浙江大學

本科实验报告

课程名称：嵌入式系统

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浙江大学实验报告

课程名称：　　嵌入式系统　　　　　　　　　　实验类型：　综合

实验项目名称：　AirPlay

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同组学生姓名：　None　　　　　　　　指导老师：　蔡铭

实验地点：　　None　　　　　　　　实验日期：2015 年 3 月 26 日

一、　实验目的和要求

1. 在 Acadia 或 RPi 或 WRTnode 上实现 AirPlay 播放歌曲的功能，使其能够产生音频流；
2. 掌握 Acadia 或 RPi 或 WRTnode 和 PC 建立音频交互的方式。

二、　实验器材

硬件

- RPi 板一块；
- 5V/2A 电源一个；
- USB-TTL 串口线一根（PL2303 芯片）。
- PC（Windows）一台；
- 以太网线一根（可能还需要路由器等）;

软件

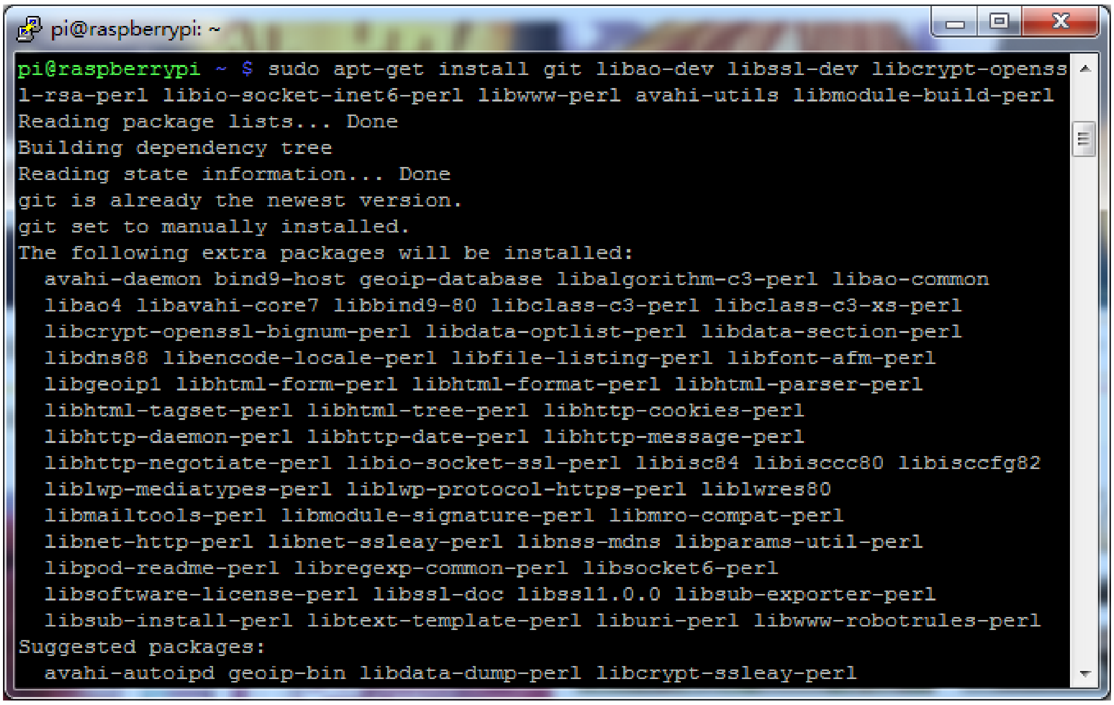
- PC 上的 USB-TTL 串口线配套的驱动程序；
- PC 上的串口终端软件，Putty;
- PC 上的 SSH 软件，如 Xshell 等。

三、　实验过程和数据记录及结果分析

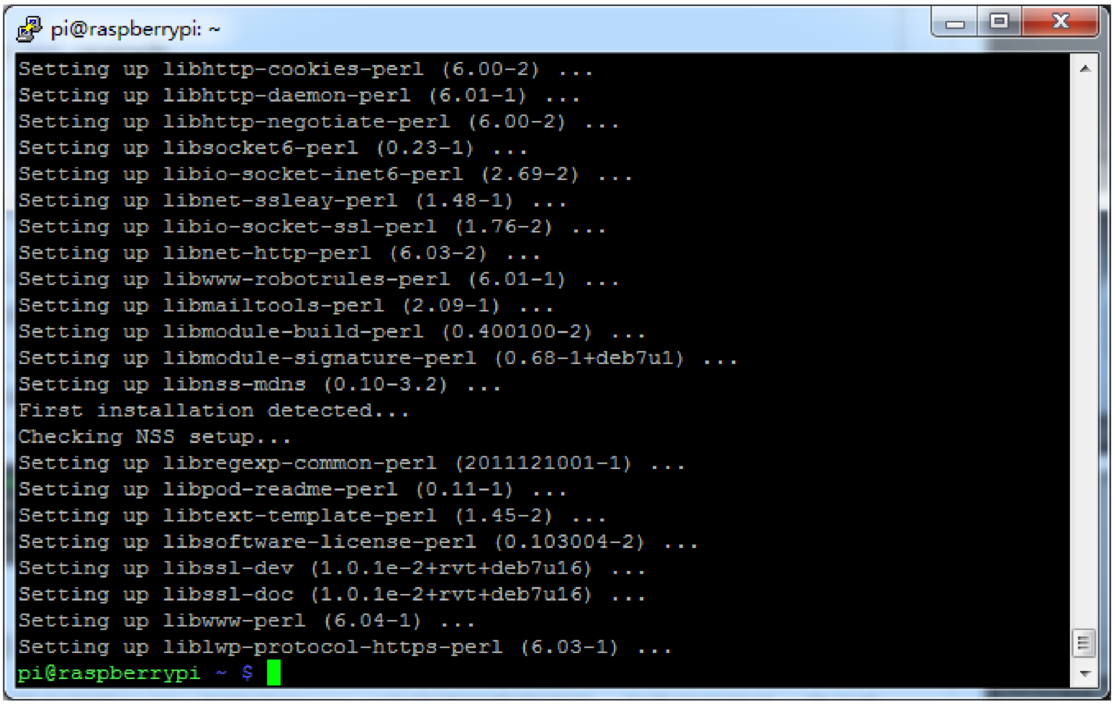
1. 下载 Shairport 的前置软件

   a) 从源下载安装包

      命令为：sudo apt-get install git libao-dev libssl-dev libcrypt-openssl-rsa-perl libio-socket-inet6-perl libwww-perl avahi-utils libmodule-build-perl



```
pi@raspberrypi ~ $ sudo apt-get install git libao-dev libssl-dev libcrypt-openss
l-rsa-perl libio-socket-inet6-perl libwww-perl avahi-utils libmodule-build-perl
Reading package lists... Done
Building dependency tree
Reading state information... Done
git is already the newest version.
git set to manually installed.
The following extra packages will be installed:
  avahi-daemon bind9-host geoip-database libalgorithm-c3-perl libao-common
  libao4 libavahi-core7 libbind9-80 libclass-c3-perl libclass-c3-xs-perl
  libcrypt-openssl-bignum-perl libdata-optlist-perl libdata-section-perl
  libdns88 libencode-locale-perl libfile-listing-perl libfont-afm-perl
  libgeoip1 libhtml-form-perl libhtml-format-perl libhtml-parser-perl
  libhtml-tagset-perl libhtml-tree-perl libhttp-cookies-perl
  libhttp-daemon-perl libhttp-date-perl libhttp-message-perl
  libhttp-negotiate-perl libio-socket-ssl-perl libisc84 libisccc80 libisccfg82
  liblwp-mediatypes-perl liblwp-protocol-https-perl liblwres80
  libmailtools-perl libmodule-signature-perl libmro-compat-perl
  libnet-http-perl libnet-ssleay-perl libnss-mdns libparams-util-perl
  libpod-readme-perl libregexp-common-perl libsocket6-perl
  libsoftware-license-perl libssl-doc libssl1.0.0 libsub-exporter-perl
  libsub-install-perl libtext-template-perl liburi-perl libwww-robotrules-perl
Suggested packages:
  avahi-autoipd geoip-bin libdata-dump-perl libcrypt-ssleay-perl
```

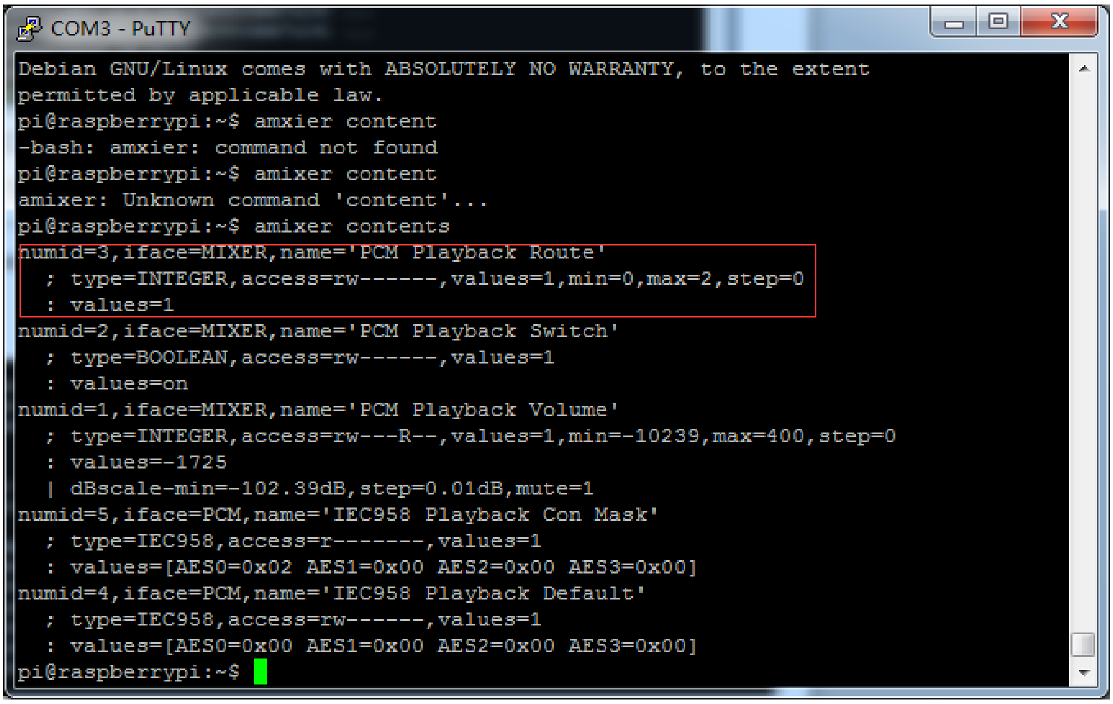


```
Setting up libhttp-cookies-perl (6.00-2) ...
Setting up libhttp-daemon-perl (6.01-1) ...
Setting up libhttp-negotiate-perl (6.00-2) ...
Setting up libsocket6-perl (0.23-1) ...
Setting up libio-socket-inet6-perl (2.69-2) ...
Setting up libnet-ssleay-perl (1.48-1) ...
Setting up libio-socket-ssl-perl (1.76-2) ...
Setting up libnet-http-perl (6.03-2) ...
Setting up libwww-robotrules-perl (6.01-1) ...
Setting up libmailtools-perl (2.09-1) ...
Setting up libmodule-build-perl (0.400100-2) ...
Setting up libmodule-signature-perl (0.68-1+deb7u1) ...
Setting up libnss-mdns (0.10-3.2) ...
First installation detected...
Checking NSS setup...
Setting up libregexp-common-perl (2011121001-1) ...
Setting up libpod-readme-perl (0.11-1) ...
Setting up libtext-template-perl (1.45-2) ...
Setting up libsoftware-license-perl (0.103004-2) ...
Setting up libssl-dev (1.0.1e-2+rvt+deb7u16) ...
Setting up libssl-doc (1.0.1e-2+rvt+deb7u16) ...
Setting up libwww-perl (6.04-1) ...
Setting up liblwp-protocol-https-perl (6.03-1) ...
pi@raspberrypi ~ $
```

2. 修改音频输出端口

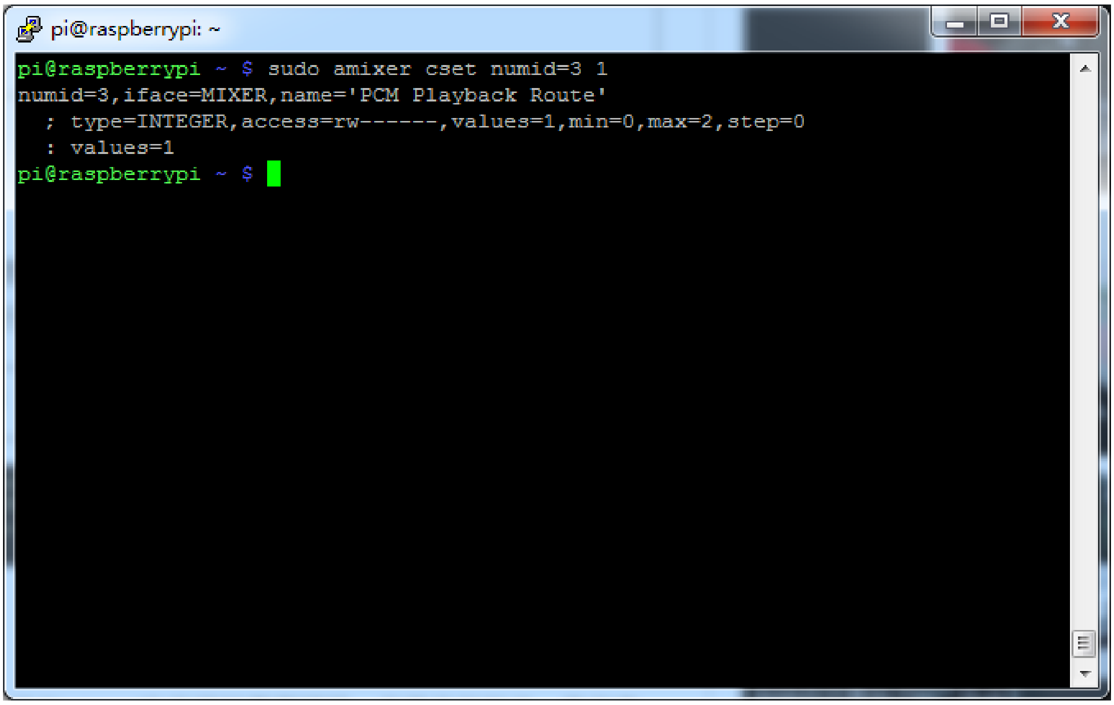
   a) Amixer 命令可用于修改音频输出端口

用 amixer contents 可以查看声卡可修改内容



```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
pi@raspberrypi:~$ amxier content
-bash: amxier: command not found
pi@raspberrypi:~$ amixer content
amixer: Unknown command 'content'...
pi@raspberrypi:~$ amixer contents
numid=3,iface=MIXER,name='PCM Playback Route'
  ; type=INTEGER,access=rw------,values=1,min=0,max=2,step=0
  : values=1
numid=2,iface=MIXER,name='PCM Playback Switch'
  ; type=BOOLEAN,access=rw------,values=1
  : values=on
numid=1,iface=MIXER,name='PCM Playback Volume'
  ; type=INTEGER,access=rw---R--,values=1,min=-10239,max=400,step=0
  : values=-1725
  | dBscale-min=-102.39dB,step=0.01dB,mute=1
numid=5,iface=PCM,name='IEC958 Playback Con Mask'
  ; type=IEC958,access=r-------,values=1
  : values=[AES0=0x02 AES1=0x00 AES2=0x00 AES3=0x00]
numid=4,iface=PCM,name='IEC958 Playback Default'
  ; type=IEC958,access=rw------,values=1
  : values=[AES0=0x00 AES1=0x00 AES2=0x00 AES3=0x00]
pi@raspberrypi:~$
```

可以看到 numid=3 可以修改输出端口，用 sudo amixer cset numid=3 1 设置输出为耳机端口。



```
pi@raspberrypi ~ $ sudo amixer cset numid=3 1
numid=3,iface=MIXER,name='PCM Playback Route'
  ; type=INTEGER,access=rw------,values=1,min=0,max=2,step=0
  : values=1
pi@raspberrypi ~ $
```

3. 安装 perl Ner-SDP

   a) 从 git 上下载工程

      git clone https://github.com/njh/perl-net-sdp.git perl-net-sdp

   b) 编译安装 Ner-SDP

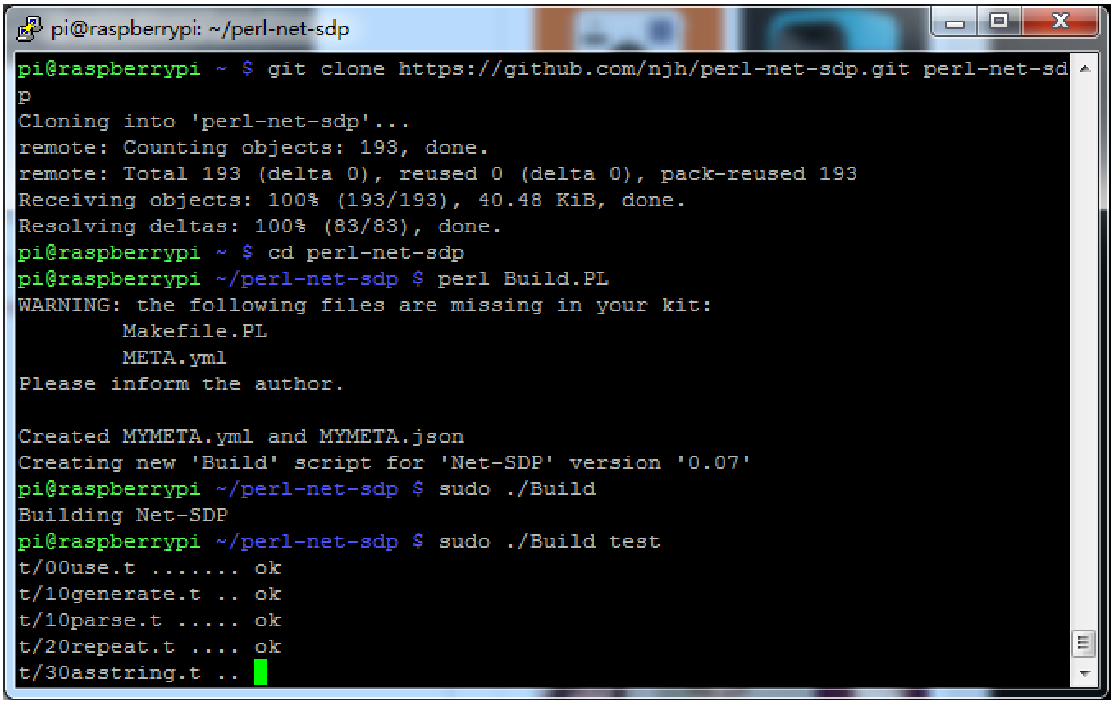
cd perl-net-sdp

perl Build.PL

sudo ./Build

sudo ./Build test

sudo ./Build install



```
pi@raspberrypi ~ $ git clone https://github.com/njh/perl-net-sdp.git perl-net-sd
p
Cloning into 'perl-net-sdp'...
remote: Counting objects: 193, done.
remote: Total 193 (delta 0), reused 0 (delta 0), pack-reused 193
Receiving objects: 100% (193/193), 40.48 KiB, done.
Resolving deltas: 100% (83/83), done.
pi@raspberrypi ~ $ cd perl-net-sdp
pi@raspberrypi ~/perl-net-sdp $ perl Build.PL
WARNING: the following files are missing in your kit:
        Makefile.PL
        META.yml
Please inform the author.

Created MYMETA.yml and MYMETA.json
Creating new 'Build' script for 'Net-SDP' version '0.07'
pi@raspberrypi ~/perl-net-sdp $ sudo ./Build
Building Net-SDP
pi@raspberrypi ~/perl-net-sdp $ sudo ./Build test
t/00use.t ....... ok
t/10generate.t .. ok
t/10parse.t ..... ok
t/20repeat.t .... ok
t/30asstring.t ..
```

4. 安装 Shairport

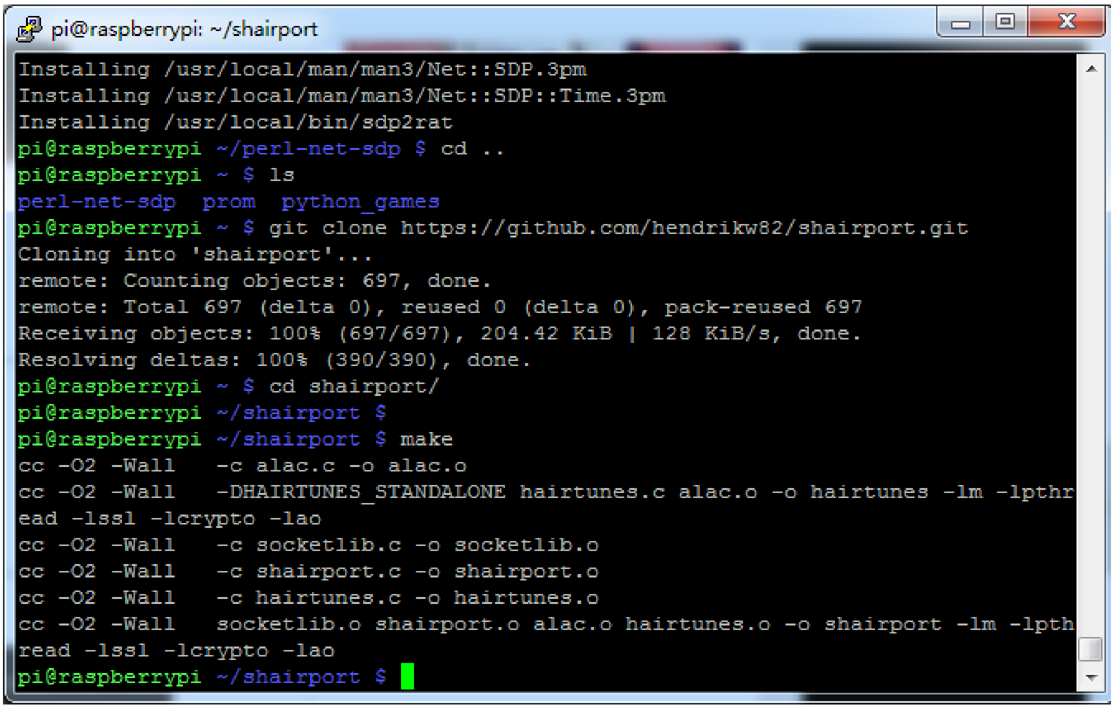
a) 从 git 上下载工程

git clone https://github.com/hendrikw82/shairport.git

b) 编译安装 Shairport

cd shairport

make



```
Installing /usr/local/man/man3/Net::SDP.3pm
Installing /usr/local/man/man3/Net::SDP::Time.3pm
Installing /usr/local/bin/sdp2rat
pi@raspberrypi ~/perl-net-sdp $ cd ..
pi@raspberrypi ~ $ ls
perl-net-sdp  prom  python_games
pi@raspberrypi ~ $ git clone https://github.com/hendrikw82/shairport.git
Cloning into 'shairport'...
remote: Counting objects: 697, done.
remote: Total 697 (delta 0), reused 0 (delta 0), pack-reused 697
Receiving objects: 100% (697/697), 204.42 KiB | 128 KiB/s, done.
Resolving deltas: 100% (390/390), done.
pi@raspberrypi ~ $ cd shairport/
pi@raspberrypi ~/shairport $
pi@raspberrypi ~/shairport $ make
cc -O2 -Wall   -c alac.c -o alac.o
cc -O2 -Wall   -DHAIRTUNES_STANDALONE hairtunes.c alac.o -o hairtunes -lm -lpthr
ead -lssl -lcrypto -lao
cc -O2 -Wall   -c socketlib.c -o socketlib.o
cc -O2 -Wall   -c shairport.c -o shairport.o
cc -O2 -Wall   -c hairtunes.c -o hairtunes.o
cc -O2 -Wall   socketlib.o shairport.o alac.o hairtunes.o -o shairport -lm -lpth
read -lssl -lcrypto -lao
pi@raspberrypi ~/shairport $
```

5. 运行 Shairport 并播放音乐

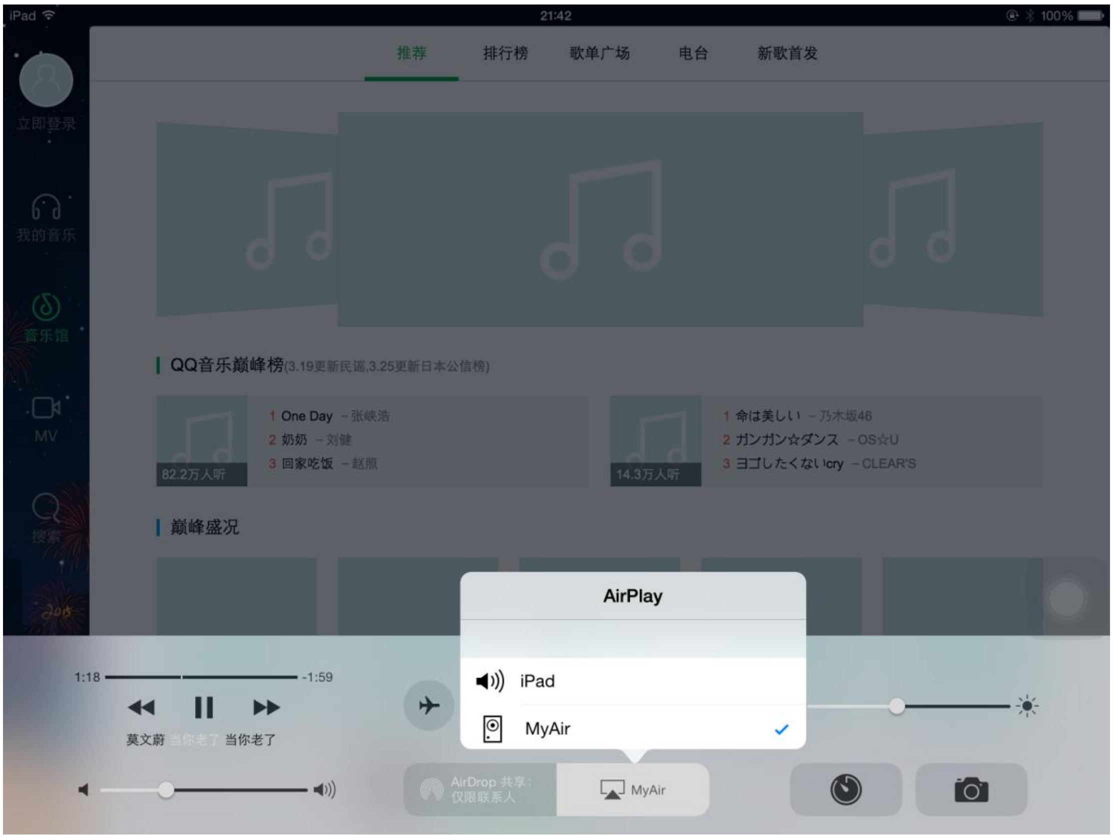
   a) 运行 Shairport

      ```
      ./shairport.pl  –a  MyAir
      ```

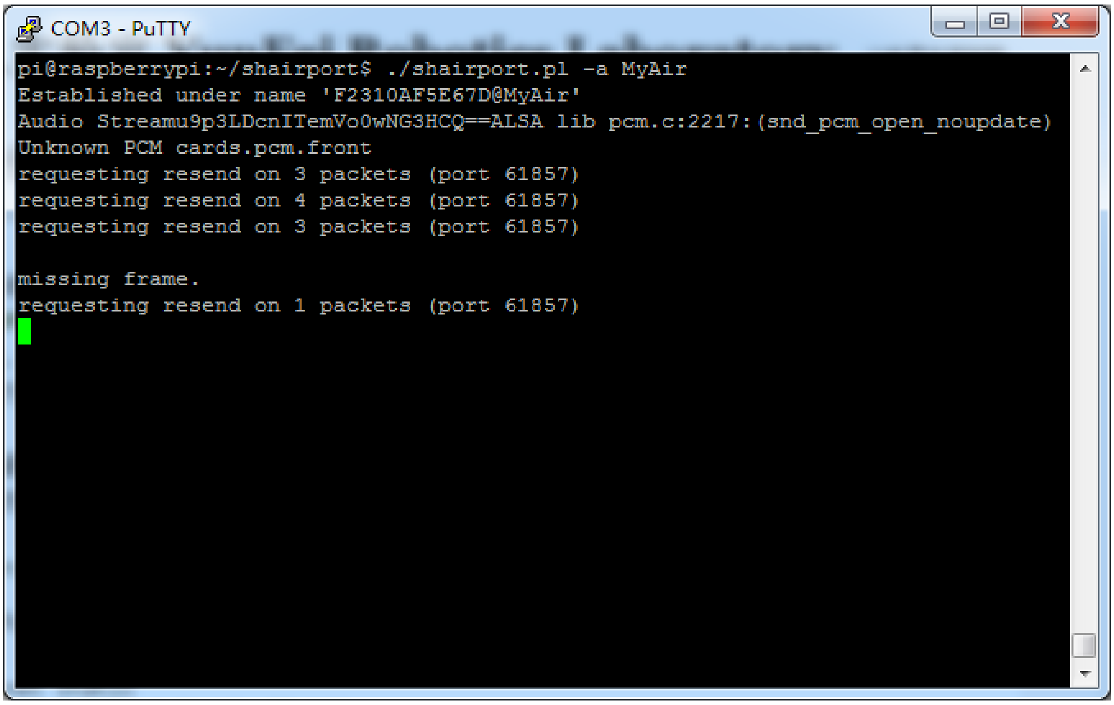
      用-a 参数设置 Airplay 的名字

   b) 播放音乐

      将 RPi 和 iPad 置于同一局域网内，在 iPad 上播放音乐，可发现 Air Play 中出现 MyAir 的选项，如下图所示。



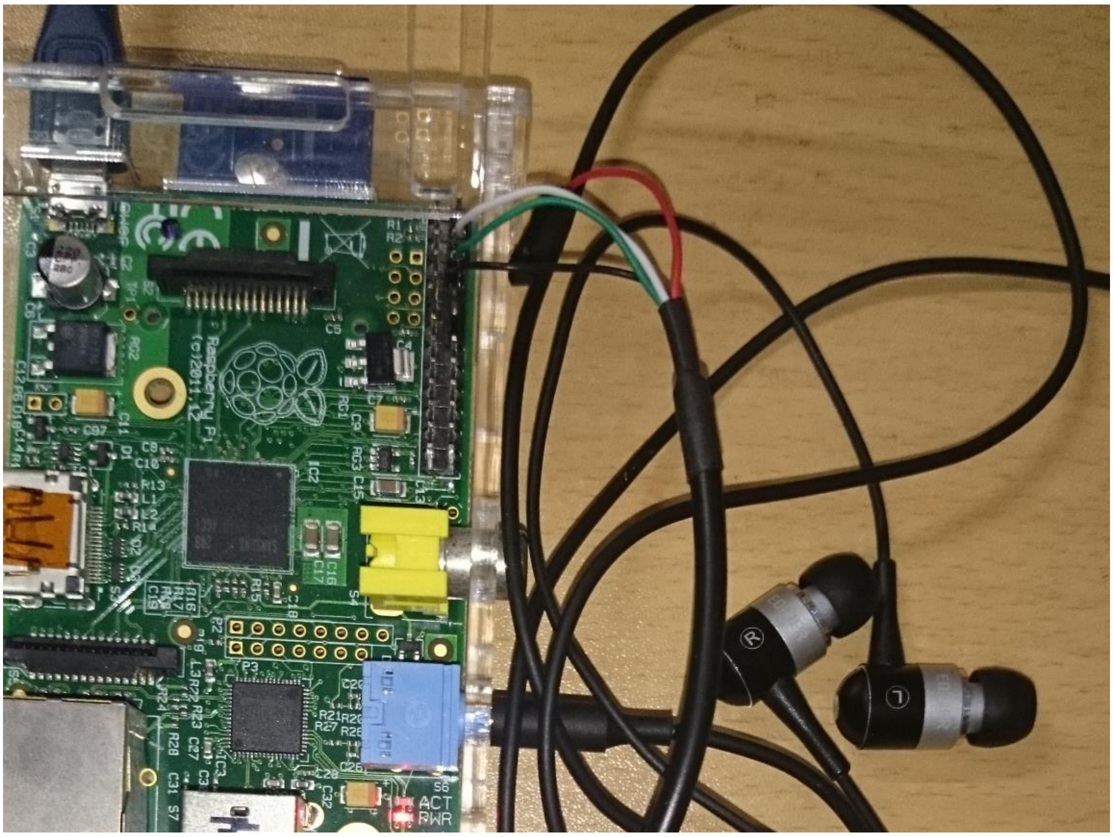
同时，可以在 RPi 界面看到播放的信息，如下图所示。



```
pi@raspberrypi:~/shairport$ ./shairport.pl -a MyAir
Established under name 'F2310AF5E67D@MyAir'
Audio Streamu9p3LDcnITemVo0wNG3HCQ==ALSA lib pcm.c:2217:(snd_pcm_open_noupdate)
Unknown PCM cards.pcm.front
requesting resend on 3 packets (port 61857)
requesting resend on 4 packets (port 61857)
requesting resend on 3 packets (port 61857)

missing frame.
requesting resend on 1 packets (port 61857)
```

将耳机插入 RPi 的耳机口，可以听到 iPad 中播放的歌曲。



四、 讨论与心得

本次实验中用到了很多开源软件，这些软件主要是找到的资料中推荐的。如果在自己 DIY 的时候，花在这方面的时间可能会更多。另外，如果对板子不够熟悉的话，很难想到还要对声卡进行设置。希望将来在这些方面能够多多扩展。最后，从板子中听到的音乐音质下降地较为厉害，应该还有增强的余地，期待进一步改进。