

ESE 2025 Using sysfs Report

Instructor:

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Introduction

This report is showing the interaction with the onboard LEDs and the GPIOs of the Beaglebone using sysfs.

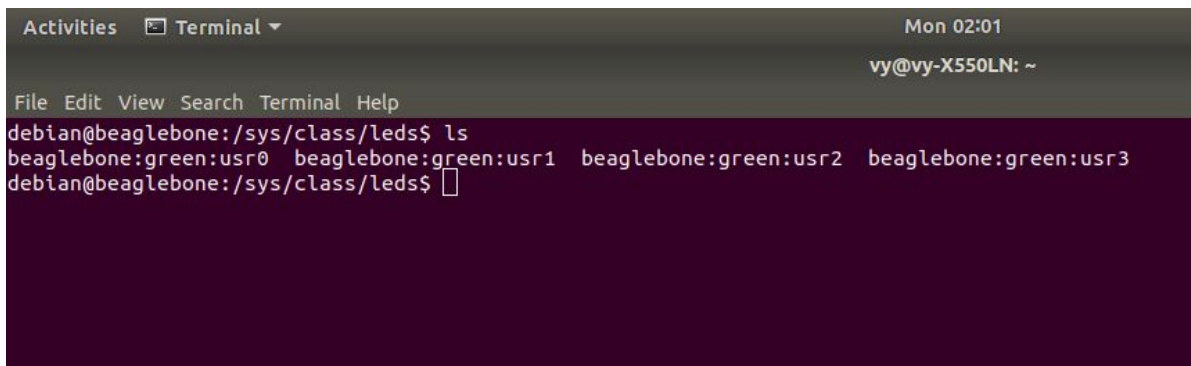
Discussion

After connecting to the Beaglebone by using `$ssh 192.168.7.2 -l debian`

We begin to experiment with the LEDs on Beaglebone. First to go to the `leds` directory on beaglebone

```
$cd /sys/class/leds
$ls
```

it will show the results



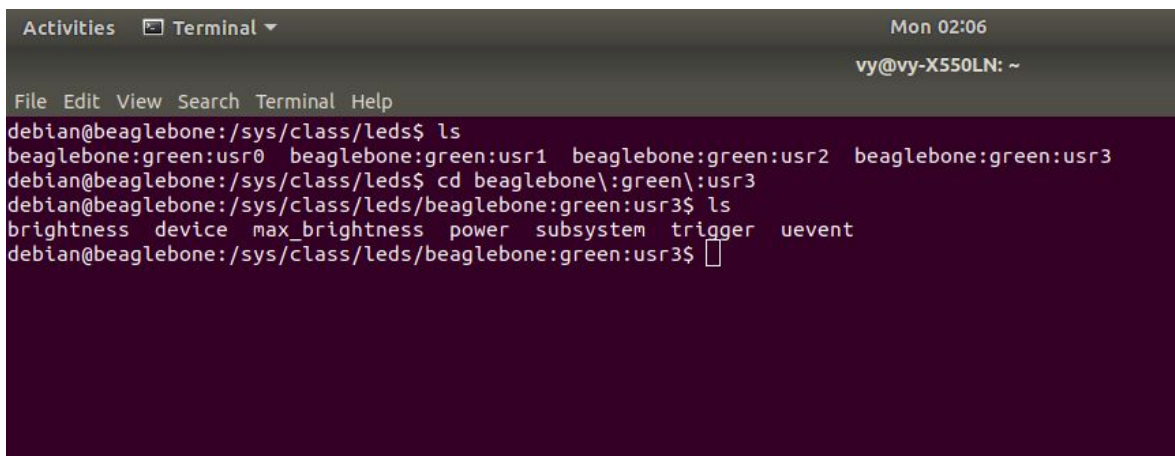
```
Activities  Terminal  Mon 02:01
vy@vy-X550LN: ~

File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds$ ls
beaglebone:green:usr0  beaglebone:green:usr1  beaglebone:green:usr2  beaglebone:green:usr3
debian@beaglebone:/sys/class/leds$
```

where:

- USR0 flashes in a heartbeat sequence, indicating the BBB is alive.
- USR1 flashes during micro-SD card activity.
- USR2 flashes depending on the level of CPU activity.
- USR3 flashes during eMMC activity.

Now we go into the `usr3` directory on Beaglebone



```
Activities  Terminal  Mon 02:06
vy@vy-X550LN: ~

File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds$ ls
beaglebone:green:usr0  beaglebone:green:usr1  beaglebone:green:usr2  beaglebone:green:usr3
debian@beaglebone:/sys/class/leds$ cd beaglebone\green\usr3
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness  device  max_brightness  power  subsystem  trigger  uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$
```

There are several entries in this directory. We can use `$cat trigger` to determine the current status of LEDs

```
Activities Terminal Mon 02:14 1:0.6 KiB/s 1:0.0 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds$ ls
beaglebone:green:usr0 beaglebone:green:usr1 beaglebone:green:usr2 beaglebone:green:usr3
debian@beaglebone:/sys/class/leds$ cd beaglebone\green\usr3
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cat trigger
-bash: cat: command not found
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cat trigger
none rc-feedback rfkill-any kbd-scrolllock kbd-numlock kbd-capslock kbd-kanalock kbd-shiftlock kbd-altgrlock kbd-ctrllock kbd-altlock kbd-shiftllock kbd-shiftrlock kbd-ctrlrlock kbd-ctrlrlock usb-gadget usb-host mmc0 [mmc1] timer oneshot disk-activity ide-disk mtd nand-disk heartbeat backlight gpio cpu cpu0 activity default-on panic n etdev
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$
```

The USR3 LED is configured to show activity on the mmc1 device. We can trigger it off by using

```
$echo none > trigger
```

means deploy nothing to trigger entry. The LED will stop immediately after this command. This usr3 LED can be turned on/off fully by using

```
$echo 1 > brightness
$echo 0 > brightness
```

Where 1 = on, 0 = off

```
Activities Terminal Mon 02:19 1:0.7 KiB/s 1:3.1 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds$ ls
beaglebone:green:usr0 beaglebone:green:usr1 beaglebone:green:usr2 beaglebone:green:usr3
debian@beaglebone:/sys/class/leds$ cd beaglebone\green\usr3
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cat trigger
-bash: cat: command not found
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cat trigger
none rc-feedback rfkill-any kbd-scrolllock kbd-numlock kbd-capslock kbd-kanalock kbd-shiftlock kbd-altgrlock kbd-ctrllock kbd-altlock kbd-shiftllock kbd-shiftrlock kbd-ctrlrlock kbd-ctrlrlock usb-gadget usb-host mmc0 [mmc1] timer oneshot disk-activity ide-disk mtd nand-disk heartbeat backlight gpio cpu cpu0 activity default-on panic n etdev
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 1 > brightness
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 0 > brightness
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$
```

To make the LED flash we can use

```
$echo timer > trigger
```

And the LED will flash on/off with one second period with new delay entries:

```
Activities Terminal Mon 02:24 1:0.3 KiB/s 1:3.6 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds$ ls
beaglebone:green:usr0 beaglebone:green:usr1 beaglebone:green:usr2 beaglebone:green:usr3
debian@beaglebone:/sys/class/leds$ cd beaglebone\:green\:usr3
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cat trigger
-bash: cat: command not found
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cat trigger
none rc-feedback rkill-any kbd-scrolllock kbd-numlock kbd-capslock kbd-kanalock kbd-shiftlock kbd-altgrlock kbd
-ctrllock kbd-altlock kbd-shiftllock kbd-shiftrlock kbd-ctrllock kbd-ctrlrlock usb-gadget usb-host mmc0 [mmc1]
timer oneshot disk-activity ide-disk mtd nand-disk heartbeat backlight gpio cpu cpu0 activity default-on panic n
etdev
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 1 > brightness
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 0 > brightness
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 1 > brightness
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 0 > brightness
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo timer > trigger
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness delay_off delay_on device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$
```

When i tried to set up the new timer for delay_on and delay_off. Ther permission is denied, even I do it as superuser:

```
Activities Terminal Mon 02:28 1:2.3 KiB/s 1:3.1 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ sudo echo 50 > delay_on
-bash: delay_on: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ sudo chmod +wx delay_on
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 50 > delay_on
-bash: delay_on: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$
```

After exploring the commands, to set the LED to its defaults state, we can use:

```
$echo mmc1 > trigger
```



```
Activities Terminal Mon 02:30 vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ sudo echo 50 > delay_on
-bash: delay_on: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ sudo chmod +wx delay_on
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo 50 > delay_on
-bash: delay_on: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ echo mmc1 > trigger
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ ls
brightness device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$
```

Now trying another usr LED

Trying usr0 LED with similar commands, I have the result:

```
Activities Terminal Mon 02:36 vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/leds/beaglebone:green:usr3$ cd
debian@beaglebone:~$ cd /sys/class/leds
debian@beaglebone:/sys/class/leds$ cd beaglebone\:green\:usr0
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ ls
brightness device invert max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ echo timer > trigger
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ ls
brightness delay_off delay_on device max_brightness power subsystem trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ echo 50 > delay_off
-bash: delay_off: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ sudo echo 50 > delay_on
-bash: delay_on: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ echo mmc1 > trigger
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ cat trigger
none rc-feedback rfkill-any kbd-scrolllock kbd-numlock kbd-capslock kbd-kanalock kbd-shiftlock kbd-altgrlock kbd
-ctrllock kbd-altlock kbd-shiftrllock kbd-shiftrlock kbd-ctrlrlock kbd-ctrlrlock usb-gadget usb-host mmc0 [mmc1]
timer oneshot disk-activity ide-disk mtd nand-disk heartbeat backlight gpio cpu cpu0 activity default-on panic n
etdev
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ echo timer > trigger
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ ls -F
brightness delay_off delay_on device@ max_brightness power/ subsystem@ trigger uevent
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$ echo 100 > delay_on
-bash: delay_on: Permission denied
debian@beaglebone:/sys/class/leds/beaglebone:green:usr0$
```

GPIO INTERACTION:

To interact with the GPIOs, first, we have to go to its directory.

```
$cd /sys/class/gpio
$ls
```

```
Activities Terminal Mon 02:47 1:0.1 KiB/s 1:0.2 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:~$ cd /sys/class/gpio
debian@beaglebone:/sys/class/gpio$ ls
export  gpio114  gpio15  gpio27  gpio35  gpio45  gpio60  gpio68  gpio74  gpio80  gpiochip0
gpio10  gpio115  gpio19  gpio3  gpio36  gpio46  gpio61  gpio69  gpio75  gpio81  gpiochip32
gpio11  gpio116  gpio2  gpio30  gpio37  gpio47  gpio62  gpio7  gpio76  gpio86  gpiochip64
gpio110  gpio117  gpio20  gpio31  gpio38  gpio48  gpio63  gpio70  gpio77  gpio87  gpiochip96
gpio111  gpio12  gpio22  gpio32  gpio39  gpio5  gpio65  gpio71  gpio78  gpio88  unexport
gpio112  gpio13  gpio23  gpio33  gpio4  gpio50  gpio66  gpio72  gpio79  gpio89
gpio113  gpio14  gpio26  gpio34  gpio44  gpio51  gpio67  gpio73  gpio8  gpio9
debian@beaglebone:/sys/class/gpio$
```

As there are 32 GPIOs on each GPIO chip, the internal GPIO number corresponding to pin GPIO1_17 is calculated as follows: $(1 \times 32) + 17 = 49$. To enable GPIO 49, we use:

```
$echo 49 > export
$ls
```

```
Activities Terminal Mon 02:50 1:1.4 KiB/s 1:0.9 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:~$ cd /sys/class/gpio
debian@beaglebone:/sys/class/gpio$ ls
export  gpio114  gpio15  gpio27  gpio35  gpio45  gpio60  gpio68  gpio74  gpio80  gpiochip0
gpio10  gpio115  gpio19  gpio3  gpio36  gpio46  gpio61  gpio69  gpio75  gpio81  gpiochip32
gpio11  gpio116  gpio2  gpio30  gpio37  gpio47  gpio62  gpio7  gpio76  gpio86  gpiochip64
gpio110  gpio117  gpio20  gpio31  gpio38  gpio48  gpio63  gpio70  gpio77  gpio87  gpiochip96
gpio111  gpio12  gpio22  gpio32  gpio39  gpio5  gpio65  gpio71  gpio78  gpio88  unexport
gpio112  gpio13  gpio23  gpio33  gpio4  gpio50  gpio66  gpio72  gpio79  gpio89
gpio113  gpio14  gpio26  gpio34  gpio44  gpio51  gpio67  gpio73  gpio8  gpio9
debian@beaglebone:/sys/class/gpio$ echo 49 > export
debian@beaglebone:/sys/class/gpio$ ls
export  gpio113  gpio13  gpio22  gpio31  gpio37  gpio46  gpio51  gpio66  gpio71  gpio77  gpio86  gpiochip32
gpio10  gpio114  gpio14  gpio23  gpio32  gpio38  gpio47  gpio60  gpio67  gpio72  gpio78  gpio87  gpiochip64
gpio11  gpio115  gpio15  gpio26  gpio33  gpio39  gpio48  gpio61  gpio68  gpio73  gpio79  gpio88  gpiochip96
gpio110  gpio116  gpio19  gpio27  gpio34  gpio4  gpio49  gpio62  gpio69  gpio74  gpio8  gpio89  unexport
gpio111  gpio117  gpio2  gpio3  gpio35  gpio44  gpio5  gpio63  gpio7  gpio75  gpio80  gpio9
gpio112  gpio12  gpio20  gpio30  gpio36  gpio45  gpio50  gpio65  gpio70  gpio76  gpio81  gpiochip0
debian@beaglebone:/sys/class/gpio$
```

A new sysfs directory has appeared, and it can be used to change the properties of the GPIO as follows:

```
$cd gpio49
$cd ls -l
```



```
$cat direction
$echo out > direction
$cat direction
```

```

export gpio113 gpio13 gpio22 gpio31 gpio37 gpio46 gpio51 gpio66 gpio71 gpio77 gpio86 gpiochip32
gpio10 gpio114 gpio14 gpio23 gpio32 gpio38 gpio47 gpio60 gpio67 gpio72 gpio78 gpio87 gpiochip64
gpio11 gpio115 gpio15 gpio26 gpio33 gpio39 gpio48 gpio61 gpio68 gpio73 gpio79 gpio88 gpiochip96
gpio110 gpio116 gpio19 gpio27 gpio34 gpio4 gpio49 gpio62 gpio69 gpio74 gpio8 gpio89 unexport
gpio111 gpio117 gpio2 gpio3 gpio35 gpio44 gpio5 gpio63 gpio7 gpio75 gpio80 gpio9
gpio112 gpio12 gpio20 gpio30 gpio36 gpio45 gpio50 gpio65 gpio70 gpio76 gpio81 gpiochip0
debian@beaglebone:/sys/class/gpio$ cd gpio49
debian@beaglebone:/sys/class/gpio/gpio49$ ls -l
total 0
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 active_low
lrwxrwxrwx 1 root gpio 0 Oct 1 16:13 device -> ../../../../gpiochip1
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 direction
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 edge
-r--r--r-- 1 root gpio 4096 Oct 1 16:13 label
drwxrwxr-x 2 root gpio 0 Oct 1 16:13 power
lrwxrwxrwx 1 root gpio 0 Oct 1 16:13 subsystem -> ../../../../../../class/gpio
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 uevent
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 value
debian@beaglebone:/sys/class/gpio/gpio49$ cat direction
in
debian@beaglebone:/sys/class/gpio/gpio49$ echo out > direction
debian@beaglebone:/sys/class/gpio/gpio49$ cat direction
out
debian@beaglebone:/sys/class/gpio/gpio49$ 

```

Now the GPIO 49 is set up as an output, and the value can be changed. By using these commands below we can turn it on or off.

```

gpio111 gpio117 gpio2 gpio3 gpio35 gpio44 gpio5 gpio63 gpio7 gpio75 gpio80 gpio9
gpio112 gpio12 gpio20 gpio30 gpio36 gpio45 gpio50 gpio65 gpio70 gpio76 gpio81 gpiochip0
debian@beaglebone:/sys/class/gpio$ cd gpio49
debian@beaglebone:/sys/class/gpio/gpio49$ ls -l
total 0
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 active_low
lrwxrwxrwx 1 root gpio 0 Oct 1 16:13 device -> ../../../../gpiochip1
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 direction
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 edge
-r--r--r-- 1 root gpio 4096 Oct 1 16:13 label
drwxrwxr-x 2 root gpio 0 Oct 1 16:13 power
lrwxrwxrwx 1 root gpio 0 Oct 1 16:13 subsystem -> ../../../../../../class/gpio
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 uevent
-rw-rw-r-- 1 root gpio 4096 Oct 1 16:13 value
debian@beaglebone:/sys/class/gpio/gpio49$ cat direction
in
debian@beaglebone:/sys/class/gpio/gpio49$ echo out > direction
debian@beaglebone:/sys/class/gpio/gpio49$ cat direction
out
debian@beaglebone:/sys/class/gpio/gpio49$ echo 1 > value
debian@beaglebone:/sys/class/gpio/gpio49$ echo 0 > value
-bash: vale: Permission denied
debian@beaglebone:/sys/class/gpio/gpio49$ echo 0 > value
debian@beaglebone:/sys/class/gpio/gpio49$ 

```

1 means on, 0 means off,

To remove gpio 49, we can follow:

```
$echo 49 > unexport
```

```
Activities Terminal Mon 02:57 1:3.0 KiB/s 1:8.4 KiB/s en
vy@vy-X550LN: ~
File Edit View Search Terminal Help
debian@beaglebone:/sys/class/gpio$ echo 49 > unexport
debian@beaglebone:/sys/class/gpio$ ls
export gpio114 gpio15 gpio27 gpio35 gpio45 gpio60 gpio68 gpio74 gpio80 gpiochip0
gpio10 gpio115 gpio19 gpio3 gpio36 gpio46 gpio61 gpio69 gpio75 gpio81 gpiochip32
gpio11 gpio116 gpio2 gpio30 gpio37 gpio47 gpio62 gpio7 gpio76 gpio86 gpiochip64
gpio110 gpio117 gpio20 gpio31 gpio38 gpio48 gpio63 gpio70 gpio77 gpio87 gpiochip96
gpio111 gpio12 gpio22 gpio32 gpio39 gpio5 gpio65 gpio71 gpio78 gpio88 unexport
gpio112 gpio13 gpio23 gpio33 gpio4 gpio50 gpio66 gpio72 gpio79 gpio89
gpio113 gpio14 gpio26 gpio34 gpio44 gpio51 gpio67 gpio73 gpio8 gpio9
debian@beaglebone:/sys/class/gpio$
```

Summary:

This report is only a brief of how to working on internal LEDs on Beaglebone as well as the GPIOs.