Lab #2 Exploring BBB

Leonardo Fusser (1946695)

Objectives:

- BBB components Identification.
- Establish an SSH connection and a serial connection.
- File access to LEDS (SysFs).

Hardware: BBB

To hand in: No report to hand-in. Answer all questions.

Theory: Manual: Beagle_board_black_BBB_SRM.pdf
Exploring BeagleBone Black

Skip Part 1 for now

Part1: backup the eMMC card

You do not need to do this if your BBB is brand new.

Using FileZilla, back up your home directory before flashing the eMMC card.
You can also use a USB drive.

Part2: Install BeagleBone Black Firmware

The version from Linux:

- Get the following image:

Debian 7.9 2015-11-12 4GB SD LXDE

at : https://beagleboard.org/latest-images

go to: http://beagleboard.org/getting-started and do the following steps:

Download **Win32diskImager** application, or Etcher (etcher.io).

Step #3: Decompress the image

Step #4: Install SD card programming utility

Step #5: Connect SD card to your compute

Step #6: Write the image to your SD card

It takes 30 minutes to download and write the image (3.5 GB).

You can go for a little 10-minute break while it is imaging!!

Now the OS is on the SD card! You can insert it into BBB.

Part3: Connection to the board

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SSH connection

If you use Windows 10, download the latest USB drivers:
go to: http://beagleboard.org/getting-started and run 64-bit installer or 32-bit installer.

You can remotely gain access to the command line of a BBB from another computer on the same network using SSH connection.

You can also use the Ethernet over USB:

- Plug in the board.
- Open tera-term or PuTTY terminal.
- Make an SSH connection at 192.168.7.2 (for user "debian", use "temppwd" as password).
  (for user "root", there is no password).

You should be able to see the BBB console.

- Answer the following questions about the four user LEDS:

User LED	State:	Explain:
USER0	*Heart-beat pattern*	*is configured at boot to blink in a heartbeat pattern.*
USER1	*Varies*	*is configured at boot to light during microSD card accesses.*
USER2	*Varies*	*is configured at boot to light during CPU activity.*
USER3	*None*	*is configured at boot to light during eMMC accesses.*

You can also use the serial over USB:

- Plug in the board.
- Open tera-term terminal.
- Make a serial connection and use the appropriate com port (get from your PC device manager).
  What com port was that: *USB Serial Device COM5.*

  Type the following command to verify Linux version:

  `BBB:~#` **`uname -a`** (you could try this with and without the SD card)

  Answer: (with SD card): *Linux beaglebone 3.8.13-bone79 #1 SMP Tue Oct 13 20:44:55 UTC 2015 armv71 GNU/Linux.* (without SD card): *Linux beaglebone 4.14.71-ti-r80 #1 SMP PREEMPT Fri Oct 5 23:50:11 UTC 2018 2018 armv71 GNU/Linux.*

  Do some research and find the command for finding out the release version:

  Command: cat /etc/os-release
  Release version (without SD card): 9 (Stretch)
  Release version (with SD card): 7 (wheezy)

You can use man command to navigate all options of the uname.

You should also be able to connect to BBB web server:

- Open a web browser.
- Log into the router by entering the default gateway (192.168.7.2) into the address bar of the internet browser.

Note: it is also possible to bridge Ethernet over USB to the LAN network.
That's it! You are connected and can use the command line to navigate.

Flashing the eMMC: you need to have be logged in **as root** and through the serial debug.
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Here is the procedure to flash the SD card into the eMMC on board flash.
This way, you don't need the SD card anymore.

MAKE sure you make your window BIG. Every time you resize your window you lose the content previously displayed.

Follow the steps:

```
root@beaglebone:~# cd /opt/scripts/tools/eMMC/
root@beaglebone: /opt/scripts/tools/eMMC#./init-eMMC-flasher-v3.sh
```

The blue on-board LEDs should light in sequence and then continue to flash for the next 5–25 minutes.

1. Wait until the LEDs stop blinking and all 4 LEDs are fully lit.
2. Observe the console output, and answer the few questions below: some of the answers are in the pdf document.

   a) From which mmc block to which mmc block does it copy?
   /dev/mmcb1k0 to /dev/mmcb1k1 (MMC0 to MMC1).
   b) Which mmc block is the SD card?
   /dev/mmcb1k0 (MMC0).
   c) Which mmc block is the eMMC?
   /dev/mmcb1k1 (MMC1).
   d) Which mmc block is being erased and reformatted?
   /dev/mmcb1k1 (MMC1).
   e) What are the new eMMC partitions (p)?

Partition (p)	**MB**	**System**
/dev/mmc1k1p1	*96*	*E W95 FAT16 (LBA)*
/dev/mmc1k1p2	*3647*	*83 Linux*
/dev/mmc1k1p3	*-*	*0 Empty*
/dev/mmc1k1p4	*-*	*0 Empty*

3. Turn off the board by pushing the Power button (S3) **or by typing in "halt".**
4. Remove the micro-SD card. This is important, as you could end up flashing the eMMC again by accident.
5. Finally, press the Power button (S3) to power up the board and you should have the latest image installed.
6. Again, answer the following questions about the four user LEDs.

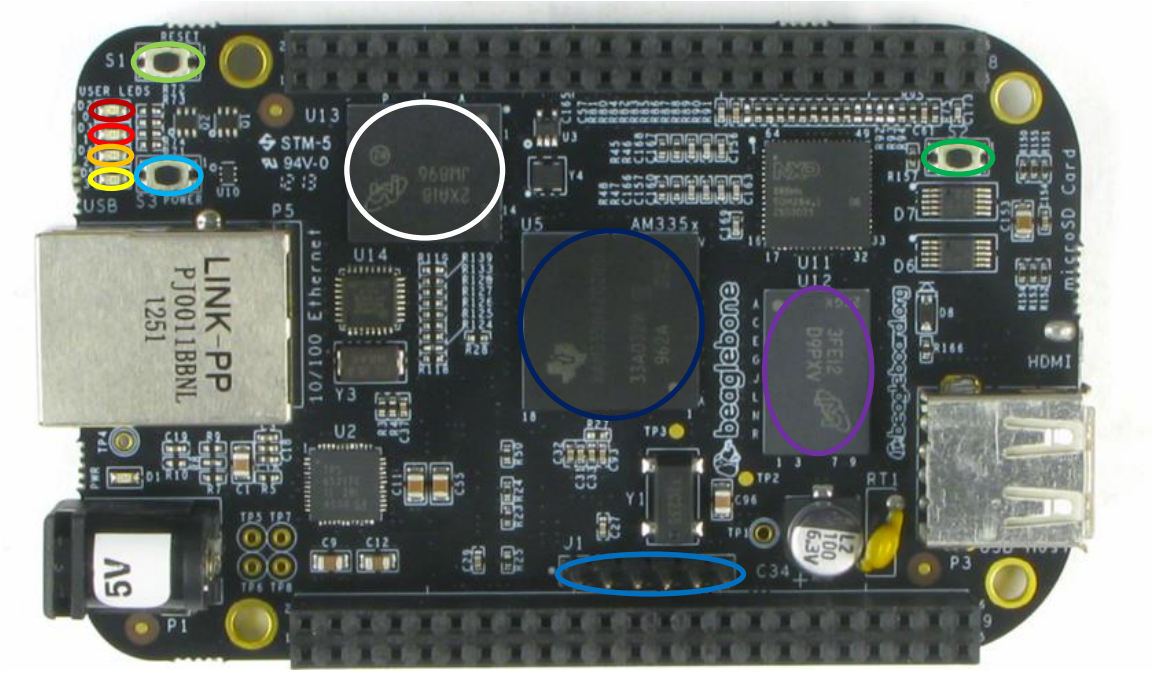
User LED	**State:**	**Explain:**
USER0	*Heart-beat pattern*	*is configured at boot to blink in a heartbeat pattern.*
USER1	*None*	*is configured at boot to light during microSD card accesses.*
USER2	*Varies*	*is configured at boot to light during CPU activity.*
USER3	*Varies*	*is configured at boot to light during eMMC accesses.*

Part 4: Components Identification

- Using the manual and/or the picture below, identify by circling the following parts:

Component	**Ref Designator**
USR0 Led	*Dark red.*
USR1 Led	*Red.*
USR2 Led	*Orange.*

USR3 Led	*Yellow.*
Reset Button	*Light green.*
Boot Button	*Green.*
Power button	*Light blue.*
Debug serial header	*Blue.*
Arm Processor	*Dark blue.*
Ram memory	*Purple.*
eMMC	*White.*



- For P9 header pin connectors, measure the voltages at pins 3, 5 and 7 considering that the ground is at pin 1.

***Warning**: be careful, don't short Vdd to GND!*

Measures:

PIN3: *3.41V* | PIN5: *0V* | PIN7: *4.98V*

Part 5: USR LEDs

In this part, you will disable usr0 and usr1 LEDs

- Browse to the directory `/sys/class/leds` . The output is as follows:

```
root@beaglebone:~# cd /sys/class/leds
root@beaglebone:/sys/class/leds# ls
beaglebone:green:usr0   beaglebone:green:usr2
beaglebone:green:usr1   beaglebone:green:usr3
```

You can see the four (green!) LED sysfs mappings—usr0 , usr1 , usr2 , and usr3 .

You can change the directory to alter the properties of one of these LEDs—for example, usr0 (use the Tab key to reduce typing):

```
root@beaglebone:/sys/class/leds# cd beaglebone\:green\:usr0
root@beaglebone:/sys/class/leds/beaglebone:green:usr0# ls
brightness device max_brightness power subsystem trigger uevent
```

Here you see various different file entries that give you further information and access to settings.
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- Determine the current status of an LED by typing:

```
root@beaglebone:/sys/class/leds/beaglebone:green:usr0# cat trigger
none nand-disk mmc0 mmc1 timer oneshot [heartbeat] backlight gpio cpu0 .
. .
```

where you can see that the USR0 LED is configured to show a heart-beat pattern.

- Turn this trigger off by typing:

```
root@beaglebone:/sys/class/leds/beaglebone:green:usr0# echo none >
trigger
```

And you will see that the LED stops flashing completely. You can use `more trigger` to see the new state.

- Now, turn the USR0 LED fully on or off using:

```
root@beaglebone:/sys/class/leds/beaglebone:green:usr0# echo 1 >
brightness
root@beaglebone:/sys/class/leds/beaglebone:green:usr0# echo 0 >
brightness
```

- Do the same thing for usr1 LED.

  Now the two LEDs should not blink anymore.

Approval _____

Questions:

Most answers can be found in the Reference Manual

1. Name four boot modes.
   1: eMMC, 2: SD card, 3: Serial, 4: USB.
2. What boot mode was used in this lab?
   eMMC.
3. Find the different voltage rails on the board. Name them along with their voltages.
   PIN3 & 4 (VDD_3V3B): 3.3V | PIN5 & 6 (VDD_5V): 5V | PIN7 & 8 (SYS_5V): 5V.
4. Find out all Operating Systems supported by the board.
   Debian, LXDE & Ubuntu.
5. Find the maximum MIPS of the board
   2'000.
6. Find how many of the following ports are present on the board:

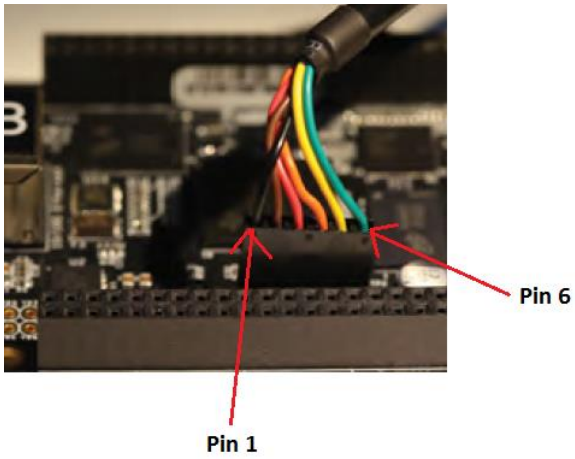
   i) SPI-2
   ii) I2C-2
   iii) ADC-0

Practice if you have the cable

Serial debug cable (1946695)

Before flashing your eMMC card you need to connect serially to the BBB. Get the FTDI usb-ttl adapter from the teacher.

- Connect the adapter to the computer and see what new com port appeared: _____ (*different that the one above)*
- Connect the other end to the BBB Pin 1 is connected to the black wire and pin 6 to the green wire. **MUST BE VALIDTED BY THE TEACHER**



- Start TeraTerm in serial mode on the correct com port.
- Set it to serial port at a speed of 115’200.
- Turn on the BBB.
- Login to the system:
  `Passwd: root`