

CSE530: EOSI - ASSIGNMENT 3 SETUP INSTRUCTIONS

Part 2

ACCURATE DELAYS IN LINUX (WS2812)

Files Included:

1. timer_delay_test.c (This is timing measurement experimentation code)
2. ws2812.c (This is a char driver to interface with WS2812)
3. main.c (This is the user level program to test implementation of ndelays. This is same as Part 1)
4. Makefile

Please refer the Report for Implementation details and Experimentation Results.

Steps to Setup

1. Connect the LED Strip to its respective pins as mentioned below:

IO1 (GPIO12) → DI

5V → 5V

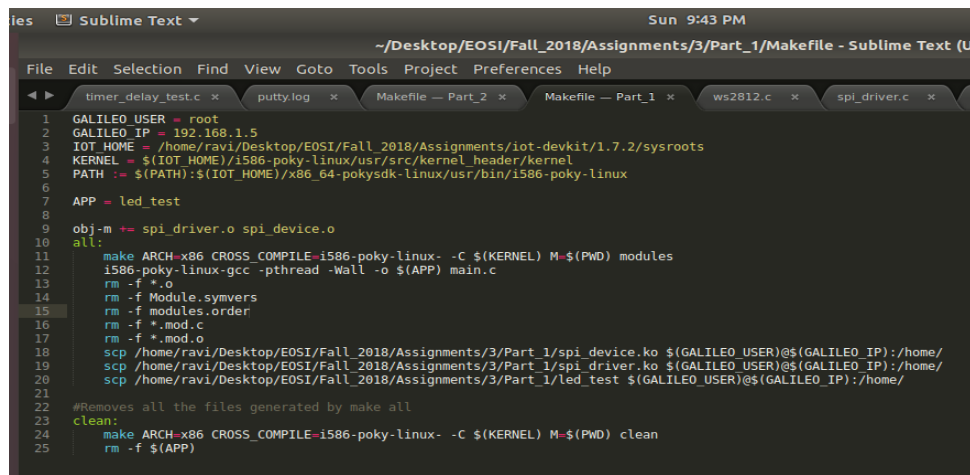
GND → GND

2. Update the makefile as per the following instructions

GALILEO_USER → Enter the user name. Default “root”

GALILEO_IP → Enter Galileo IO. Default “192.168.1.5”

IOT_HOME → Enter sysroots address



```
1 GALILEO_USER = root
2 GALILEO_IP = 192.168.1.5
3 IOT_HOME = /home/ravi/Desktop/EOSI/Fall_2018/Assignments/iot-devkit/1.7.2/sysroots
4 KERNEL = $(IOT_HOME)/i586-poky-linux/usr/src/kernel_header/kernel
5 PATH := $(PATH):$(IOT_HOME)/x86_64-pokysdk-linux/usr/bin/i586-poky-linux
6
7 APP = led_test
8
9 obj-m += spi_driver.o spi_device.o
10 all:
11     make ARCH=x86 CROSS_COMPILE=i586-poky-linux- -C $(KERNEL) M=$(PWD) modules
12     i586-poky-linux-gcc -pthread -Wall -o $(APP) main.c
13     rm -f *.o
14     rm -f Module.symvers
15     rm -f modules.order
16     rm -f *.mod.c
17     rm -f *.mod.o
18     scp /home/ravi/Desktop/EOSI/Fall_2018/Assignments/3/Part_1/spi_device.ko $(GALILEO_USER)$(GALILEO_IP):/home/
19     scp /home/ravi/Desktop/EOSI/Fall_2018/Assignments/3/Part_1/spi_driver.ko $(GALILEO_USER)$(GALILEO_IP):/home/
20     scp /home/ravi/Desktop/EOSI/Fall_2018/Assignments/3/Part_1/led_test $(GALILEO_USER)$(GALILEO_IP):/home/
21
22 #Removes all the files generated by make all
23 clean:
24     make ARCH=x86 CROSS_COMPILE=i586-poky-linux- -C $(KERNEL) M=$(PWD) clean
25     rm -f $(APP)
```

3. Insert the modules loaded on the /home directory onto kernel using the following commands in any order. Please see the image for the expected output

First inorder to run the measurement tests

```
cd /home
```

```
insmod timer_delay_test.ko
```

This would print measurement outputs of the timing experiments which involves ndelay and hrtimers.

In order to test the driver implementation using the ndelay that uses the bit-banging approach do the following steps. Please note that we will need to remove the earlier inserted module here.

```
rmmod timer_delay_test.ko
```

```
insmod ws2812.ko
```

4. User Level Test Code: Run the ./led_test command from /home directory. This would ask you to input the following entries:

- No of LEDs to switch on currently
- No of times you want the pattern to run in circles
- Led color for each led that you want to light up

```
2863.077862] WS_WRITE: Write Completed
2863.084814] WS_WRITE: Write Completed
2863.089047] WS_WRITE: Write Completed
2863.095799] WS_WRITE: Write Completed
2863.101470] WS_WRITE: Write Completed
2863.105910] WS_WRITE: Write Completed
2863.112767] WS_WRITE: Write Completed
2863.117205] WS_WRITE: Write Completed
2863.123567] WS_WRITE: Write Completed
2863.128390] WS_WRITE: Write Completed
2863.135225] WS_WRITE: Write Completed
2863.138667] WS_WRITE: Write Completed
2863.146396] WS_WRITE: Write Completed
2863.152087] WS_WRITE: Write Completed
2863.156520] WS_WRITE: Write Completed
2863.163289] WS_WRITE: Write Completed
[ 2864.034402] WS_RELEASE: Driver Released Successfully

root@quark:/home#
root@quark:/home#
root@quark:/home#
root@quark:/home#
root@quark:/home#
root@quark:/home#
root@quark:/home#
root@quark:/home#
root@quark:/home# ./led_tester
sh: ./led_tester: No such file or directory
root@quark:/home# ./led_test
sh: ./led_test: No such file or directory
root@quark:/home# ./led_test
[ 2893.602824] WS_OPEN: Device opened
[ 2893.607423] WS_IOCTL: RESET Command Received
How many LEDs do you want to light up?[1-16]16
How many times do you want the circular display to repeat?[[0=infinite]1
Color Panel
1 - Red      2 - Green  3 - Blue    4 - Yellow
5 - White   6 - Violet  7 - Cyan    8 - Magenta
9 - Orange 10 - Brown 11 - Maroon 12 - Pink
13 - Custom Color(Need to enter RGB value)
LED 1 color[1-13]1
LED 2 color[1-13]2
LED 3 color[1-13]3
LED 4 color[1-13]4
LED 5 color[1-13]5
LED 6 color[1-13]6
LED 7 color[1-13]7
LED 8 color[1-13]8
LED 9 color[1-13]9
LED 10 color[1-13]10
LED 11 color[1-13]11
LED 12 color[1-13]12
LED 13 color[1-13]1
LED 14 color[1-13]2
LED 15 color[1-13]3
LED 16 color[1-13]4
```

As can be seen in the image above, we were asked for the choices as explained earlier. Upon successful user input, it successfully calls WS_WRITE function from the driver file_operations datastructures. This is evident by the printing as shown below.

```
3083.473597 WS_WRITE: Write Completed
3083.185345 WS_WRITE: Write Completed
3083.433074 WS_WRITE: Write Completed
3083.495504 WS_WRITE: Write Completed
3083.203705 WS_WRITE: Write Completed
3083.508130 WS_WRITE: Write Completed
3083.244867 WS_WRITE: Write Completed
3083.413899 WS_WRITE: Write Completed
3083.226232 WS_WRITE: Write Completed
3083.231959 WS_WRITE: Write Completed
3083.238388 WS_WRITE: Write Completed
3083.243153 WS_WRITE: Write Completed
3083.247625 WS_WRITE: Write Completed
3083.354653 WS_WRITE: Write Completed
3083.258004 WS_WRITE: Write Completed
3083.257171 WS_WRITE: Write Completed
3083.271630 WS_WRITE: Write Completed
3083.275878 WS_WRITE: Write Completed
3083.282757 WS_WRITE: Write Completed
3083.297190 WS_WRITE: Write Completed
3083.294028 WS_WRITE: Write Completed
3083.296469 WS_WRITE: Write Completed
3083.302311 WS_WRITE: Write Completed
3083.309745 WS_WRITE: Write Completed
3084.316789 WS_WRITE: Write Completed
3084.321530 WS_WRITE: Write Completed
3084.325759 WS_WRITE: Write Completed
3084.332613 WS_WRITE: Write Completed
3084.338952 WS_WRITE: Write Completed
3084.344868 WS_WRITE: Write Completed
3084.349298 WS_WRITE: Write Completed
3084.356163 WS_WRITE: Write Completed
3084.361887 WS_WRITE: Write Completed
3084.365203 WS_WRITE: Write Completed
3084.373124 WS_WRITE: Write Completed
3084.377925 WS_WRITE: Write Completed
3084.384367 WS_WRITE: Write Completed
3084.388798 WS_WRITE: Write Completed
3084.395612 WS_WRITE: Write Completed
3084.401320 WS_WRITE: Write Completed
3084.405752 WS_WRITE: Write Completed
3084.412545 WS_WRITE: Write Completed
3084.416984 WS_WRITE: Write Completed
3084.423789 WS_WRITE: Write Completed
3084.428231 WS_WRITE: Write Completed
3084.435124 WS_WRITE: Write Completed
3084.435679 WS_WRITE: Write Completed
3084.440309 WS_WRITE: Write Completed
3084.452134 WS_WRITE: Write Completed
3084.455567 WS_WRITE: Write Completed
3084.463460 WS_WRITE: Write Completed
3084.467881 WS_WRITE: Write Completed
3084.474709 WS_WRITE: Write Completed
3084.478142 WS_WRITE: Write Completed
3084.485978 WS_WRITE: Write Completed
3084.491597 WS_WRITE: Write Completed
```

The LED Ring looks as follows for the color inputs chosen by me.

