LIAB ApS
Østre Allé 6
DK-9530 Støvring
Tlf: +45 98 37 06 44
http://www.liab.dk

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1 A Sound System for the nanoLIAB

As described in its User's Manual [1] the nanoLIAB microprocessor board employs a high quality stereo audio DAC (TLV320DAC23 from Texas Instruments). This device is connected to the ARM microprocessor using two serial busses: a high speed Synchronous Serial Interface (SSI) and a I^2C bus. The first bus is used for the transmission of audio samples from the microprocessor to the audio DAC. The second is used to configure the DAC and to read back status information. The ARM microprocessor includes a rather elaborated SSI channel controlle, complete with chained DMA support. In order to play music in a set of headphones, you need a Linux device driver to handle both the SSI and the I^2C channels. A preliminary version of such a sound driver is now included in the distribution on the nanoLIAB when you receive it from LIAB ApS.

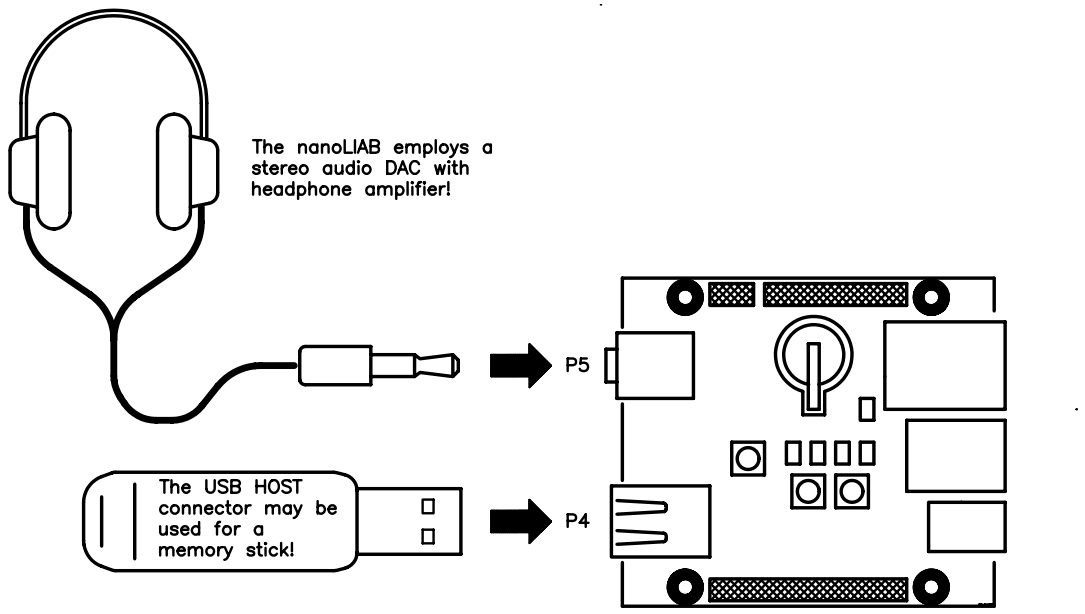

Figure 1: *The nanoLIAB as an MP3-player: Headphones and USB stick.*

In the following, it is assumed that you have knowledge on how to operate the nanoLIAB using either the serial port `P2` or the Ethernet network connector `P3`. We further assume that you are logged onto the nanoLIAB as `root`. If not, please look up the thorough discussions on these topics found in [1].

2 External Connections

As depicted in Fig. 1, you connect a pair of headphones to the nanoLIAB using the jack socket `P5` on the left side of the board. The audio DAC employs a 2×32 mW headphone amplifier which is quite sufficient for any standard pairs of headphones. Alternatively, you can connect the nanoLIAB to a stereo amplifier.

The standard edition of the nanoLIAB has 32MB of RAM and 16MB of FPROM. Thus, you cannot store a large number of compressed audio files directly on the nanoLIAB. As a secondary storage you may use a USB memory stick as shown in Fig. 1. Alternatively, you may export a NFS file system with audio files and mount this on the nanoLIAB. However, the latter requires a Linux kernel with NFS support.

3 The tar archive: `NanoSoundVer10.tgz`

When delivered, the nanoLIAB contains a compressed tar archive ("a tar-ball") called `NanoSoundVer10.tgz`. This contains a sound device driver in the shape of a kernel module and a software MP3 decoder, complete with all relevant libraries and configuration files. You may now untar the archive by applying the following command:

```
root@liab# tar -C / -xzf NanoSoundVer10.tgz
root@liab#
```

Now all files should be located in the correct locations and you may test the sound driver by starting the test-script as follows:

```
root@liab# TryToPlayMusic
High Performance MPEG 1.0/2.0/2.5 Audio Player for Layer 1, 2, and 3.
....
```

You should now hear approxiamtely 20 seconds of Zydeco music in your headphones! Next the script will turn the volume slightly down and play the music again. If so, everything work correctly.

4 Playing from a USB memory stick

Next, you may try to insert a USB memory stick with some MP3-files into the USB socket P4. If you have a terminal emulator connected to the serial port on P2 (115200 8N1) you should see a console message like:

```
...
usb 1-1: new full speed USB device using at91_ohci and address 2
usb 1-1: configuration #1 chosen from 1 choice
...
```

From a suitable telnet network terminal session, you should now load the necessary Linux drivers in order to get support for USB storage:

```
root@liab# modprobe sd_mod
root@liab# modprobe usb-storage
root@liab#
```

On the serial console you should get something like:

```
...
SCSI subsystem initialized
Initializing USB Mass Storage driver...
scsi0 : SCSI emulation for USB Mass Storage devices
usbcore: registered new driver usb-storage
USB Mass Storage support registered.
  Vendor: Kingston  Model: DataTraveler 2.0  Rev: PMAP
  Type:   Direct-Access                      ANSI SCSI revision: 00
....
....
sd 0:0:0:0: Attached scsi removable disk sda
```

It may take 5 to 10 seconds before you see the last line, indicating that the Linux system has fully understood the nature of the USB storage device. Now you can mount the USB device using the following command:

```
root@liab# mount /dev/sda1 /mnt
root@liab# mpg321 /mnt/MadonnaAmericanPie.mp3
....
```

The second command above initiates the decoding of the relevant MP3 file. You may turn the volume up and down using the program aumix, which is included in a command line version:

```
root@liab# aumix -v 100   < max volume >
root@liab# aumix -v 50    < barely noticeable >
....
```

5 Technically: the kernel module nanosound.ko

The kernel module nanosound.ko is written as a OSS (Open Sound System) sound module to interface the OSS API with the two serial channels of the audio DAC. When inserted, you get device support for the following two device special files:

```
/dev/dsp          ( char special file, major 14 minor 3)
/dev/mixer        ( char special file, major 14 minor 0)
```

When the module is inserted using the modprobe command:

```
root@liab# modprobe nanosound.ko
root@liab#
```

you should see the following on the serial console:

```
...
nanoSound: Hello from the nanoLIAB sound module
nanoSound: Only 44100KHz/Stereo/AFMT_S16_LE presently supported
nanoSound: Initialization of TLV320DAC23 successful ...
...
```

The last line indicates that the DAC has been successfully initialized using the I^2C bus. Presently, only a sample rate of 44100KHz is supported and the only data format allowed is stereo samples of 16 bits in signed little endian format.

The sound driver has one mixer device: the main volume control. This can be accessed using aumix using its -v option.

References

[1] LIAB ApS, *"Users Manual for the nanoLIAB microprocessor board"*, November 2006, document no. LIAB-UM0008.1. 1, 2