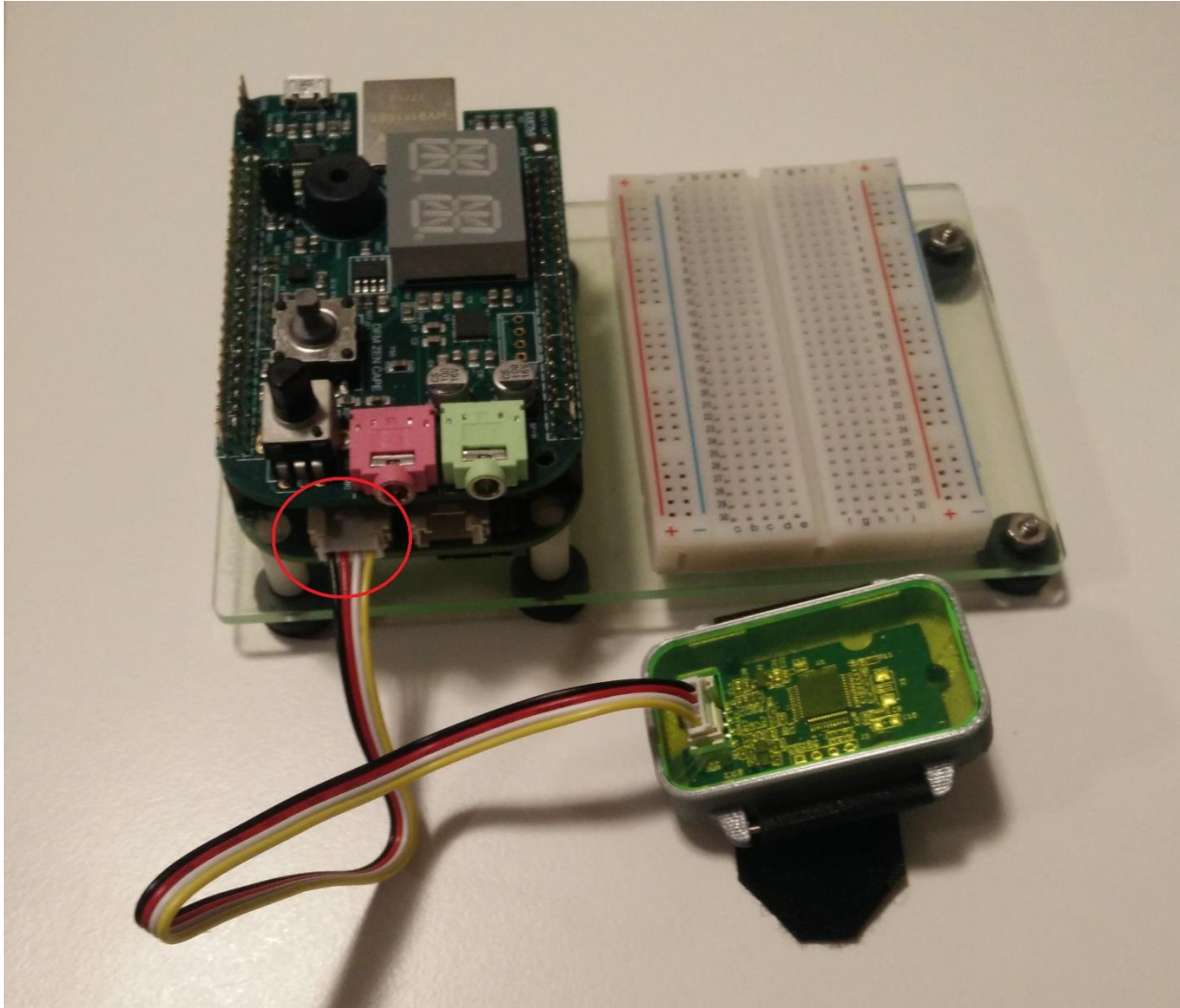


Figure 2, BeagleBone and Heart Rate Sensor connection. The circled port is the I2C Grove Interface.

Checking Setup via Command Line

This guide assumes that you have the univ-emmc virtual cape disabled.

1. To begin, first ensure that the i2c-2 bus is loaded:

```
# i2cdetect -l
i2c-0 i2c    OMAP I2C adapter          I2C adapter
i2c-2 i2c    OMAP I2C adapter          I2C adapter
```

2. To confirm that the heart beat sensor is correctly connected, display the I2C devices on the I2C2 bus with the following:

```
# i2cdetect -y -r 2
```

```
root@lochee-beagle:~# i2cdetect -y -r 2
      0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
10:  --  --  --  --  --  --  --  --  UU  --  --  --  --  --  --  --
20:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
30:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
40:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
50:  50  --  --  --  UU  UU  UU  UU  --  --  --  --  --  --  --  --
60:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
70:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
```

Figure 3, #i2cdetect -y -r 2 output. Circled is the address of the i2c device address.

Ensure that the circled i2c device address is not "--", this means that the heartbeat sensor is correctly connected.

3. The read register for the heart beat sensor is 0xA0. To read from this register you can use the command below. The output will be a value such as 0x56 is a hex value which you can convert into bpm.

```
#i2cget -y 2 0x50 0xA0
```

4. Troubleshooting

- If you get the output:

```
# i2cdetect -y -r 2
```

```
root@lochee-beagle:~# i2cdetect -y -r 2
      0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
10:  --  --  --  --  --  --  --  --  UU  --  --  --  --  --  --  --
20:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
30:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
40:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
50:  --  --  --  --  UU  UU  UU  UU  --  --  --  --  --  --  --  --
60:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
70:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
```

Figure 4, #i2cdetect -y -r 2 output. Output is the result of an incorrect connection.

You most likely connected the Grove cable into the wrong port. Make sure the grove cable is connected to the I2C Grove interface on the left as shown in the Connecting Parts section.

- If you get the following output:

```
# i2cdetect  
-bash: i2cdetect: command not found
```

You need to download the I2C tools for the BeagleBone. Use the following command:

```
# sudo apt-get install i2c-tools
```

Heart Rate Sensor via C Code

1. Initializing

To begin, we must first initialize the I2C device with the following function. The Heart beat sensor's device address is 0x50 on the ic2-2 cape. Use the following function:

```
#define I2C_DEVICE_ADDRESS 0x50
#define I2CDRV_LINUX_BUS2 "/dev/i2c-2"

int initI2cBus(char* bus, int address)
{
    int i2cFileDesc = open(bus, O_RDWR);
    if (i2cFileDesc < 0) {
        printf("I2C: Unable to open bus for read/write (%s)\n",
bus);
        perror("Error is:");
        exit(1);
    }
    int result = ioctl(i2cFileDesc, I2C_SLAVE, address);
    if (result < 0) {
        perror("I2C: Unable to set I2C device to slave
address.");
        exit(1);
    }
    return i2cFileDesc;
}
```

2. Reading the BPM

Now that we have the file descriptor, we can access the register address where we can read the current bpm of the heartbeat sensor.

```
#define READING_ADDRESS 0xA0
unsigned char readI2cReg(int i2cFileDesc, unsigned char regAddr)
{
    // To read a register, must first write the address
    int res = write(i2cFileDesc, &regAddr, sizeof(regAddr));
    if (res != sizeof(regAddr)) {
        perror("Unable to write i2c register.");
        exit(-1);
    }
    // Now read the value and return it
    char value = 0;
    res = read(i2cFileDesc, &value, sizeof(value));
    if (res != sizeof(value)) {
        perror("Unable to read i2c register");
        exit(-1);
    }
    return value;
}
```

3. Main Program

The following reads the bpm out of the heartbeat sensor and outputs it to the user.

```
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <unistd.h>
#include <sys/ioctl.h>
#include <linux/i2c.h>
#include <linux/i2c-dev.h>

#define READING_ADDRESS 0xA0
#define I2CDRV_LINUX_BUS2 "/dev/i2c-2"
#define I2C_DEVICE_ADDRESS 0x50

// Put the above functions Here

int main()
{
    //Initialize file
    int i2cFileDesc = initI2cBus(I2CDRV_LINUX_BUS2,
I2C_DEVICE_ADDRESS);

    //Read the register
    int currBPM = readI2cReg(i2cFileDesc, READING_ADDRESS);

    printf("Current BPM : %d\n", currBPM);
    close(i2cFileDesc);
    return 0;
}
```