IAC-A5D3x-Kit Linux User Manual

Version:2.0

2014/10/08

QIYANG INTELLIGNET TECHNOLOGY Co., Ltd

Catalogue

Version Updates

Version	Hardware Platform	Description	Date	Revisor
1.0	IAC-A5D3x-Kit	Launched	2014-02-08	yao
2.0	IAC-A5D3x-Kit	Modify uboot, kernel, file system version	2014-10-08	WWX

Preface

Welcome to use the IAC-A5D3x-Kit from Hangzhou Qiyang Intelligent Technology Company. It include four manuals in Linux:

IAC-A5D3x-Kit Linux User Manual. pdf

IAC-A5D3x-Kit Hardware Manual. pdf

IAC-A5D3x-Kit Linux Module Specification and Test Manual. pdf

IAC-A5D3x-Kit Linux System Image Burning Manual. pdf

Hardware Part, you could refer to ***IAC-A5D3x-Kit Hardware Manual. pdf***

Mainboard Test, you could refer to ***IAC-A5D3x-Kit Linux Module Specification and Test Manual. pdf***

Image Burning, you could refer to ***IAC-A5D3x-Kit Linux System Image Burning Manual.pdf***

This manual is used for introducing how to set up the cross compiler, source code and application demo compiling.

Before using this manual, please read *IAC-A5D3x-Kit Hardware Manual. pdf* carefully.

Ⅰ.Illustration

◆Build in Linux OS (ubuntu or other Linux release version). Operation Example: ubuntu 12.04. Installation, please refer to ***Ubuntu Installation for Virtual Machine Manual.PDF***

◆ Copy file to virtual machine [ubuntu] while it is in compiling process, create a directory[mkdir~/work /*], [~]means user catalogue; Absolute Path is[/home/st*/].

All documentations are copied to this directory, users could create directory by themselves. Example:[~/work]

◆ Please refer to relevant materials about the common commands and vi operation in Linux.

◆ All of the copies of PC and virtual machine adopt samba shared access mode.

◆ Serial Connect: Connect Debugging UART Interface (J7) on development board to serial port on PC by serial port cable.

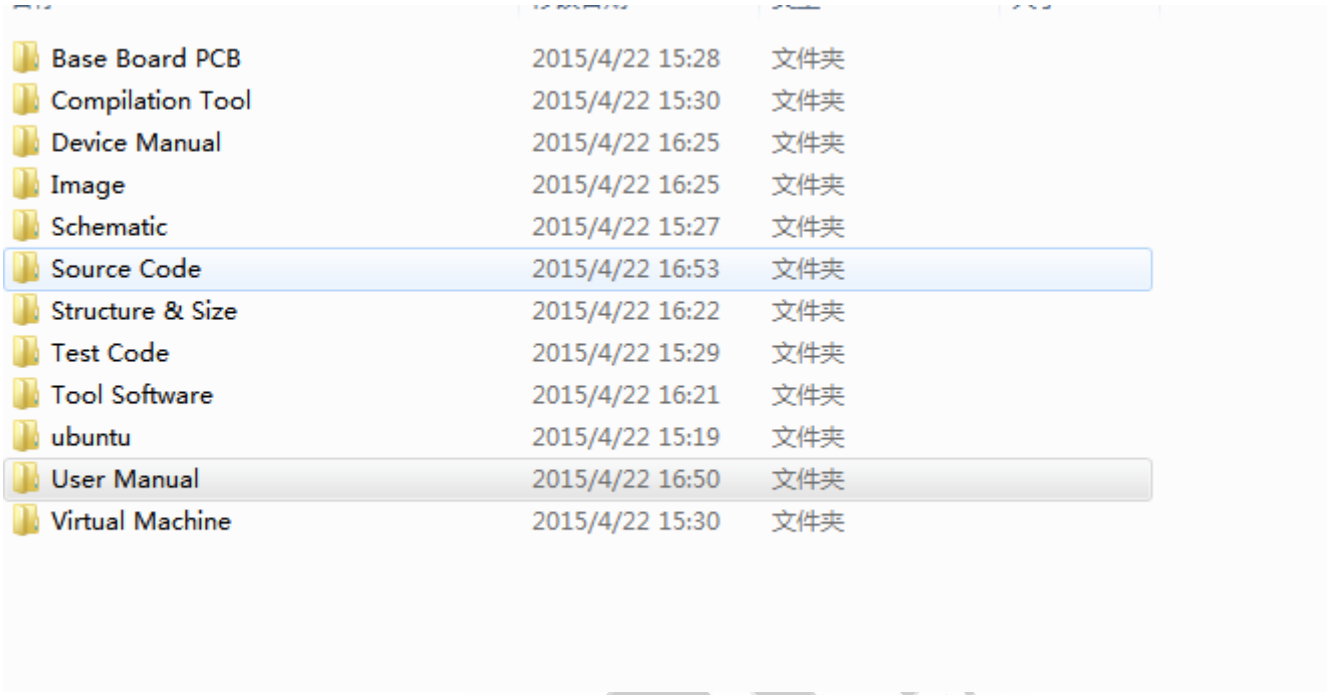
◆ Network Connect: Connect Ethernet Interface (J16) to Network Interface on PC by network cable.

◆USB Connect: Connect USB Device(J22) on development board to USB on PC by USB cable

◆ Set Serial Port: Open terminal communication software(minicom or hyper terminal in PC),select baud rate [115200],stop bit [1], data bit [8], parity bit [none] and data flow control[none]. Then test every serial port.

◆Find out the J1 jumper wire, you will need to use it in the following operation steps.

◆ Mainboard has CD catalogue, the tools software and code file are in the relative catalogue in CD. Please ensure that the materials are all in readiness.



Ⅱ. Burn Linux System Image

If you need to re-burn Linux system, the development board provides two boot methods: dataflash and nandflash. Please select the most suitable boot method to burn, the specific method ,please refer to this manual:

IAC-A5D3x-Kit Linux System Image Burning Manual. pdf

This manual introduces the burning method from dataflash and nandflash, and the method to update the image by network.

Ⅲ. Function and Test

The development board file system has already integrated the test programs. After booting, you could find the corresponding test programs in [/usr/local/board_test]directory. The specific test method ,you could refer to this manual:

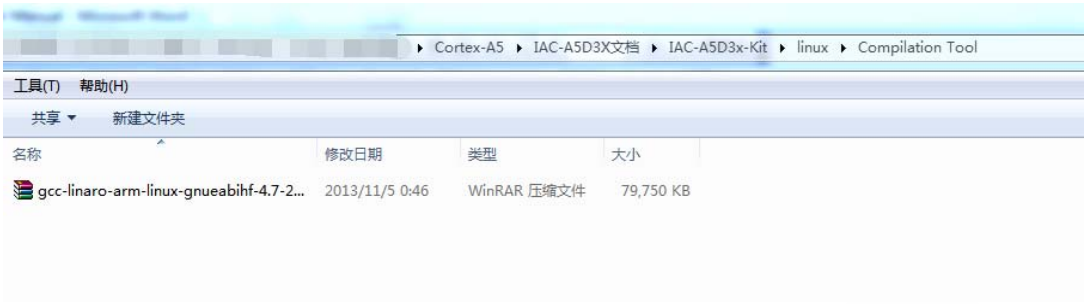
IAC-A5D3x-Kit Linux Module Specification And Test Manual. pdf

Ⅳ. Install Cross Compiler Tool Chain

[Bootloader],[kernel] and[fs] need cross-compiler to recompile.

All application programs and library files need cross-compiler to compile, they want to run on the mainboard. So, we will install the cross-compiler tool chain at first, there is a prepared cross-compiler tool in CD.

Users could use it directly. The GCC version is 4.7.3 .



Next, we will introduce “How to install Cross-Compiler Tool Chains?”

Copy[gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2] cross-compiler tool chains to [~/work]directory.

```
st@st-virtual-machine:~/work$ ls
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2
st@st-virtual-machine:~/work$
```

$ tar -xjvf gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2

Generate[gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux] in current directory.

```
gnueabihf/4.7.3/liblto_plugin.so.0.0.0
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/libexec/gcc/arm-linux-
gnueabihf/4.7.3/collect2
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/libexec/gcc/arm-linux-
gnueabihf/4.7.3/liblto_plugin.so.0
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/libexec/gcc/arm-linux-
gnueabihf/4.7.3/liblto_plugin.so
st@st-virtual-machine:~/work$ ls
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2
st@st-virtual-machine:~/work$
```

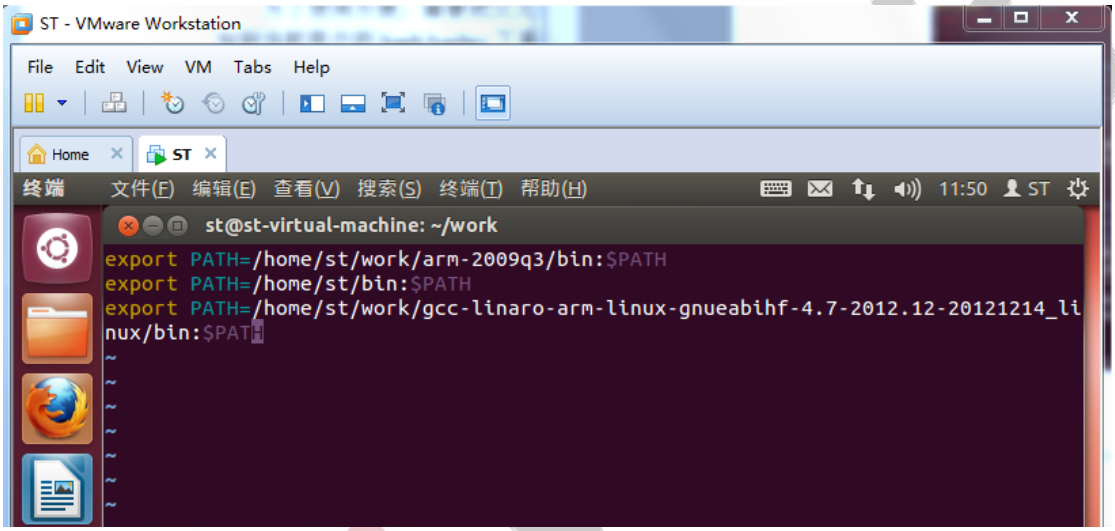
Add this cross-compilers' path to system environment variables [PATH], and add into the current user's [bash.bashrc].

```
$ vi ~/.bashrc
```

Add the following path in the file.

```
export PATH=
/home/st/work/gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/bin:$PATH
```

Note: The above environment variables do not need a line feed.

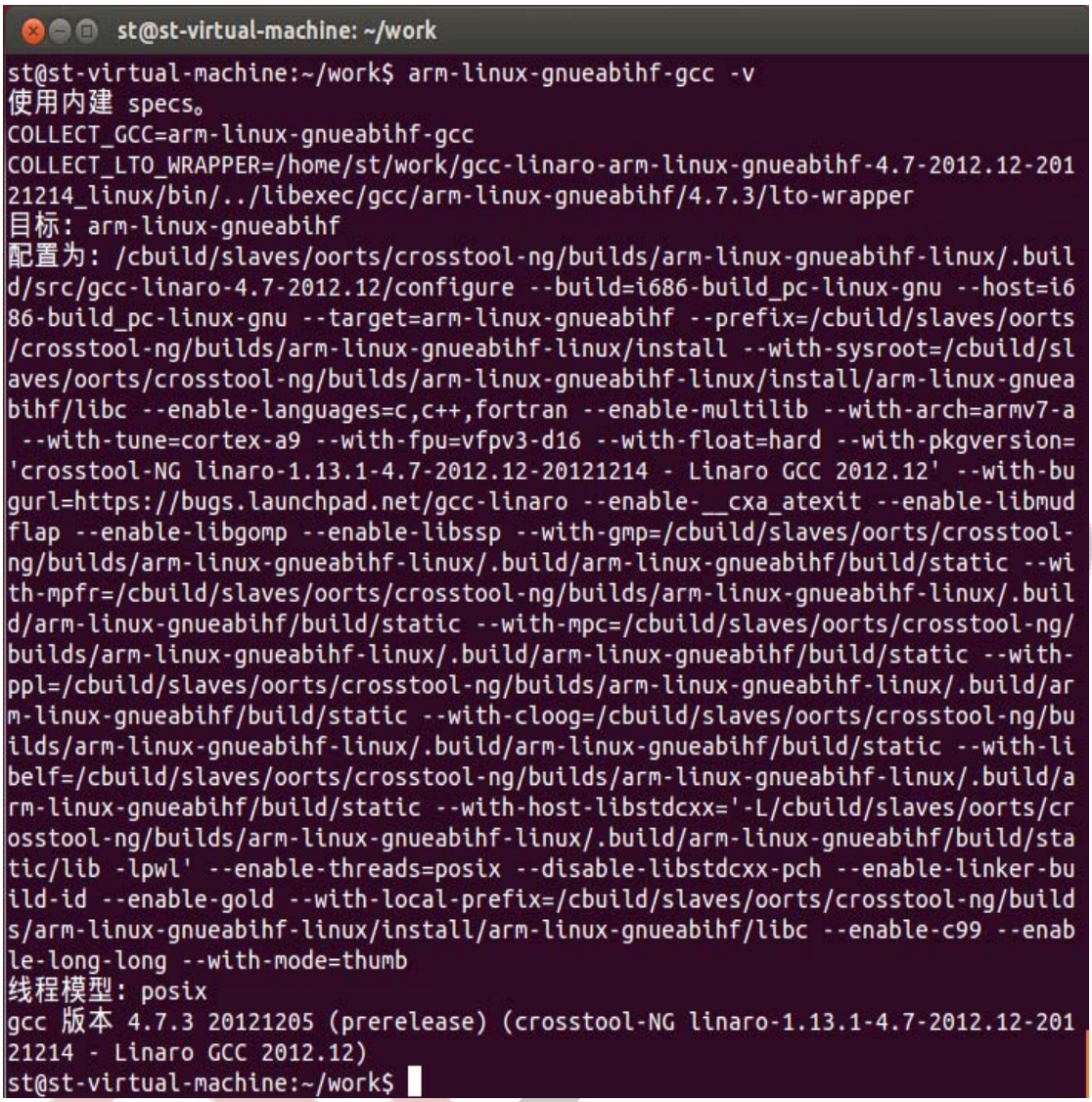


Save & Exit!

Make the new environment variables effective.

```
$ source ~/.bashrc
```

After the environment variables taking effect, next, we confirm whether the cross-compiler has been installed successfully：



As shown, GCC version is 4.7.3.

So far, the cross-compiler is totally installed, then we could use it to compile system code and application program.

Ⅴ. Compile Bootstrap

Bootstrap is the secondary bootstrap program, the primary bootstrap program has been cured into the ROM of the CPU chip. The users could not modify!

The bootstrap is in charge of the initialization of clock, GPIO, memory etc. IAC-A5D3x-Kit development board provides three boot methods base on the different image mediums.

- dataflash boot method
- nandflash boot method
- SD Card boot method

Base on the internal program, CPU will search for boot code base on the storage medium by the following priority :

Dataflash>nandflash>SD Card

Before selecting boot method, please make sure that there is no higher level boot medium or the medium has been interrupted. Or the CPU will use the higher level boot method.

The compiled bootstrap image file is in the CD, you can use it

directly. If you want to recompile, the migrated bootstrap source code is ready too.

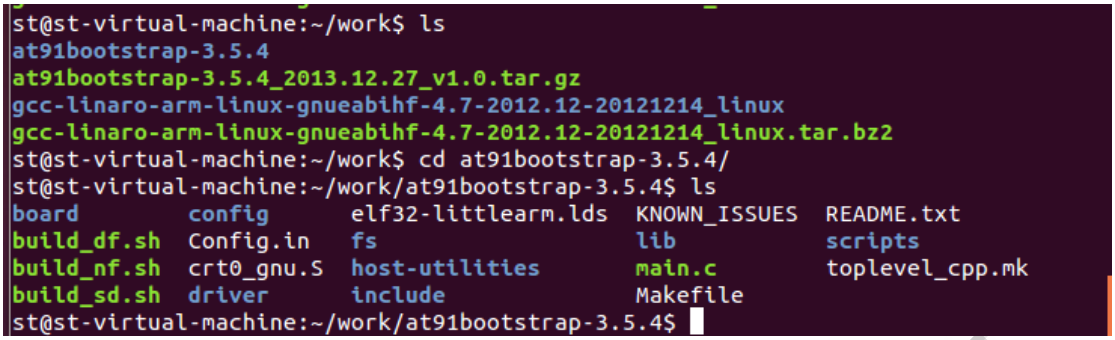
Copy the [bootstrap] source code to [~/work]directory in CD, then extract:

```
$ tar –xzvf at91bootstrap-3.5.4_2013.12.27_v1.0.tar.gz
```

```
at91bootstrap-3.5.4/fs/include/ffconf.h
at91bootstrap-3.5.4/fs/include/ff.h
at91bootstrap-3.5.4/crt0_gnu.S
at91bootstrap-3.5.4/.gitignore
at91bootstrap-3.5.4/main.c
at91bootstrap-3.5.4/README.txt
st@st-virtual-machine:~/work$ ls
at91bootstrap-3.5.4
at91bootstrap-3.5.4_2013.12.27_v1.0.tar.gz
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2
st@st-virtual-machine:~/work$
```

After extracting, there is a [at91bootstrap-3.5.4] folder, enter into this folder:

```
$ cd at91bootstrap-3.5.4
```



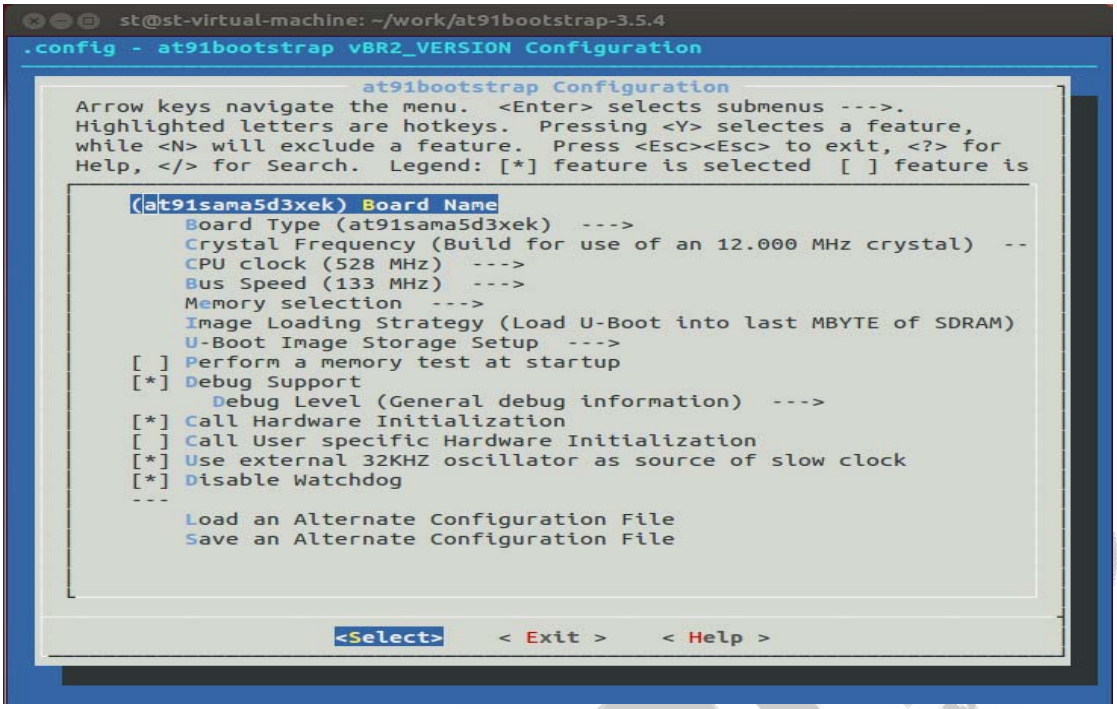
As shown: In order to compile easily, we have already made the corresponding compile steps of the boot method into a script file.

- build_df.sh It is the bootstrap script file for dataflash boot method
- build_nf.sh It is the bootstrap script file for nandflash.
- build_sd.sh It is the bootstrap script file for SD Card.

Users could select the corresponding script file to compile, here is an example : dataflash. The other boot methods' compiling method will not be illustrated again. Execute [build_df.sh]script file.

```
$ ./build_df.sh
```

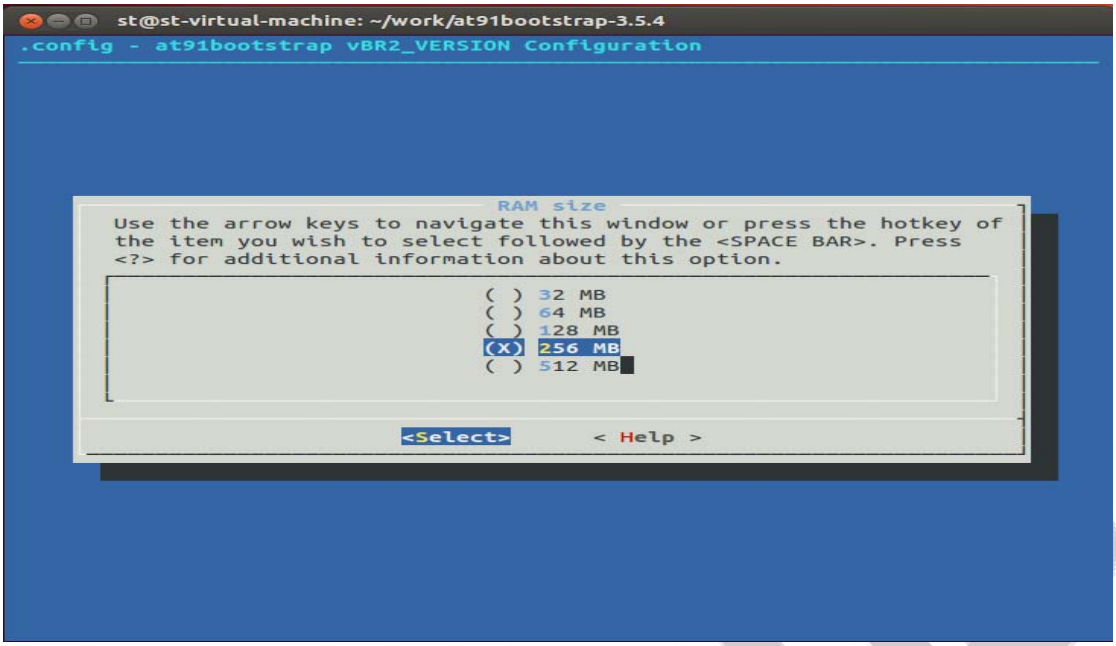
Execute the above script file, the interface shows the following message :



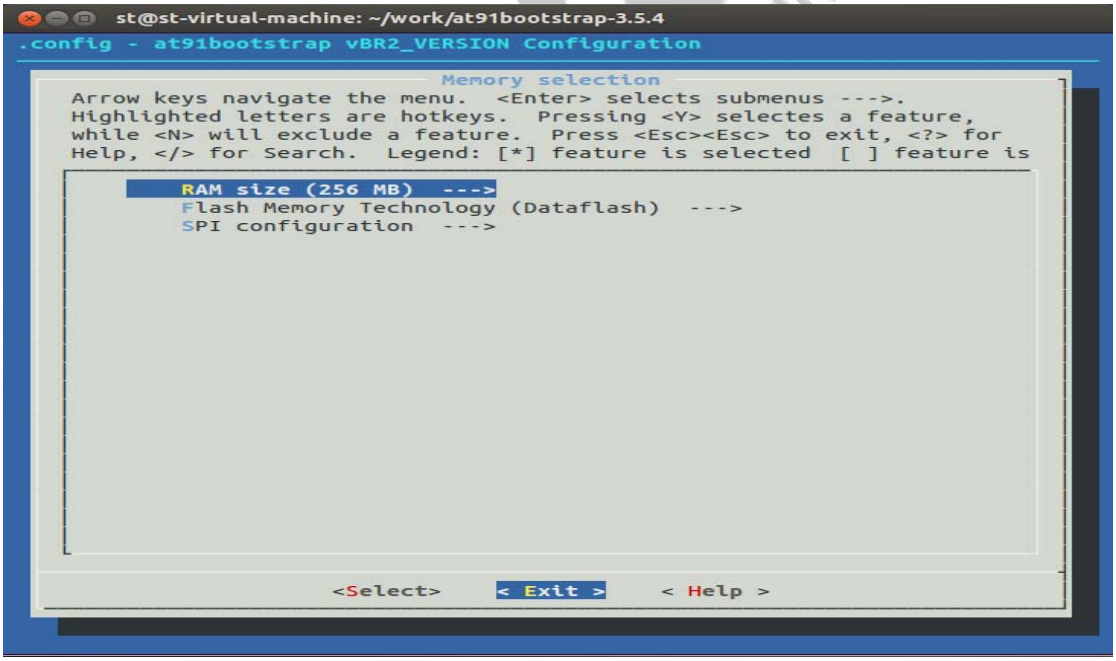
User could configure as requirement, after configuring, select [yes] to save, then exit. If it is no need to modify, then [exit] by default. The IAC-A5D3x-Kit default configuration, you should select the [Memory Selection] to 256M.

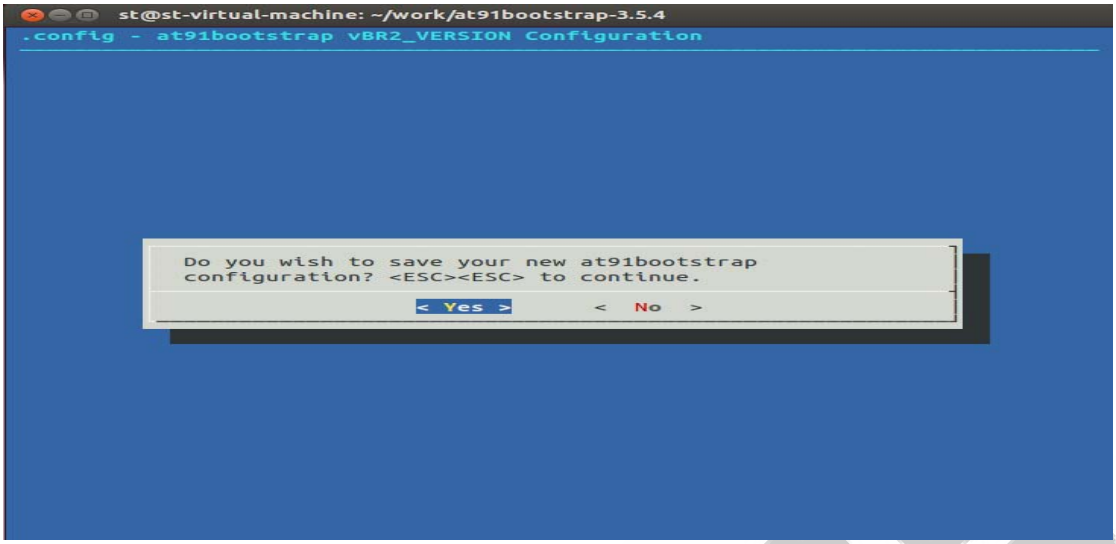
Memory selection --->

RAM size (512 MB) --->



Select, then [exit].





Select [Yes], then save.

Finish configuring, then execute [make] command to compile.

```
$ make
```

Finish compiling , there is no error.

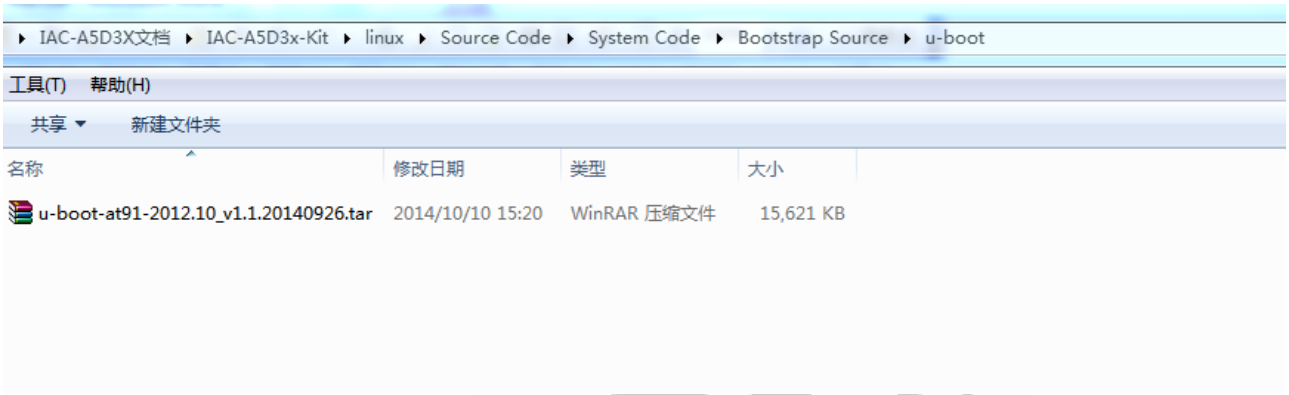
```
st@st-virtual-machine: ~/work/at91bootstrap-3.5.4
G_CPU_CLK_528MHZ -DCONFIG_BUS_SPEED_133MHZ -DCONFIG_HAS_PIO3 -DCONFIG_LOAD_ONE_WI
RE -DCONFIG_MMC_SUPPORT -DCONFIG_DDR2 -DCONFIG_RAM_256MB -DCONFIG_DATAFLASH -DCON
FIG_SMALL_DATAFLASH -DAT91C_SPI_CLK=33000000 -DAT91C_SPI_PCS_DATAFLASH=AT91C_SPI_
PCS0_DATAFLASH -DBOOTSTRAP_DEBUG_LEVEL=DEBUG_INFO -DCONFIG_DISABLE_WATCHDOG

ld FLAGS
========
-nostartfiles -Map=/home/st/work/at91bootstrap-3.5.4/binaries/at91sama5d3xek-data
flashboot-uboot-3.5.4.map --cref -static -T elf32-littlearm.lds --gc-sections -Tt
ext 0x300000

  AS        /home/st/work/at91bootstrap-3.5.4/crt0_gnu.S
  CC        /home/st/work/at91bootstrap-3.5.4/main.c
  CC        /home/st/work/at91bootstrap-3.5.4/board/at91sama5d3xek/at91sama5d3xek
.c
  CC        /home/st/work/at91bootstrap-3.5.4/lib/string.c
  CC        /home/st/work/at91bootstrap-3.5.4/lib/eabi_utils.c
  CC        /home/st/work/at91bootstrap-3.5.4/lib/div.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/debug.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/at91_slowclk.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/at91_pio.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/pmc.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/at91_pit.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/at91_wdt.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/dbgu.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/ddramc.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/at91_spi.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/dataflash.c
  CC        /home/st/work/at91bootstrap-3.5.4/driver/ds24xx.c
mkdir -p /home/st/work/at91bootstrap-3.5.4/binaries
  LD        at91sama5d3xek-dataflashboot-uboot-3.5.4.elf
Size of at91sama5d3xek-dataflashboot-uboot-3.5.4.bin is 4280 bytes
[Succeeded] It's OK to fit into SRAM area
st@st-virtual-machine:~/work/at91bootstrap-3.5.4$
```

There is an executable file [at91sama5d3xek-dataflashboot-uboot-3.5.4.bin] in [binaries] directory.

```
st@st-virtual-machine:~/work/at91bootstrap-3.5.4$ ls
binaries     config      elf32-littlearm.lds  lib         scripts
board        Config.in   fs                   main.c      toplevel_cpp.mk
build_df.sh  crt0_gnu.o  host-utilities       main.o
build_nf.sh  crt0_gnu.S  include              Makefile
build_sd.sh  driver      KNOWN_ISSUES         README.txt
st@st-virtual-machine:~/work/at91bootstrap-3.5.4$ ls binaries
at91sama5d3xek-dataflashboot-uboot-3.5.4.bin
at91sama5d3xek-dataflashboot-uboot-3.5.4.elf
at91sama5d3xek-dataflashboot-uboot-3.5.4.map
st@st-virtual-machine:~/work/at91bootstrap-3.5.4$
```

Ⅵ. Compile uboot

There is a prepared source code [uboot] ,user could compile it directly.

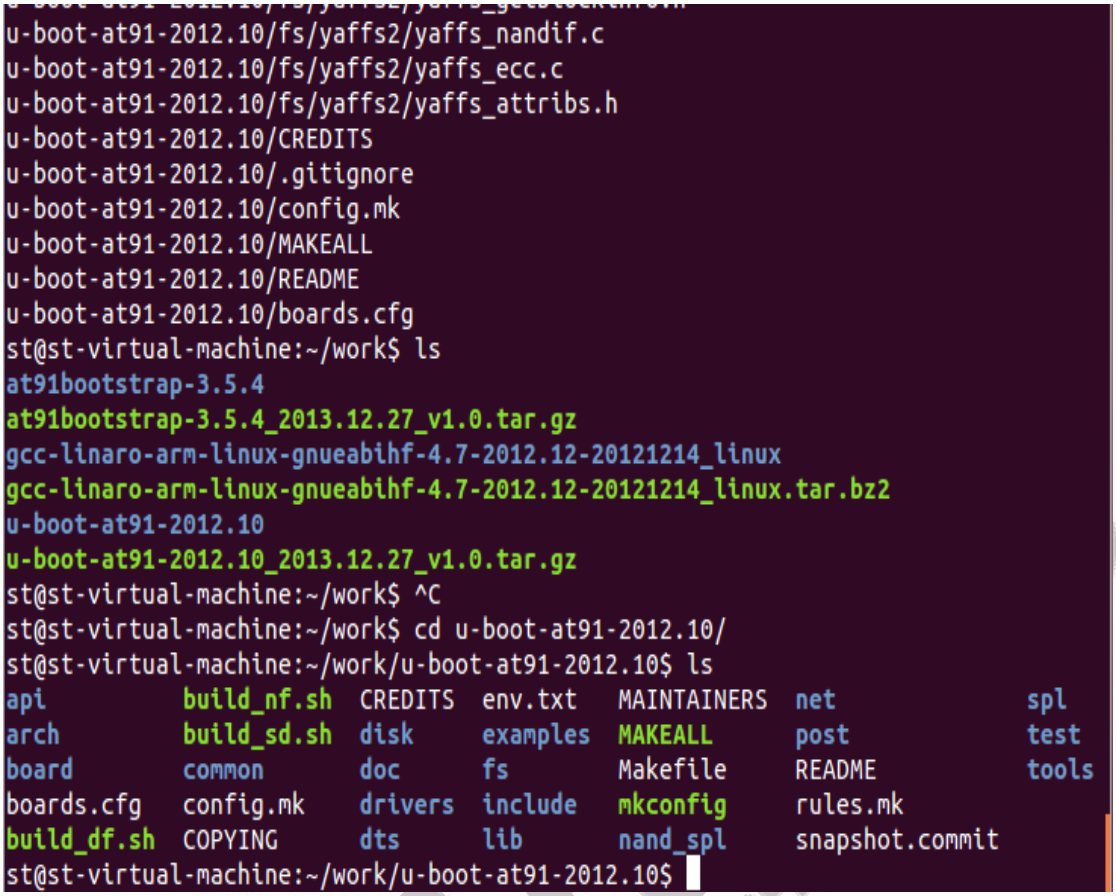


Copy the [u-boot]source code to [~/work]directory in CD, and use the following command to extract:

```
$ tar -xzvf u-boot-at91-2012.10_2013.12.27_v1.0.tar.gz
```

After extracting ,there is a folder [u-boot-at91-2012.10], enter into this folder.

```
$ cd u-boot-at91-2012.10
$ ls
```



As shown: In order to compile easily, we have already made the corresponding compilation steps of the boot method into a script file.

- build_sd.sh It is the bootstrap script file for dataflash.
- build_nf.sh It is the bootstrap script file for nandflash.
- build_sd.sh It is the bootstrap script file for SD Card.

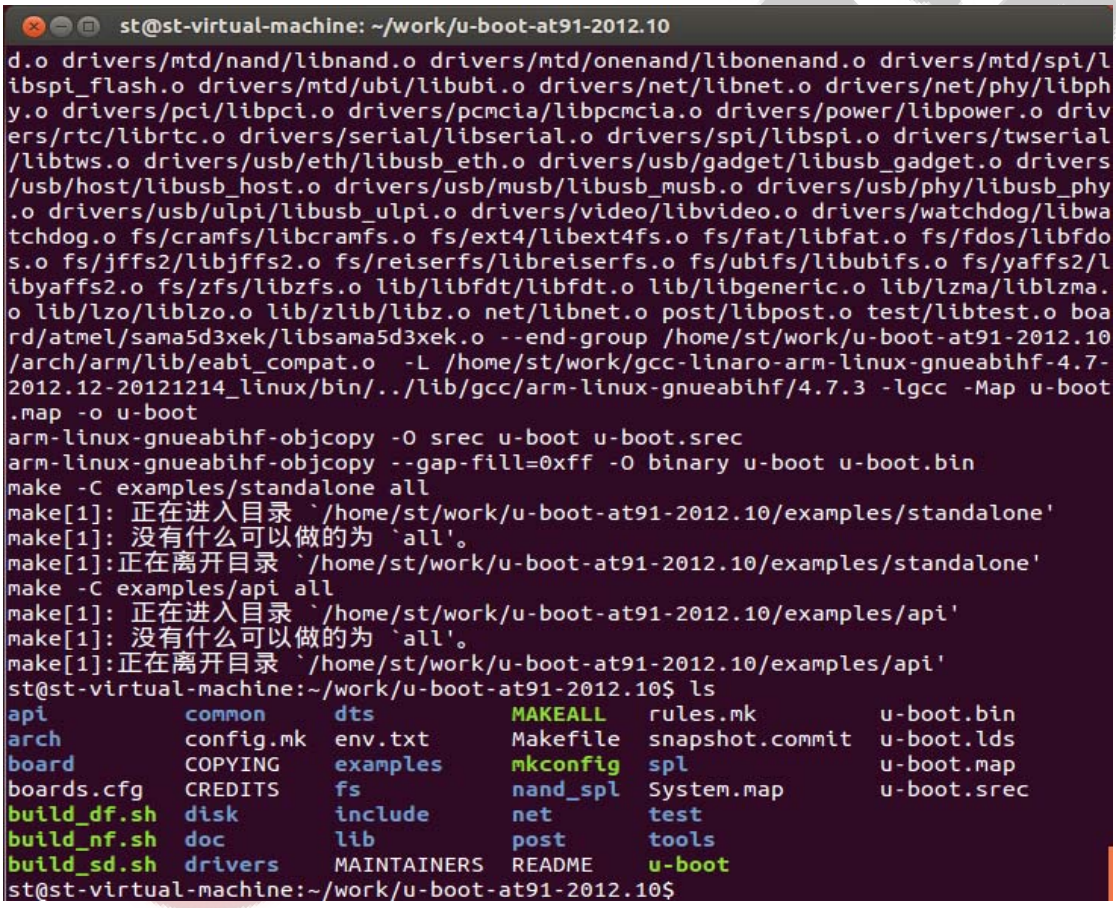
User could select the corresponding script file to compile, here is the example : dataflash. The other boot method compiling method will be

same. Execute [build_df.sh]script file.

```
$ ./build_df.sh
```

There is no error in compiling, so there will be an image file [uboot.bin] in current directory which could be burnt into the development board.

```
$ ls
```



*Note: When it is in the burning process, please make sure that the [uboot] and [bootstrap] image are compiled and obtained by the

same boot method.

Ⅶ. Compile Kernel

There is a migrated and compiled kernel source file in CD.

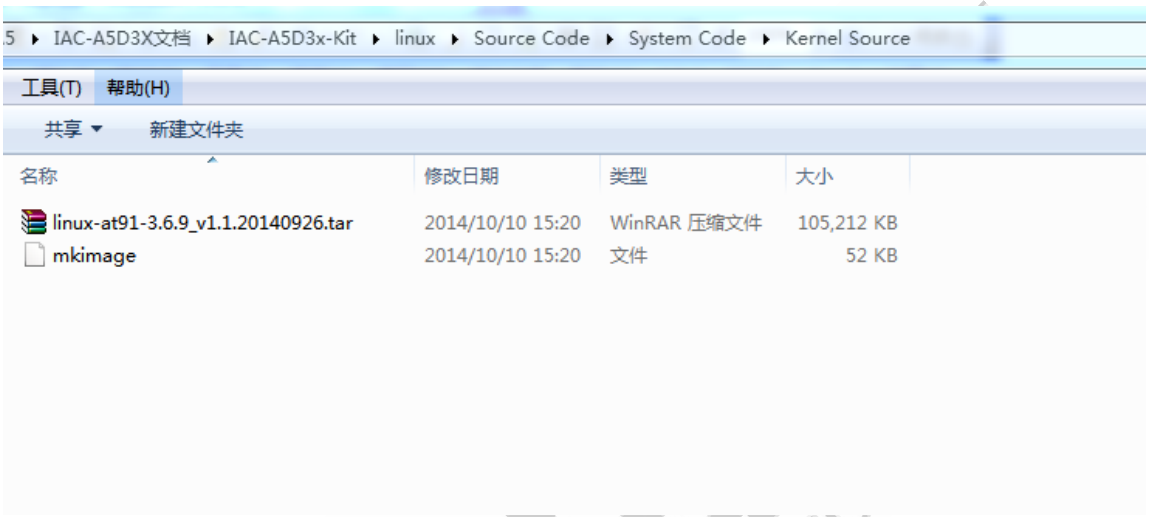


Illustration:[linux-at91-3.6.9_2014.2.8_v2.1.tar.gz] is the kernel source code.

[mkimage] is the tool to generate uImage.

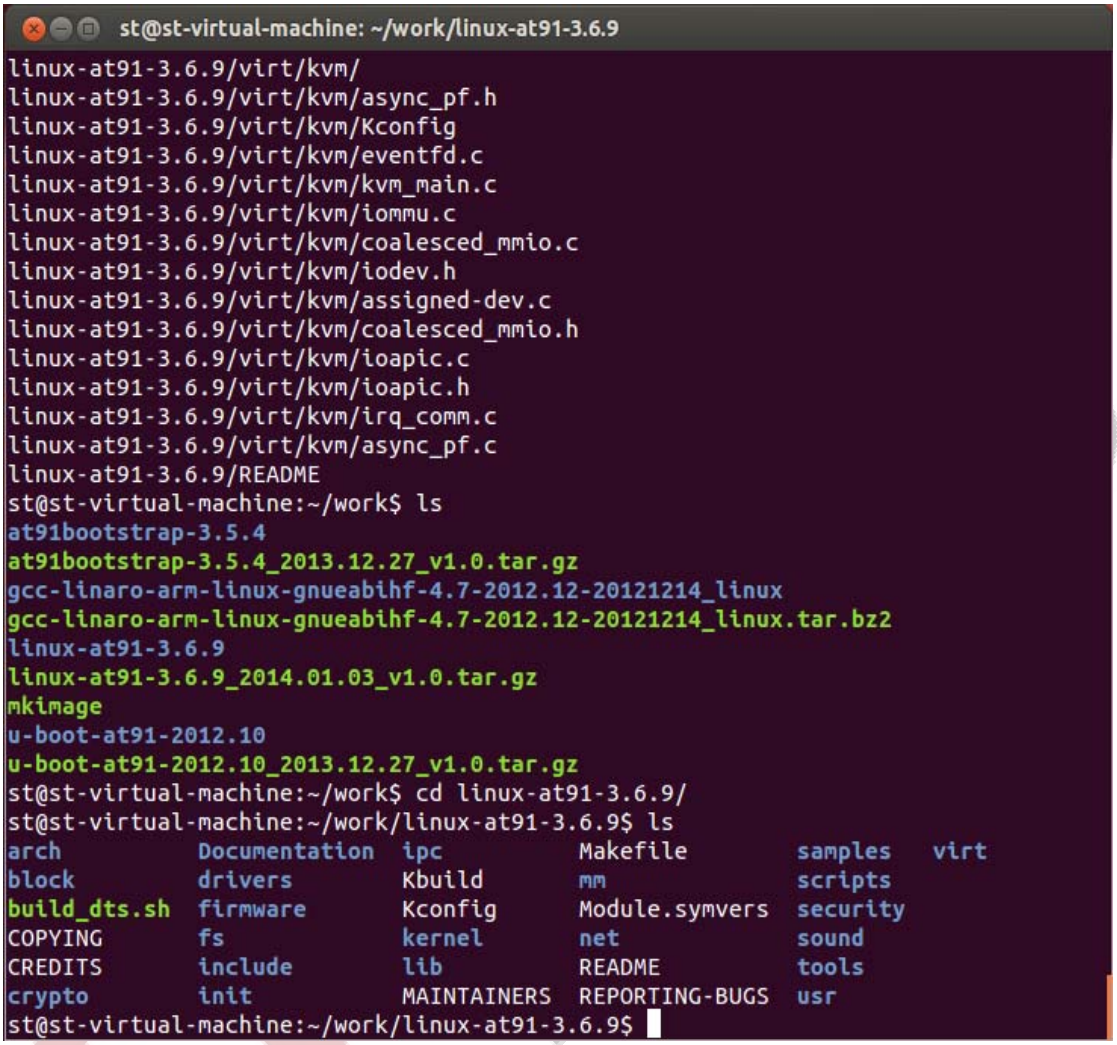
Copy [linux-at91-3.6.9_2014.2.8_v2.1.tar.gz] and [mkimage] in CD into [~/work]directory, then extract kernel source code.

```
$ tar -xzvf linux-at91-3.6.9_2014.2.8_v2.1.tar.gz
```

After extracting , generate [linux-at91-3.6.9]folder in current directory, enter into this folder.

$ cd linux-at91-3.6.9

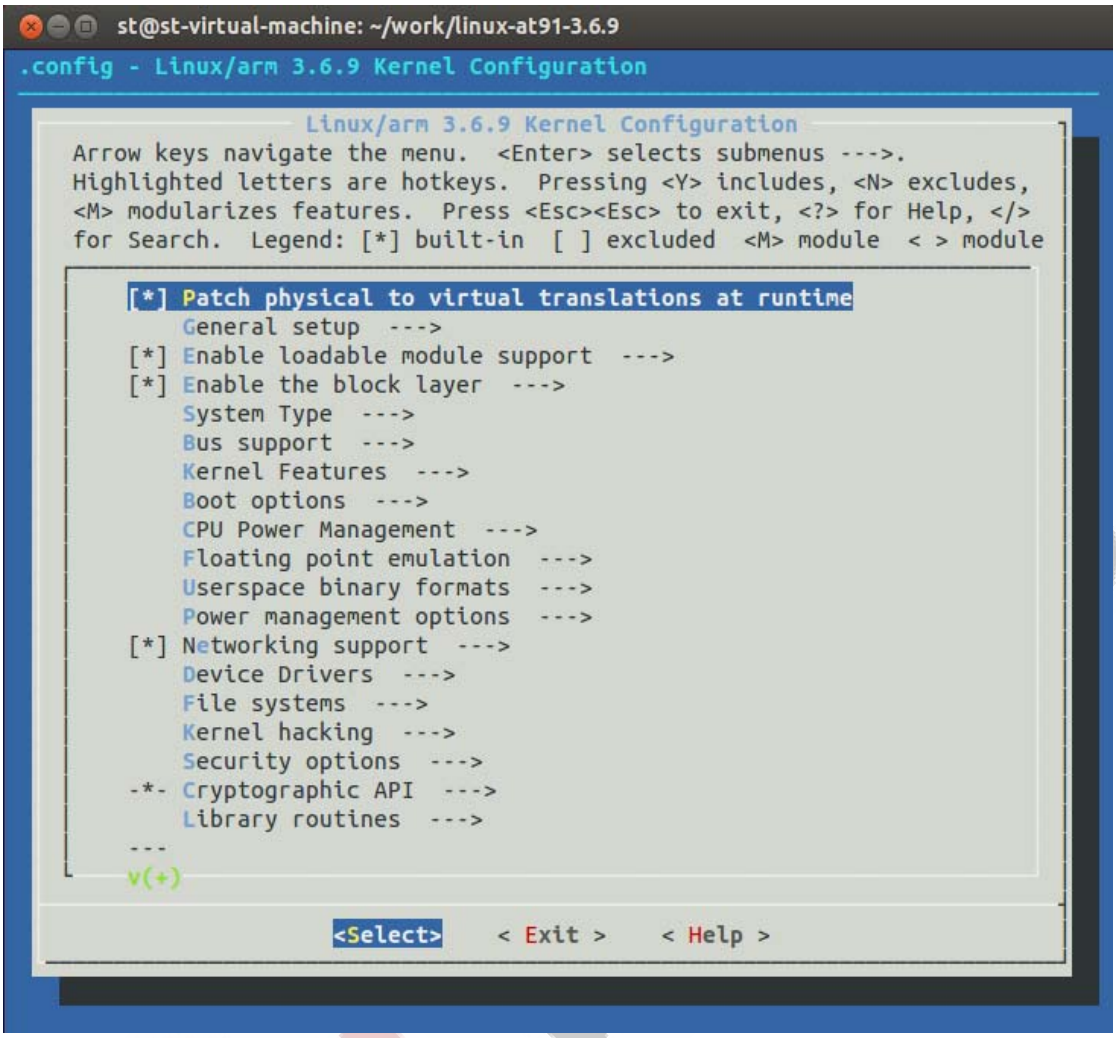
$ ls



After compiling, it needs the following command to configure kernel.

$ make menuconfig

After executing, it pop-up the following kernel selection configuration interface.



The users could modify the kernel function options. The other configurations will be illustrated here. According to the specific requirements ,the users could configure it. If there are no special requirements, you could compile kernel by the default kernel option. Here ,we take an sample for modifying kernel resolution.

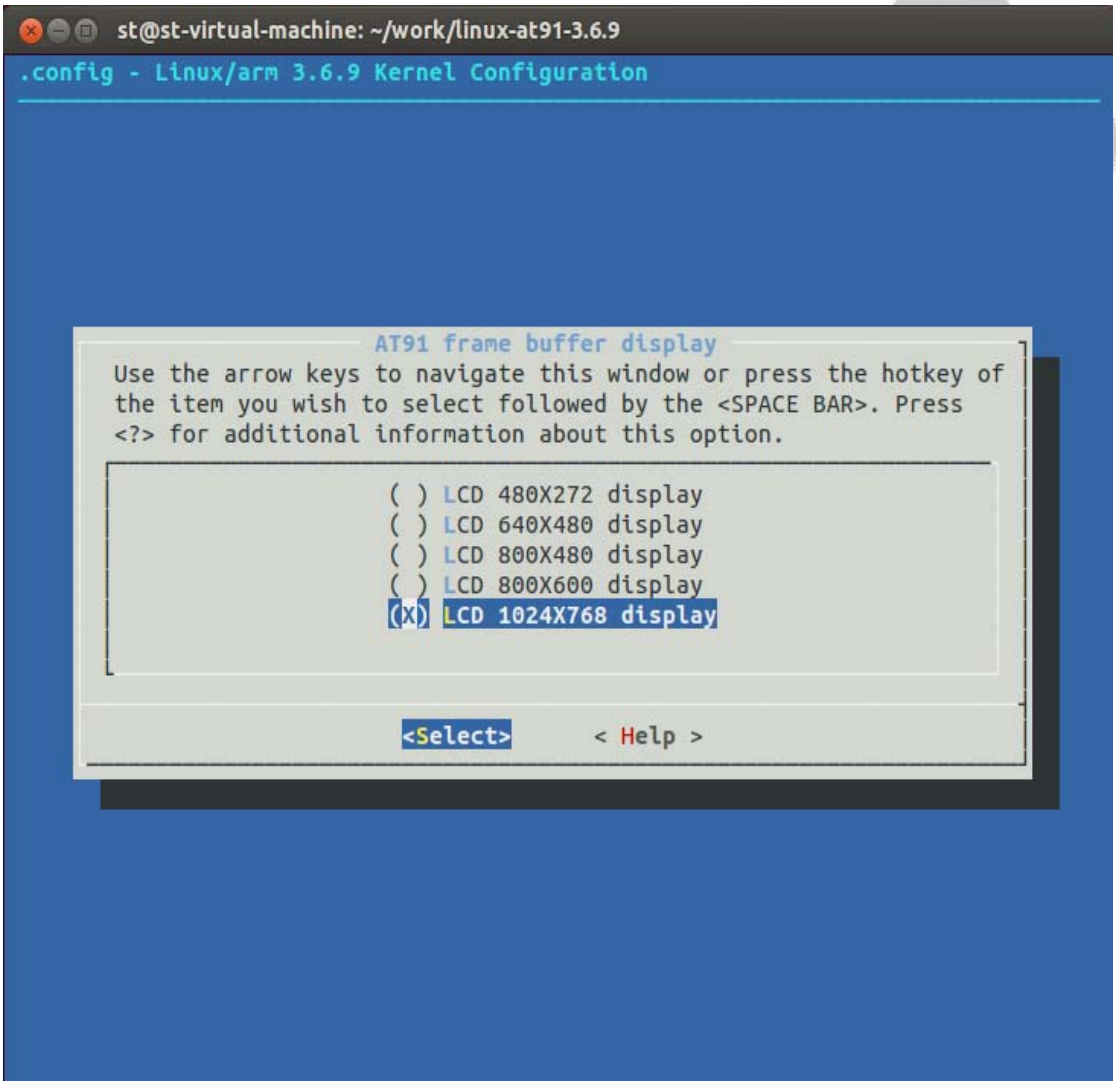
LCD resolution select configuration path in kernel option:

Device Drivers --->

Graphics supports --->

Support for frame buffer devices --->

AT91 frame buffer display (LCD 1024X768 display)



Modify the default configuration from [LCD 800X600 display]

to [LCD 1024X768 display], then save & exit.

Start to compile.

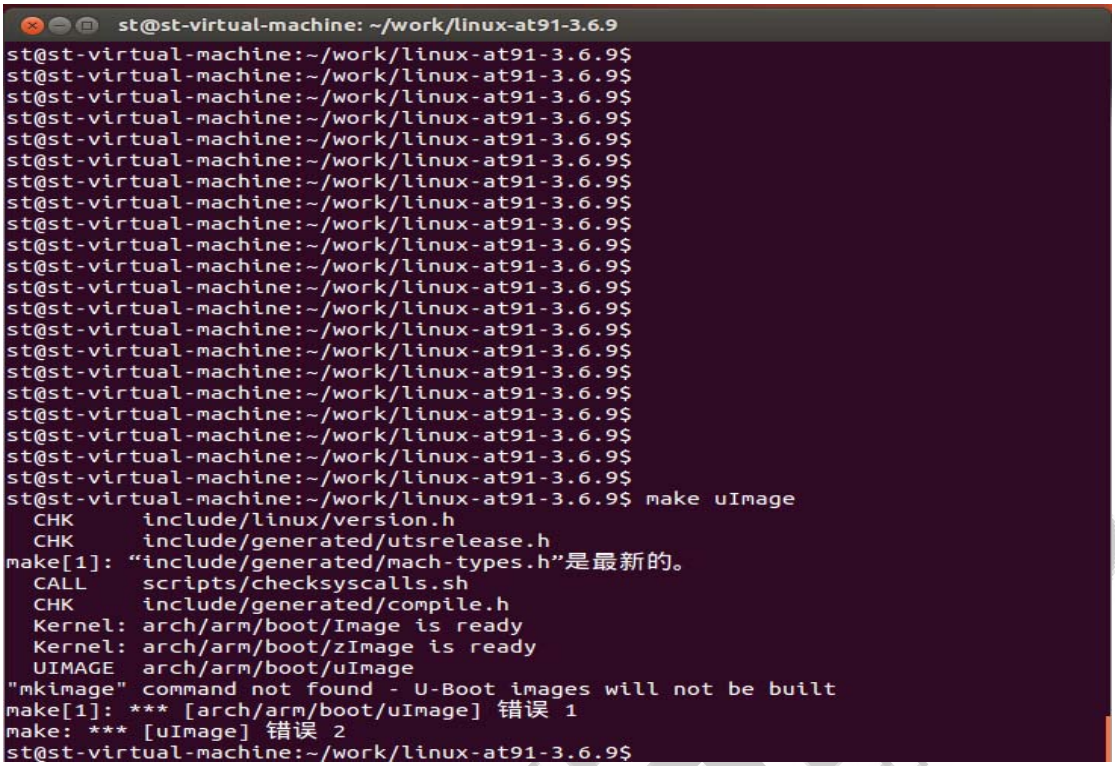
```
$ make
```

The first compilation may need 8-10 minutes, here we take a Computer /dual core 2.4GHz to install virtual machine as a reference. The different computer or server may have some difference in compilation time.

Start to compile kernel image

```
$ make uImage
```

After executing, it hints the following errors:



The above picture hints that it lacks [mkimage]command, it needs the [mkimage]tool to generate the kernel image. We have copied the [mkimage]tool to work directory. Now, we need to add it to the system environment variables. So that, the system could call automatically.

It is simple now.

Copy [mkimage] to [bin] directory in Cross-Compiler.

```
$ cp ../mkimage ~/work/gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/bin/
```

Now, we could execute the compiling command, it could compile kernel image smoothly.

```
$ make uImage
```

```
st@st-virtual-machine:~/work/linux-at91-3.6.9$ cp ../mkimage ~/work/gcc-linaro-ar
m-linux-gnueabihf-4.7-2012.12-20121214_linux/bin/
st@st-virtual-machine:~/work/linux-at91-3.6.9$ make uImage
  CHK     include/linux/version.h
  CHK     include/generated/utsrelease.h
make[1]: “include/generated/mach-types.h”是最新的。
  CALL    scripts/checksyscalls.sh
  CHK     include/generated/compile.h
  Kernel: arch/arm/boot/Image is ready
  Kernel: arch/arm/boot/zImage is ready
  UIMAGE  arch/arm/boot/uImage
Image Name:   Linux-3.6.9
Created:      Wed Jan 22 10:53:05 2014
Image Type:   ARM Linux Kernel Image (uncompressed)
Data Size:    2643344 Bytes = 2581.39 kB = 2.52 MB
Load Address: 20008000
Entry Point:  20008000
  Image arch/arm/boot/uImage is ready
st@st-virtual-machine:~/work/linux-at91-3.6.9$
```

After compiling, it will generate [uImage] kernel image file in [arch/arm/boot/] directory which could be burnt into the development board.

```
  Image arch/arm/boot/uImage is ready
st@st-virtual-machine:~/work/linux-at91-3.6.9$ ls arch/arm/boot/
bootp  compressed  dts  Image  install.sh  Makefile  tftpd32.exe  uImage  zImage
st@st-virtual-machine:~/work/linux-at91-3.6.9$
```

After compiling, there is a recompiled kernel image [uImage] in [arch/arm/boot/]directory.

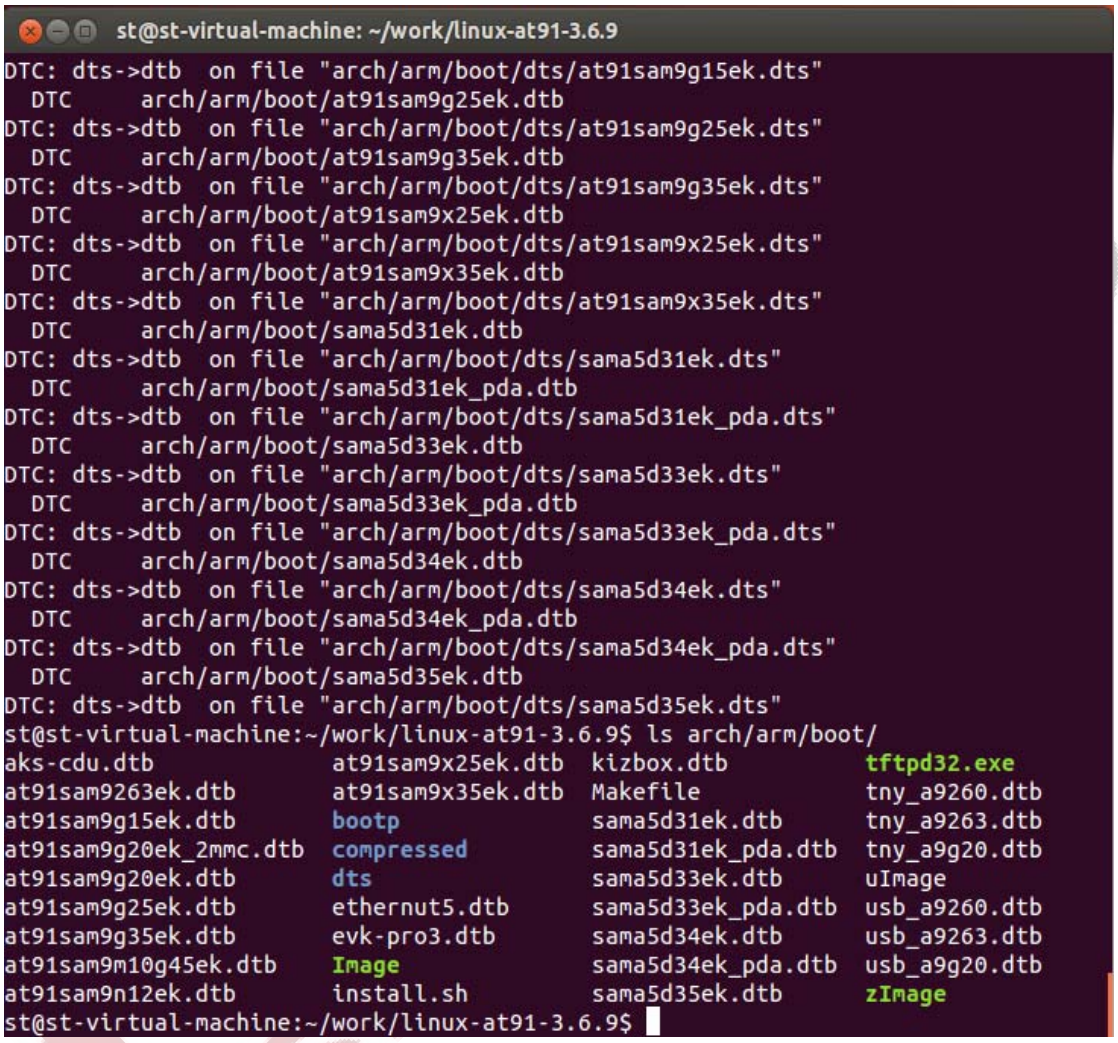
After compiling [uImage], we could compile device tree image.

```
$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- dtbs
```

After compiling, there is sama5d3x series device tree in [arch/arm/boot/]directory. The [sama5d3xek.dtb] is the device tree image. [X] means the corresponding number which use the current using

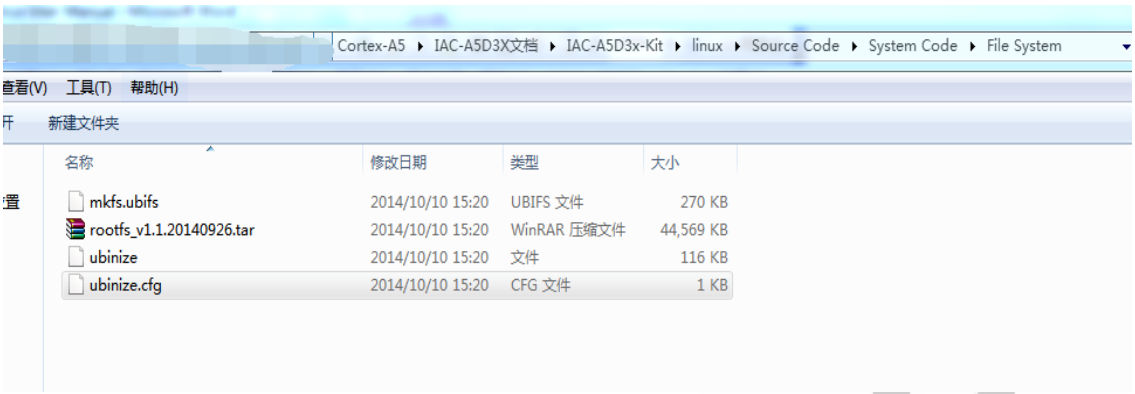
CPU model.

For example, after compiling, there is a device tree image [sama5d34ek.dtb] which sama5d34 compiled.



Ⅷ. File System Creation

There is a prepared file system code and creation tool in CD.



Copy file system source code and creation tool to [~/work]directory ,then extract.

File system source code needs [root] permission to do completed extraction.

Add [sudo] before the extracting command.

```
$ sudo tar -xzvf rootfs-2014.2.8_v2.1.tar.gz
```

After extracting , it generate [rootfs]folder.

```
st@st-virtual-machine:~/work$ ls
at91bootstrap-3.5.4
at91bootstrap-3.5.4_2013.12.27_v1.0.tar.gz
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2
linux-at91-3.6.9
linux-at91-3.6.9_2014.01.03_v1.0.tar.gz
mkfs.ubifs
mkimage
rootfs
rootfs-2014.2.8_v2.1.tar.gz
ubinize
ubinize.cfg
u-boot-at91-2012.10
u-boot-at91-2012.10_2013.12.27_v1.0.tar.gz
st@st-virtual-machine:~/work$
```

Copy creation tool [ubinize]and [mkfs.ubifs] to [bin]directory in cross-compiler.

```
$ cp ubinize ~/work/gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/bin/
$ cp mkfs.ubifs ~/work/gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux/bin/
```

Generate [rootfs.ubifs].

```
$ sudo mkfs.ubifs -r rootfs -m 2048 -e 126976 -c 1816 -o rootfs.ubifs
```

Generate [rootfs.ubi].

```
$ sudo ubinize -o rootfs.ubi -m 2048 -p 128KiB -s 2048 ./ubinize.cfg
```

```
st@st-virtual-machine:~/work$ sudo mkfs.ubifs -r rootfs -m 2048 -e 126976 -c 181
6 -o rootfs.ubifs
st@st-virtual-machine:~/work$ sudo ubinize -o rootfs.ubi -m 2048 -p 128KiB -s 20
48 ./ubinize.cfg
st@st-virtual-machine:~/work$ ls
at91bootstrap-3.5.4
at91bootstrap-3.5.4_2013.12.27_v1.0.tar.gz
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux
gcc-linaro-arm-linux-gnueabihf-4.7-2012.12-20121214_linux.tar.bz2
linux-at91-3.6.9
linux-at91-3.6.9_2014.01.03_v1.0.tar.gz
mkfs.ubifs
mkimage
rootfs
rootfs-2014.2.8_v2.1.tar.gz
rootfs.ubi
rootfs.ubifs
ubinize
ubinize.cfg
u-boot-at91-2012.10
u-boot-at91-2012.10_2013.12.27_v1.0.tar.gz
st@st-virtual-machine:~/work$
```

The generated [rootfs.ubi] is the [ubi]file system image which could be burnt into development board.

Ⅸ. Application Program Development

You could develop the application program on Personal Computer , here, we take [Hello World] as an sample. Create [app]folder in [~/work] directory, enter into [app] folder.

```
$ mkdir app
$ cd app
```

At first , program a [Hello World] code as follows:

```
#include <stdio.h>
int main(void)
{
    printf("Hello World ! \n");
    return 0;
}
```

Save it to [hello.c]file.

```
st@st-virtual-machine:~/work/app$ vi hello.c
st@st-virtual-machine:~/work/app$
st@st-virtual-machine:~/work/app$
st@st-virtual-machine:~/work/app$
st@st-virtual-machine:~/work/app$ ls
hello.c
st@st-virtual-machine:~/work/app$ cat hello.c
    #include <stdio.h>
    int main(void)
    {
    printf("Hello World ! \n");
    return 0;
    }
st@st-virtual-machine:~/work/app$
```

Enable the program to run on the development board. It needs to use

the installed cross-compiler to compile the application programs.

Here is the compiling command:

```
$ arm-linux-gnueabihf-gcc –o hello hello.c
$ file hello
```

```
st@st-virtual-machine:~/work/app$ arm-linux-gnueabihf-gcc -o hello hello.c
st@st-virtual-machine:~/work/app$ ls
hello  hello.c
st@st-virtual-machine:~/work/app$ file hello
hello: ELF 32-bit LSB executable, ARM, version 1 (SYSV), dynamically linked (use
s shared libs), for GNU/Linux 2.6.31, BuildID[sha1]=0x31f8d5b22d847b154ef6a69a87
bd2d3091aaddd9, not stripped
st@st-virtual-machine:~/work/app$
```

After compiling, there is an executable binary file [hello] in current directory.

Then, we could copy the executable program [hello] into development board by SD Card, USB flash disk, tftp or nfs mounting method. Then you could execute [hello] program in development board.

Ⅹ. Conclusion

The above contents may not be detailed enough, if you have any technical problems or suggestion, please contact us: supports@qiyangtech.com. Or you could log in our company forum to contact: http://www.qiytech.com. For more information, please contact: sales@qiyangtech.com , or log in http://www.qiytech.com/index.html.

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