Run **RT-THREAD** using **QEMU**

RT-THREAD Documentation Center

WWW.RT-THREAD.ORG

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This application note describes how to use QEMU to run

Run the RT-Thread qemu-vexpress-a9 BSP project.

1 Purpose and structure of this paper

1.1 Purpose and Background of this Paper

Embedded software development is inseparable from the development board. In the absence of a physical development board, you can use a virtual machine such as QEMU to simulate the development board. QEMU is a virtual machine that supports cross-platform virtualization. It can virtualize many development boards. In order to facilitate everyone to experience RT-Thread without a development board, RT-Thread provides a board support package (BSP) for the ARM vexpress A9 development board simulated by QEMU. This article mainly introduces how to use QEMU to run the RT-Thread qemu-vexpress-a9 BSP project on the Window platform and Ubuntu platform, and introduces how to use a virtual network card to connect QEMU to the network.

1.2 Structure of this paper

This article first introduces the usage details of qemu-vexpress-a9 BSP on the Window platform, and then introduces the usage details on the Ubuntu platform.

2. Run RT-Thread using QEMU on Windows

2.1 Preparation

- Download RT-Thread Source code, it is recommended to download version 3.1.0 or above.
- Download RT-Thread Env Tools, it is recommended to download version 1.0.0 or above.

The board support package (BSP) for the ARM vexpress A9 development board simulated by QEMU provided by RT-Thread is located in the qemu-vexpress-a9 folder under the RT-Thread source code BSP directory. This BSP implements related drivers such as LCD, keyboard, mouse, SD card, Ethernet card, serial port, etc. The folder contents are shown in the figure below.

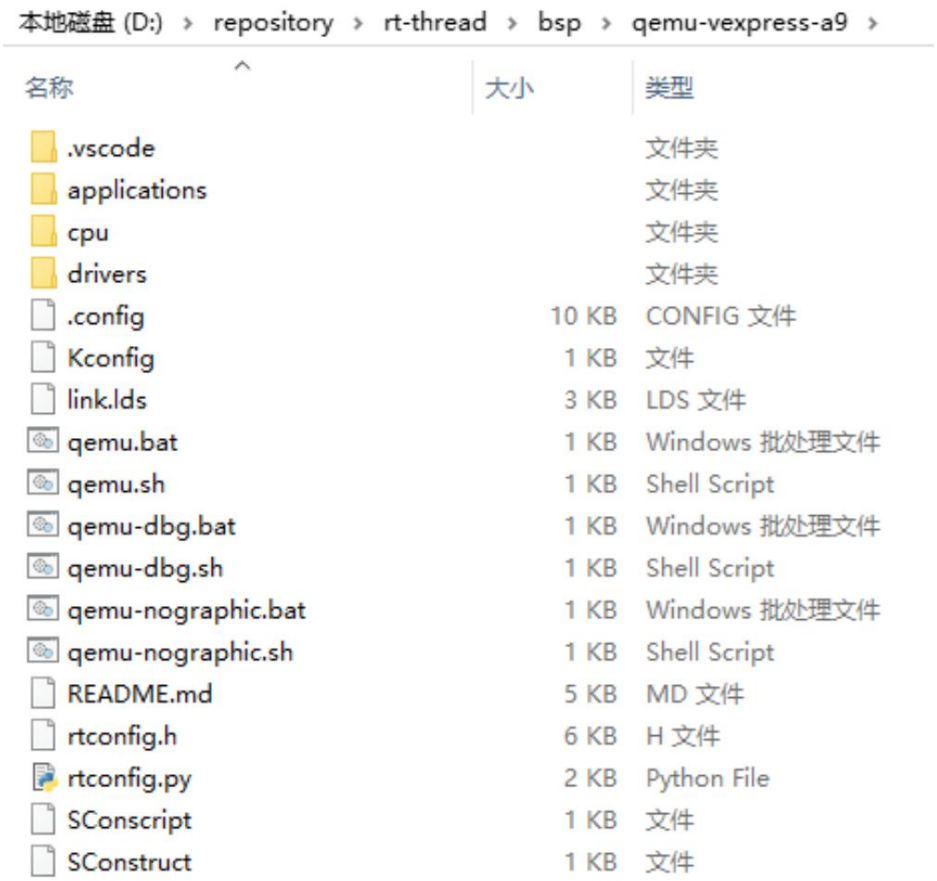

Figure **1:** *qemu-vexpress-a9* folder

The main files and directories of qemu-vexpress-a9 BSP are described as follows:

File Directory	describe
.vscode	vscode configuration file
applications	User application code directory
cpu	Chip related
drivers	The underlying driver provided by RT-Thread
qemu.bat	Running script files on Windows platform
qemu.sh	Running script files on Linux platform
qemu-dbg.bat	Windows platform debugging script file
qemu-dbg.sh	Linux platform debugging script file
README.md	BSP Documentation
rtconfig.h	BSP configuration header file

2.2 Compile and run **RT-Thread**

2.2.1. Step 1: Use **scons** command to compile the project

Open the Env folder and double-click the env.exe file to open the Env console:

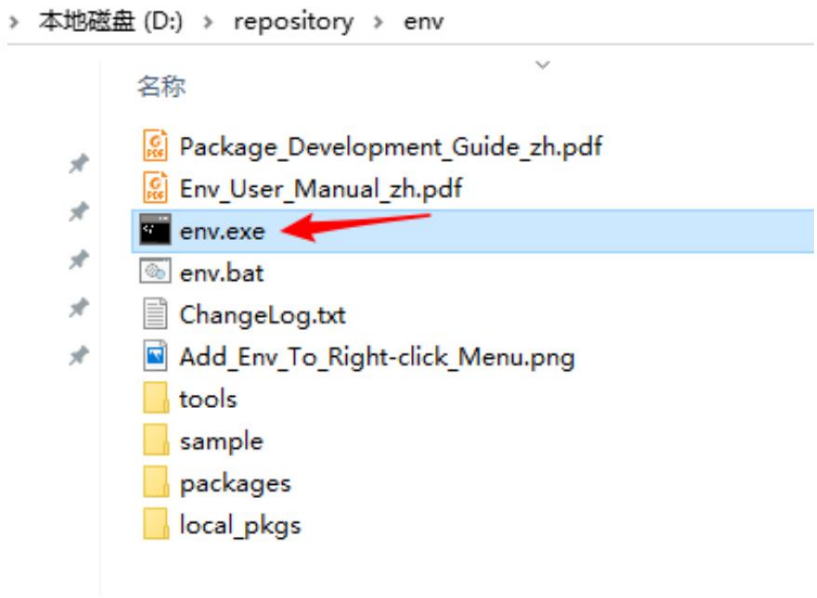

Figure **2:** *Env* folder

Switch directory in Env console and enter command cd D:\repository\rt-thread\bsp\qemu-vexpress -a9 Switch to the qemu-vexpress-a9 BSP root directory under the RT-Thread source folder, and then enter the scons command Run the command to compile the project. If the compilation is correct, the rtthread.elf target running under QEMU will be generated in the BSP directory. document.

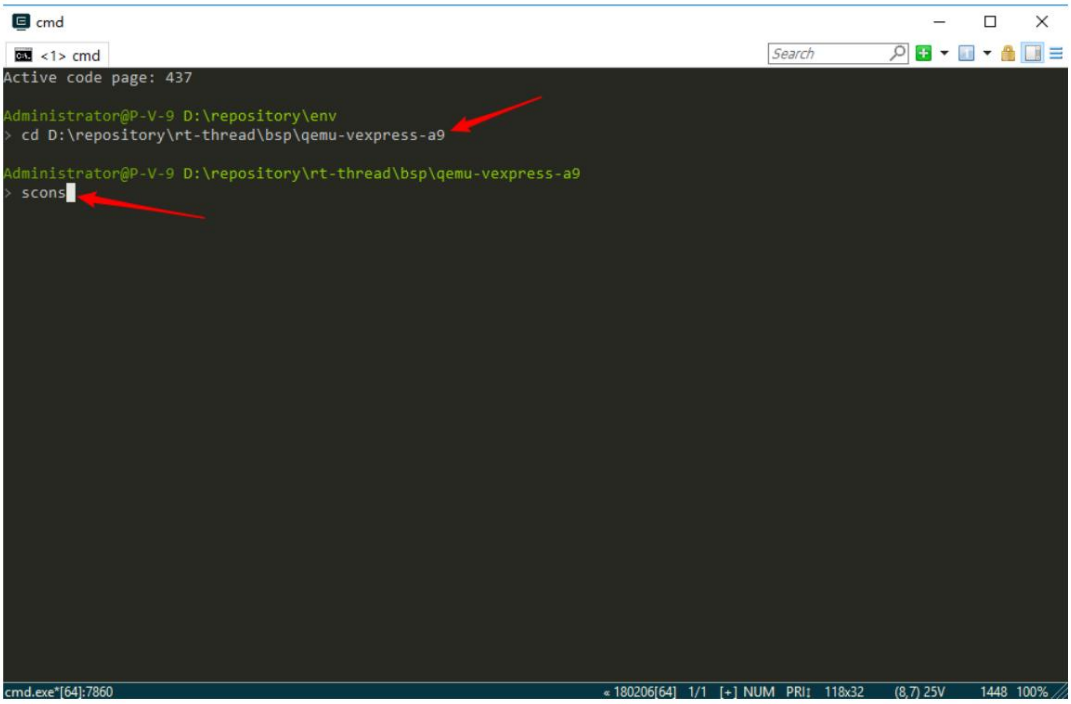

image **3:** Compile project

2.2.2. Step 2: Run the project using **the qemu.bat** command

After the compilation is complete, enter qemu.bat to start the virtual machine and BSP project. qemu.bat is a Window batch file.

This file is located in the BSP folder and mainly includes QEMU execution instructions. The first time you run the project, it will be in the BSP folder.

Create a blank sd.bin file in the folder. This is a virtual SD card with a size of 64M. The Env command line interface displays

The initialization information and version number information printed during the startup of the RT-Thread system are shown, and the qemu virtual machine is also running

As shown in the following picture:

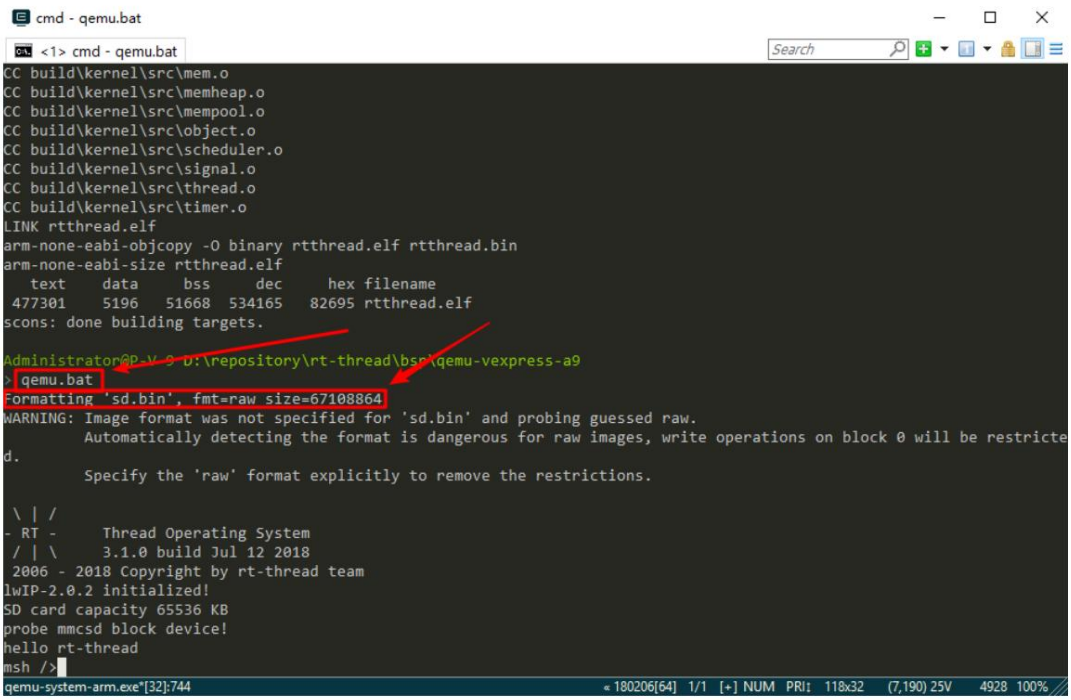

Figure **4:** Run the project

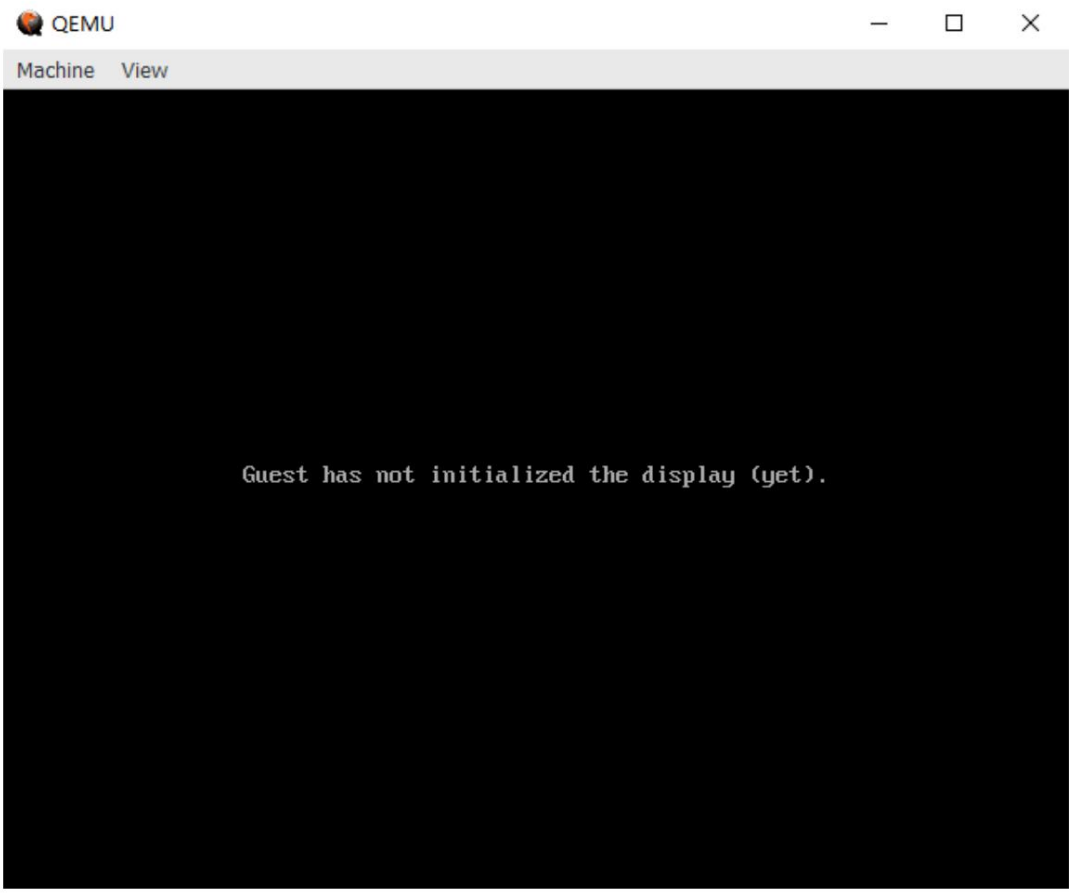

Figure **5:** virtual machine

Note: If 360 Security Guard is installed on your computer, there will be a warning. Please click to allow the program to run.

2.3 Run **RT-Thread Finsh** console

RT-Thread supports Finsh, and users can use commands in command line mode. Enter help or press the tab key

You can view all supported commands. As shown in the figure below, the left side is the command and the right side is the command description.

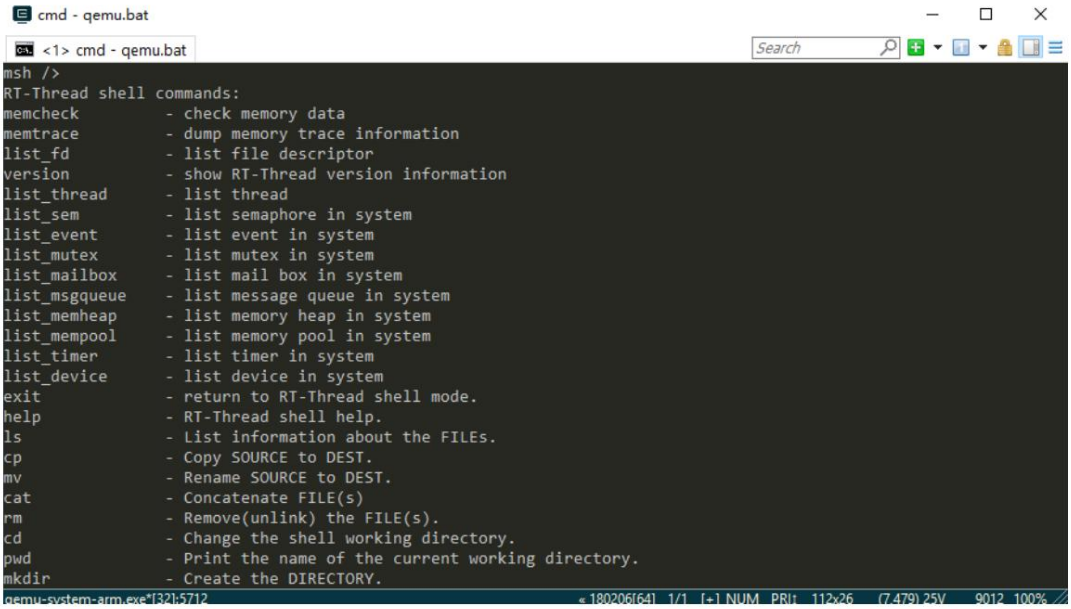

Figure **6:** Check *Finsh* Order

As shown in the figure below, for example, you can enter the list_thread command to view the currently running threads, as well as the thread status and stack

Stack size, etc. Enter list_timer to view the status of the timer.

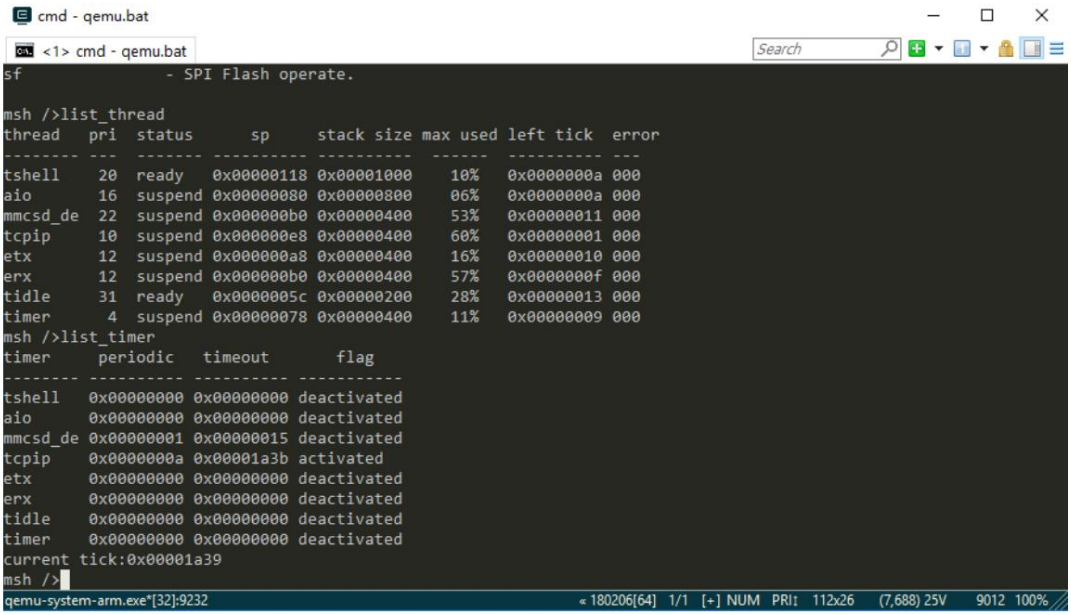

Figure **7:** Check system thread status

2.4 Run **RT-Thread** file system

Enter list_device to view all devices registered to the system. As shown in the following picture, you can see the virtual sd card "sd0" device, then we can use the mkfs sd0 command to format the sd card. Executing this command will format the sd card Formatted into FatFS file system. FatFS is a file system compatible with Microsoft FAT developed specifically for small embedded devices. The system is written in ANSI C, uses an abstract hardware I/O layer, and provides continuous maintenance, so it has good hardware Software independence and portability.

For more information about FatFS , please click on the link: http://elm-chan.org/fsw/ff/00index_e.html

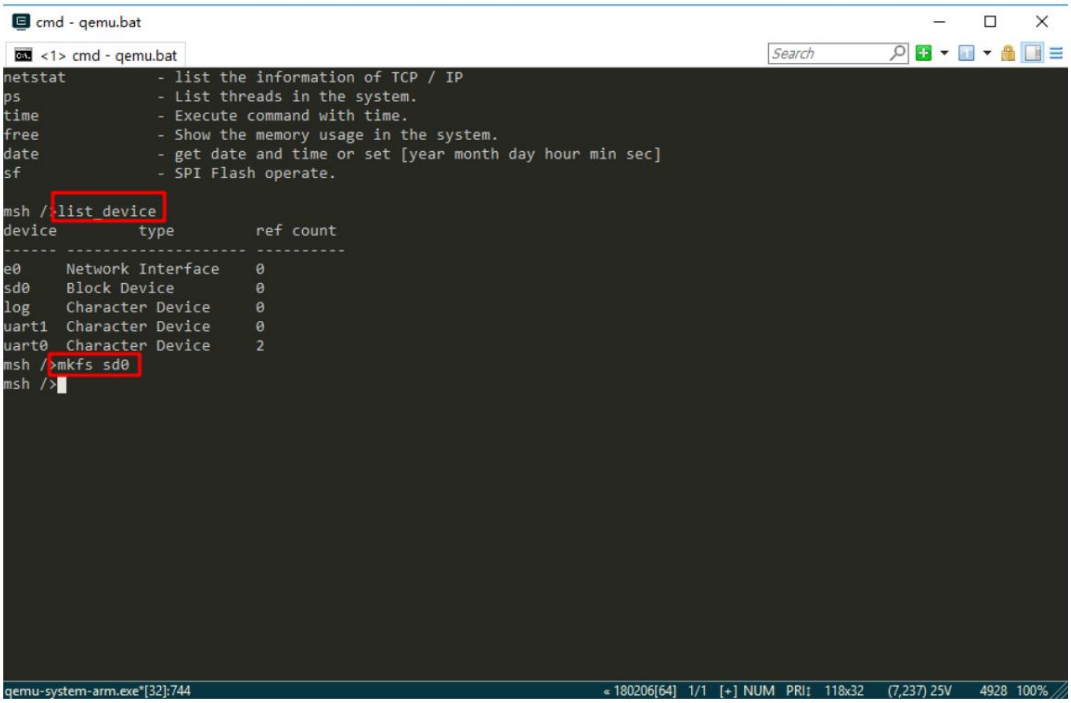

Figure 8: format *sd* Card

After formatting the SD card for the first time, the file system will not be loaded immediately, and it will be loaded correctly only after the second boot.

Exit the virtual machine, then enter qemu.bat in the Env command line interface to restart the virtual machine and project. Enter the ls command to

You can see that the Directory directory has been added and the file system has been mounted. Then you can use other functions provided by RT-Thread.

Command experience file system

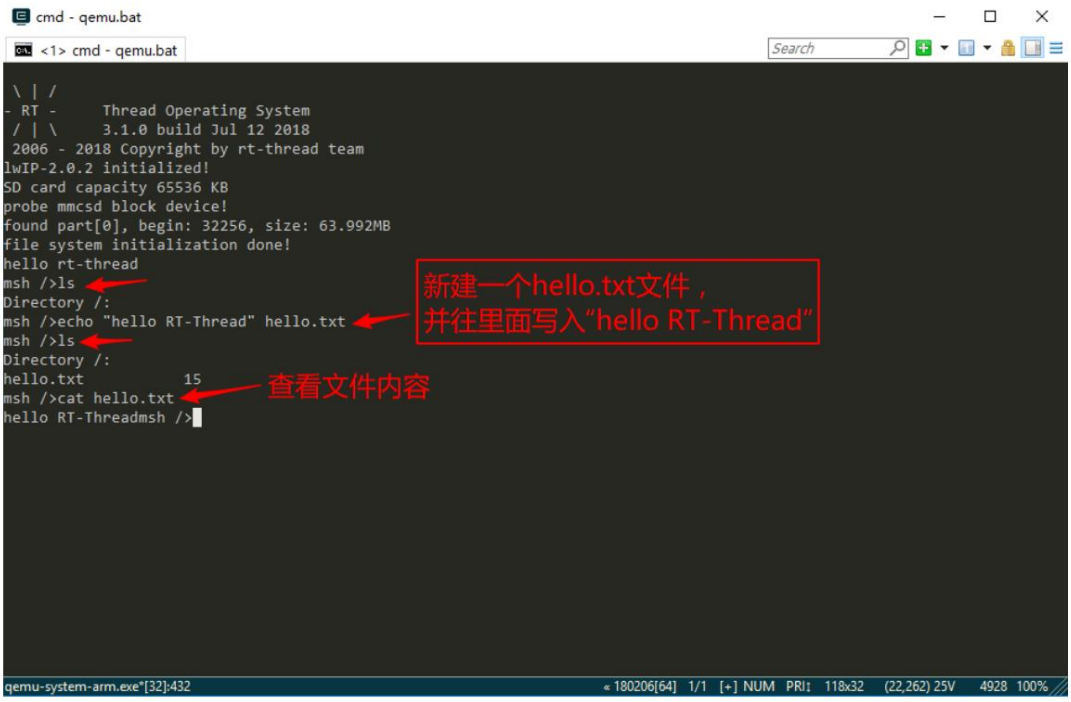

Figure 9: Other file system commands

2.5 Run **RT-Thread** Network

2.5.1. Step 1: Install and configure the **TAP** network card

1. Download the TAP network card tap-windows-9.21.2.exe. After downloading, double-click the installer and follow the default installation procedure.

2. Open the Network and Sharing Center to change the adapter settings and rename the installed virtual network card to tap, as shown in the following figure:

Figure **10:** *tap_rename*

Method **A:** Right-click the network connection that can access the Internet (this article uses Ethernet), open Properties -> Sharing, and select Home

The network connection is tap, click OK to complete the setting, as shown below:

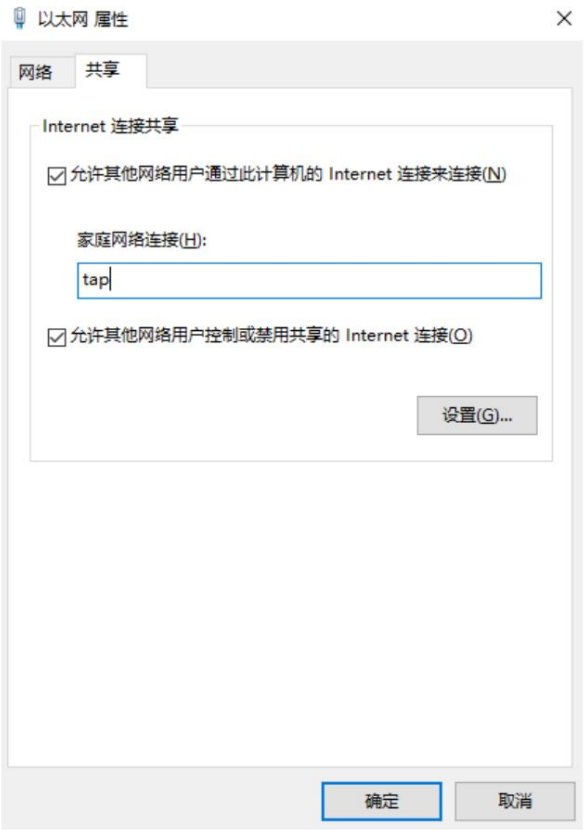

Figure **11:** *tap_share_internet*

Method B: You can also bridge a physical network card that can connect to the network normally with the tap. After the bridge is successfully connected,

A network bridge appears. As shown in the following picture:

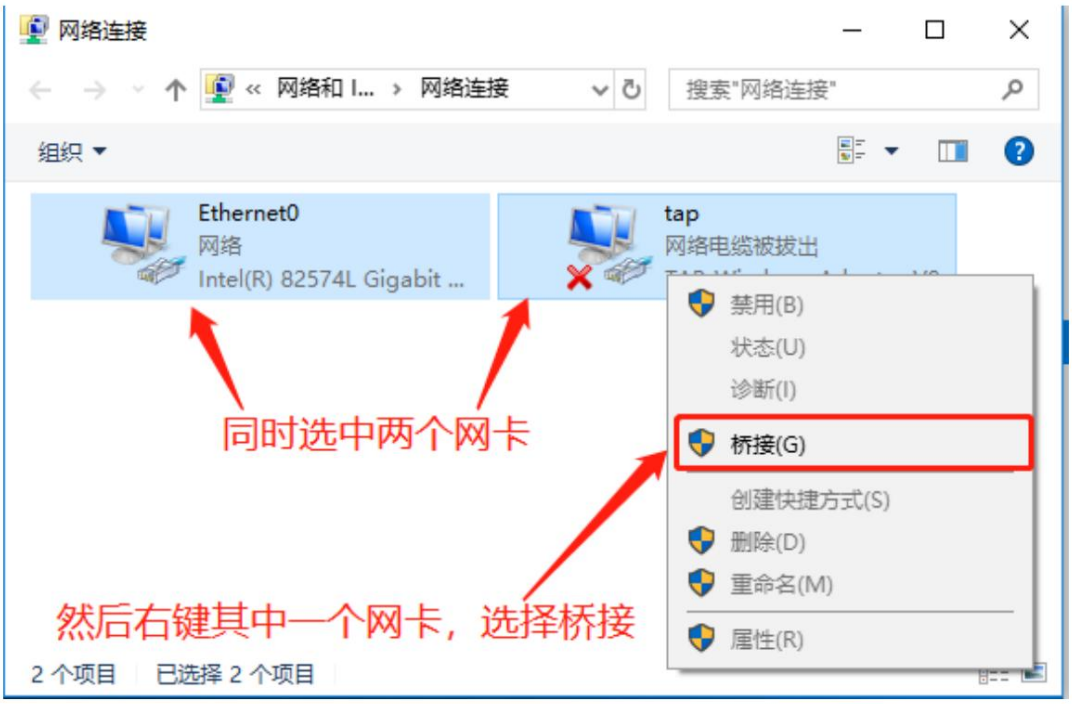

Figure **12:** *tap_* bridging

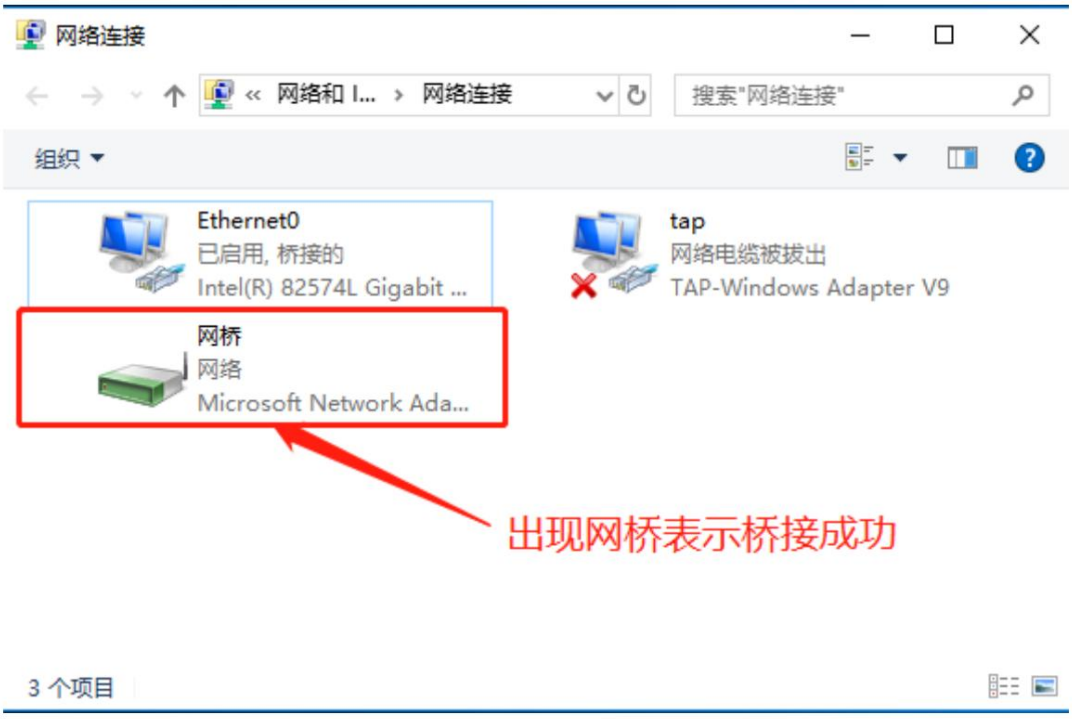

Figure **13:** *tap_* Bridge Success

Note: The tap network card and VMware's virtual network card may conflict. If network sharing cannot be enabled, Or if you cannot ping the network, please delete the VMware virtual network card and try again.

2.5.2. Step 2: Modify the **qemu.bat** script file

Open the qemu.bat file in the qemu-vexpress-a9 BSP directory and add -net nic at the location shown in the figure below -net tap,ifname=tap configuration. Ifname=tap means the name of the network card is tap.

```
qemu.bat
1  @echo off
2  if exist sd.bin goto run
3  qemu-img create -f raw sd.bin 64M
4
5  :run
6  qemu-system-arm -M vexpress-a9 -kernel rtthread.elf -serial stdio -sd sd.bin -net nic -net tap,ifname=tap
7
```

Figure **14:** *qemu_modify*

2.5.3. Step 3 Check **the IP** address

Enter the qemu.bat command to run the project, enter the ifconfig command in the shell to check the network status, and get it normally

If the IP is reached, it means the network driver is normal and the configuration is complete. The effect is as shown in the figure below:

```
cmd - qemu.bat
<1> cmd - qemu.bat                                                    Search
> qemu.bat
Formatting 'sd.bin', fmt=raw size=67108864
WARNING: Image format was not specified for 'sd.bin' and probing guessed raw.
         Automatically detecting the format is dangerous for raw images, write operations on bloc
k 0 will be restricted.
         Specify the 'raw' format explicitly to remove the restrictions.

 \ | /
- RT -     Thread Operating System
 / | \     3.1.0 build Jul  9 2018
 2006 - 2018 Copyright by rt-thread team
lwIP-2.0.2 initialized!
SD card capacity 65536 KB
probe mmcsd block device!
hello rt-thread
msh />ifconfig
network interface: e0 (Default)
MTU: 1500
MAC: 52 54 00 11 22 33
FLAGS: UP LINK_UP ETHARP BROADCAST
ip address: 192.168.137.221
gw address: 192.168.137.1
net mask  : 255.255.255.0
dns server #0: 192.168.137.1
dns server #1: 0.0.0.0
msh />
qemu-system-arm.exe*[32]:14444   « 180206[64]  1/1  [+] NUM  PRI↕  97x26  (7,32766) 25V  13616 100%
```

Figure **15:** *ifconfig*

2.5.4. Notes

- If you cannot obtain an IP address, turn off Ethernet sharing and then turn it on again.

- If the obtained IP is 10.0.x,x, it is because the startup parameter -net nic -net is not added to QEMU tap,ifname=tap .
- When a virtual machine starts running, it will not immediately obtain an IP address. Sometimes it takes a few seconds to obtain an IP address. to IP.
- To shut down the virtual machine, press Ctrl + 'C' to end the program.

2.6 Run **RT-Thread Ping** Tool

2.6.1. Step 1: Download the network tool software package

1. Open the Env tool in the path bsp\qemu-vexpress-a9 and execute menuconfig, as shown in the following figure:

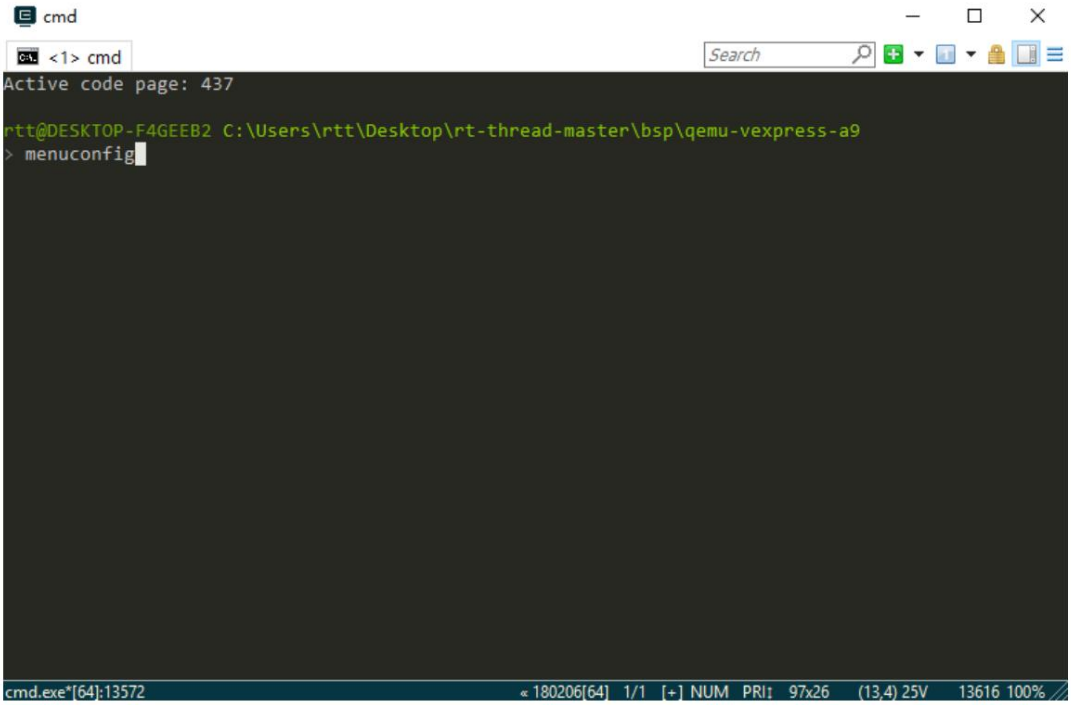

Figure **16:** *Env_menuconfig*

2. Open the netutils: Networking utilities for RT-Thread function in the RT-Thread online packages->IoT - internet of things page, as shown in the following figure:

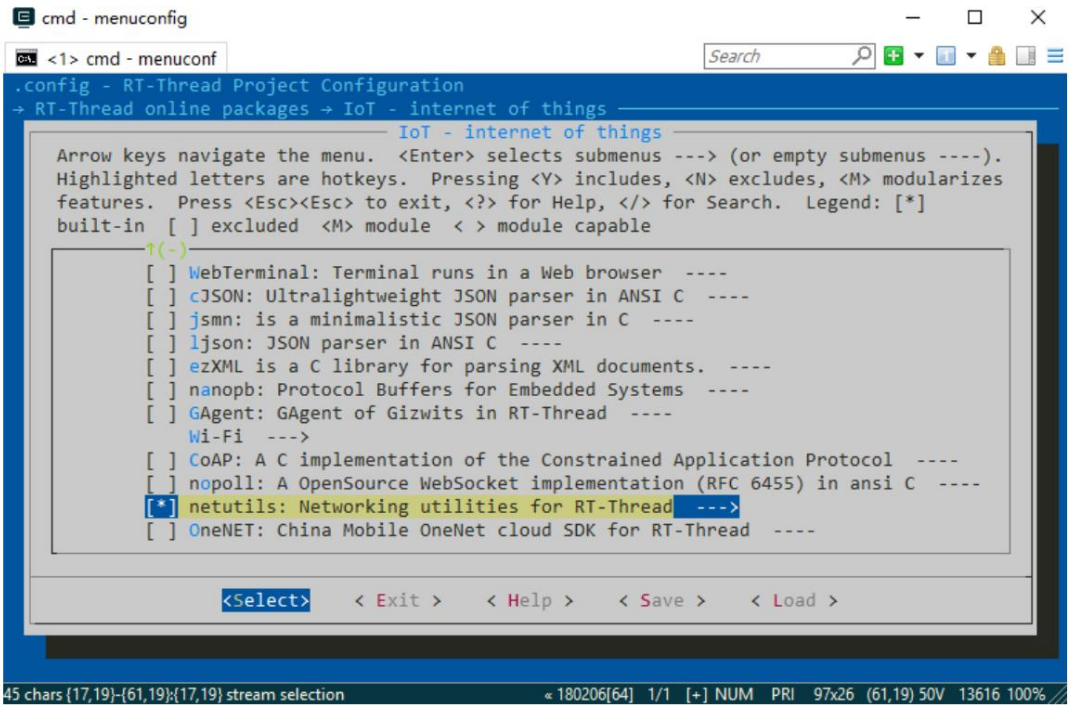

Figure **17:** *online_packages*

3. Go to netutils: Networking utilities for RT-Thread page and turn on Enable Ping utility.

Yes, as shown in the figure below:

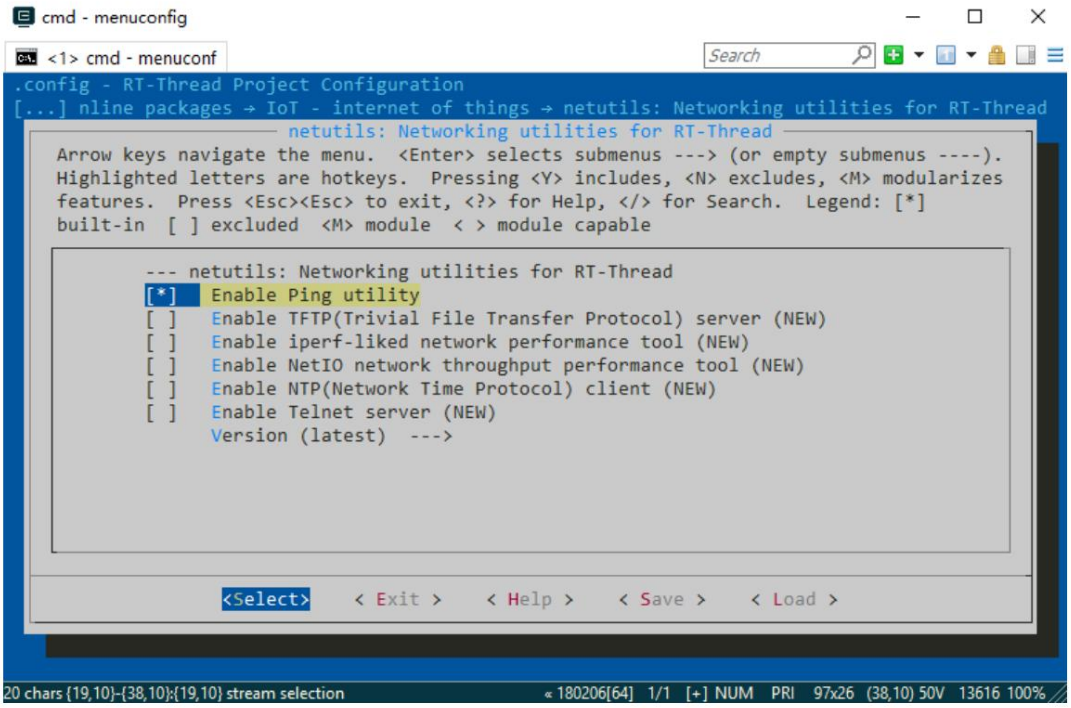

Figure **18:** *enable_ping*

4. Save and exit the configuration interface. If the Env automatic package update function is not enabled, you need to enter

pkgs --update updates the software package configuration. After the update is complete, use the scons command to recompile the project, as shown below:

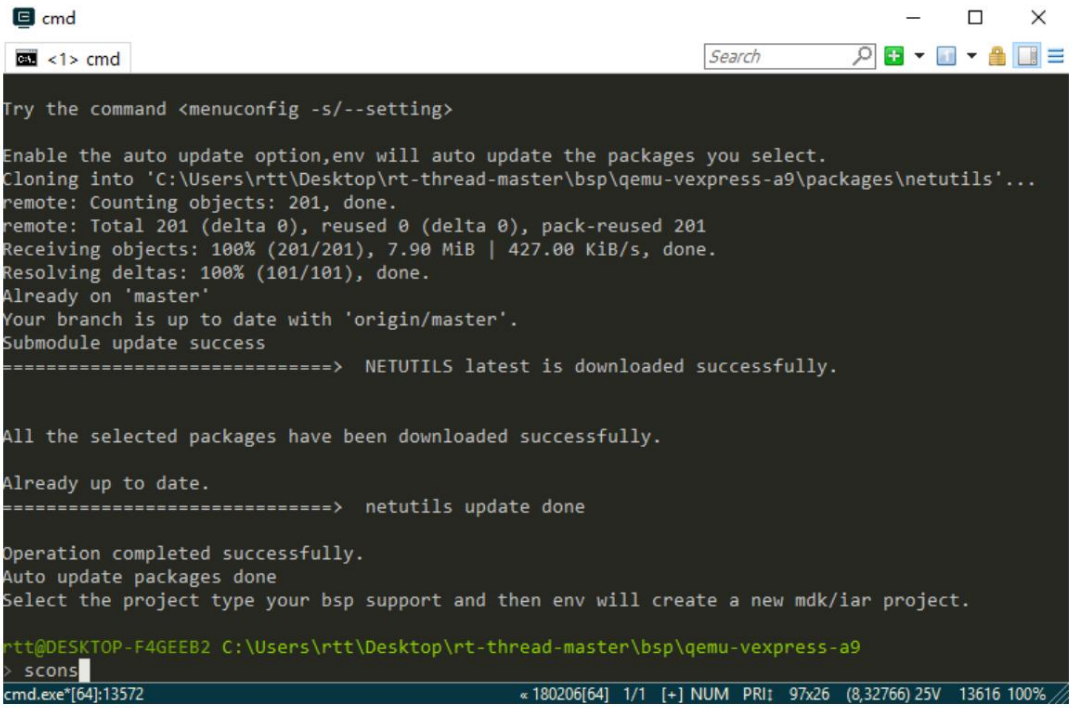

Figure **19:** *scons*

5. After the compilation is complete, run the qemu.bat file, as shown below:

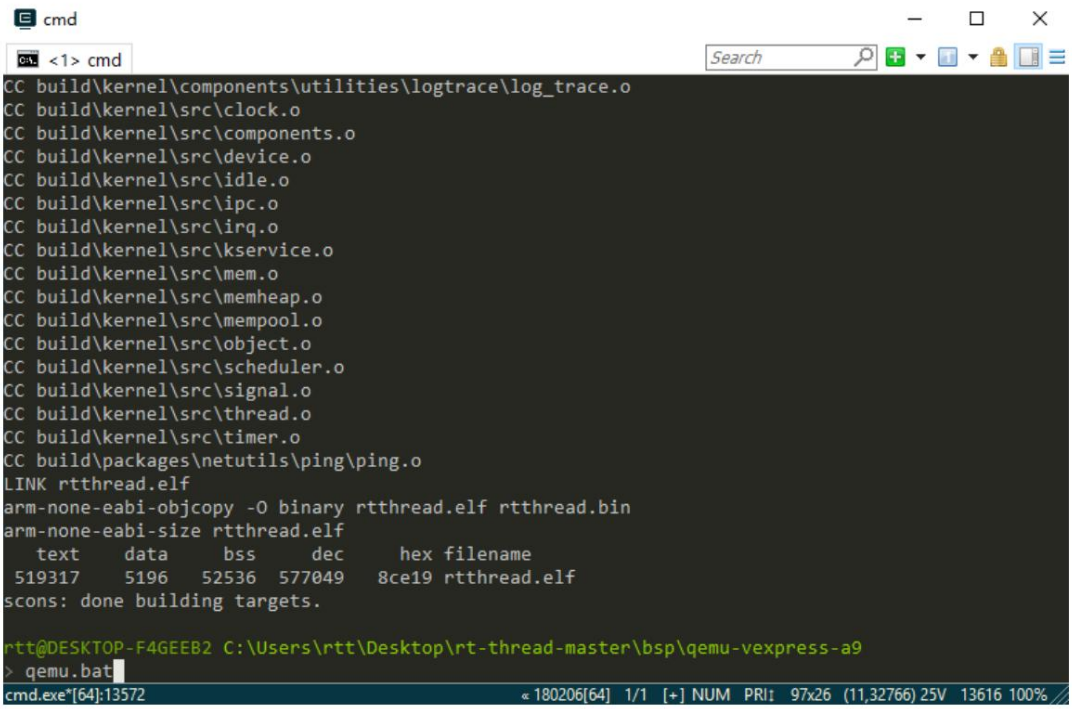

Figure **20:** *qemu_bat*

2.6.2. Step 2: Run **the ping** tool

Enter the ifconfig command in the shell to check the network status. If the IP is obtained normally, it means that the network driver is normal:

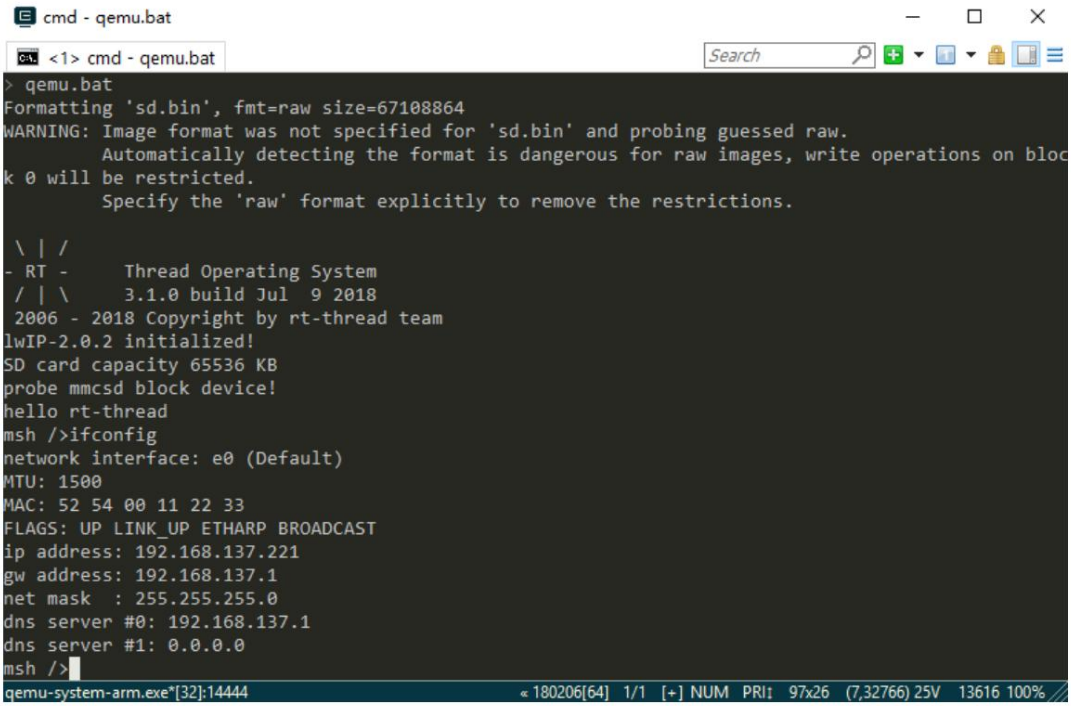

Figure **21:** *ifconfig*

Enter ping www.rt-thread.com in the shell and you can see the ping result, indicating that the network configuration is

Success, ping is successful, as shown in the following figure:

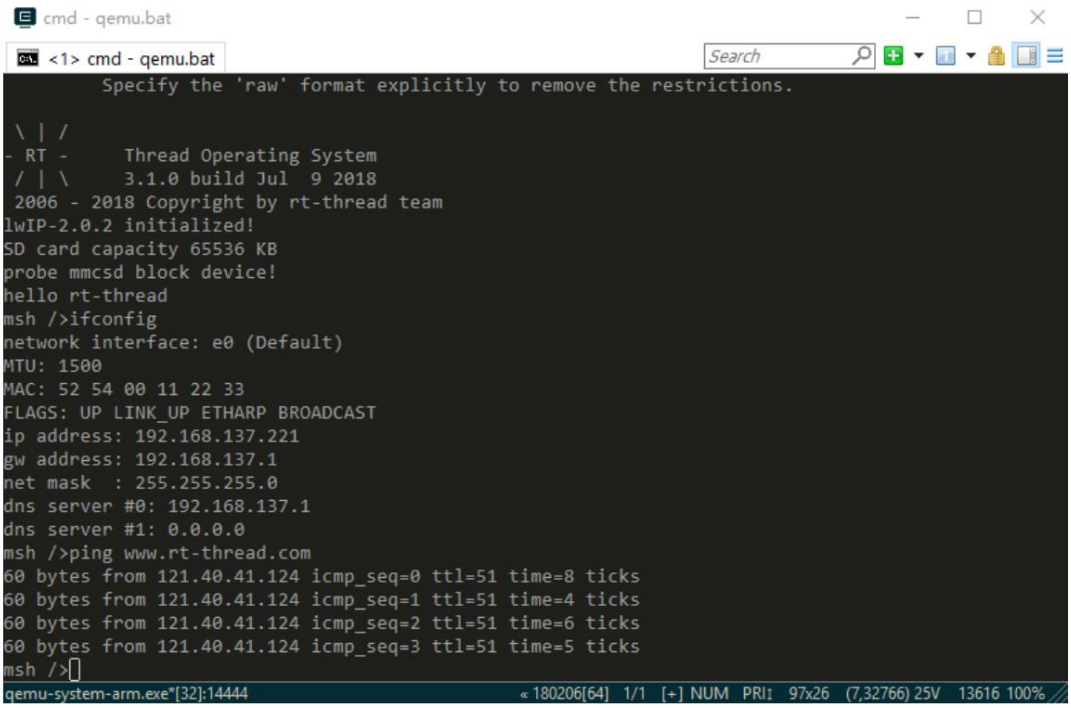

Figure **22:** *ping*

2.7 Run **RT-Thread GUI** Engine

2.7.1. Step 1: Download **the GUI** engine software package

Shut down the QEMU virtual machine, return to the ENV console, and enter the menuconfig command to enter the configuration interface:

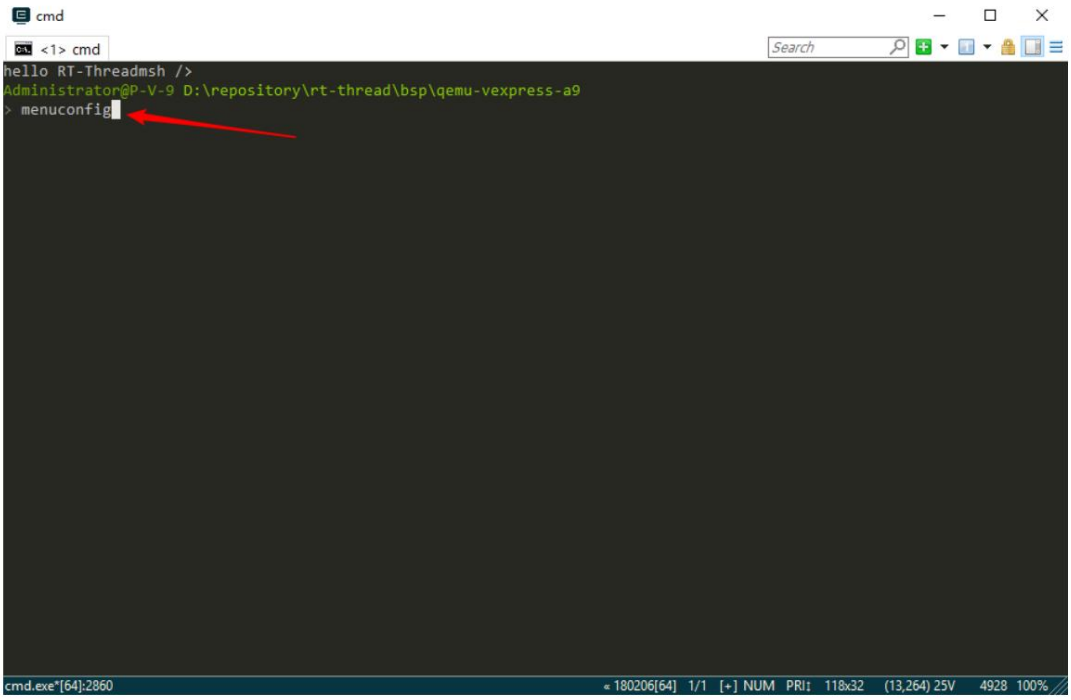

Figure **23:** *menuconfig*

Enter "RT-Thread oneline packages" ÿ "system packages" ÿ "RT-Thread GUI Engine" Submenu, select "Enable GUI Engine" and "Enable the example of GUI Engine":

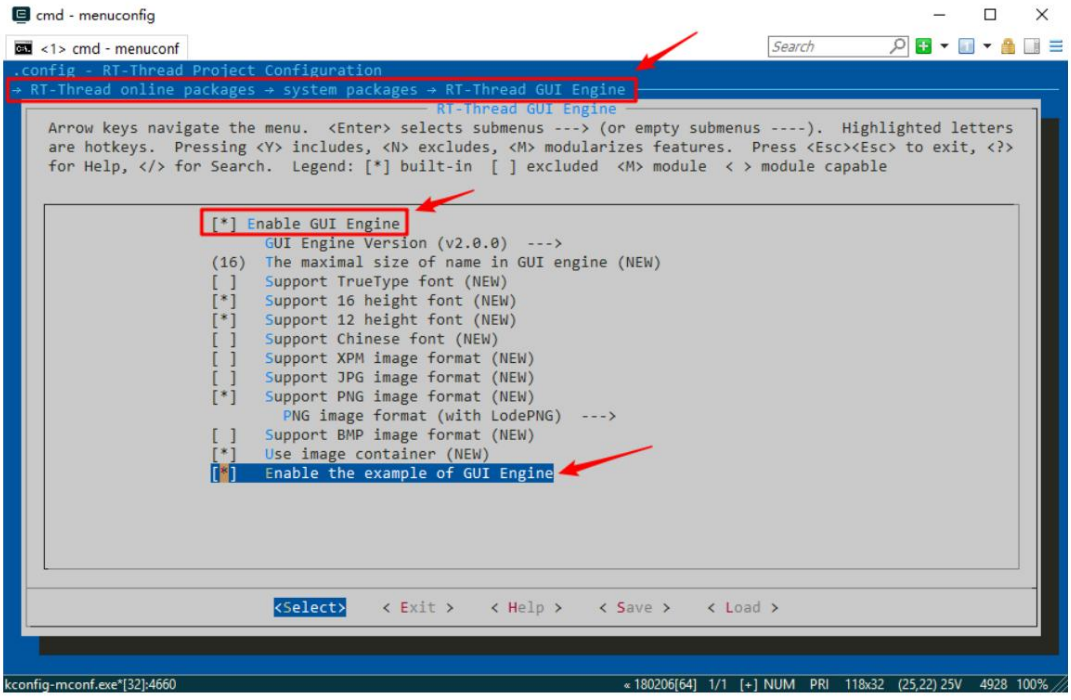

Figure **24:** choose *GUI* Example

Press the 'ÿ' key to select "save" to save the configuration, and press the "Exit" key to exit the configuration interface and return to the command line interface. Enter

pkgs --update downloads the GUI software package and sample code:

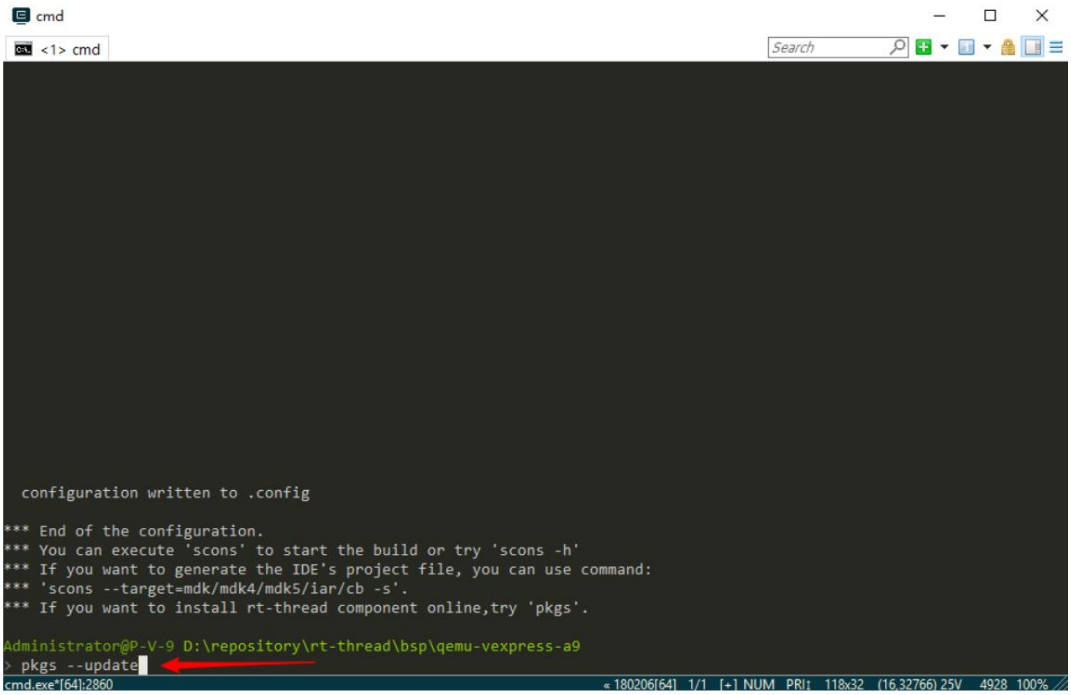

Figure **25:** download *GUI* Software Packages

2.7.2. Step 2: Run **the GUI** engine

After the software package is downloaded, enter scons to recompile the project:

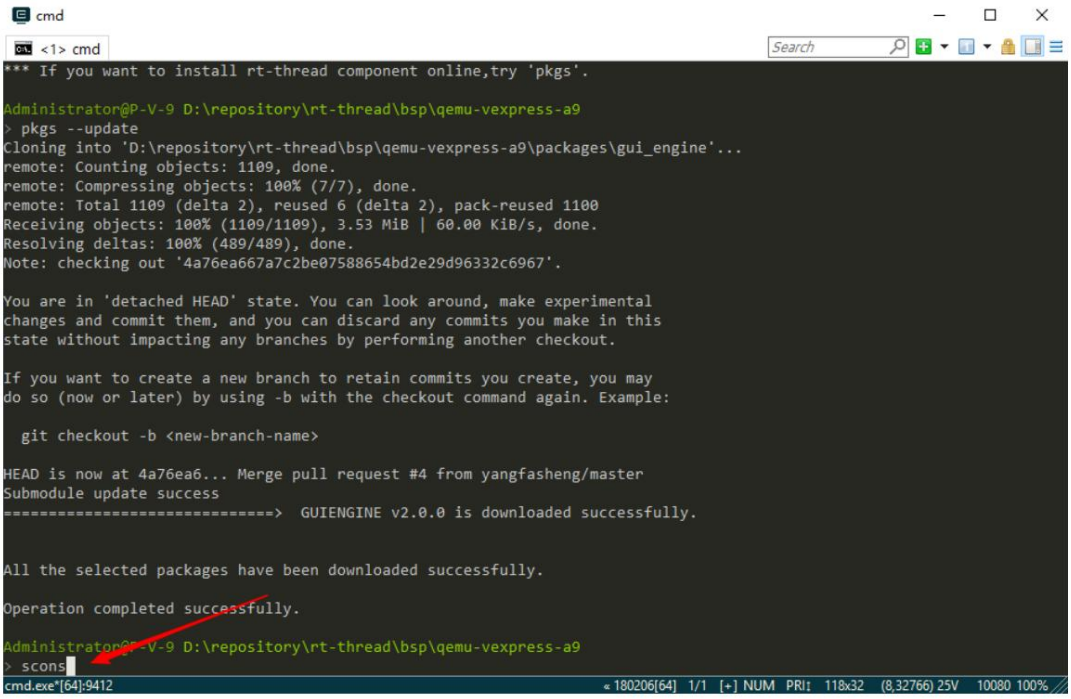

Figure **26:** *scons* Command to compile the project

After the compilation is complete, enter the qemu.bat command to start the QEMU virtual machine and project. You can see the QEMU virtual display

The screen displays the pictures, text, and graphic information displayed by the sample code:

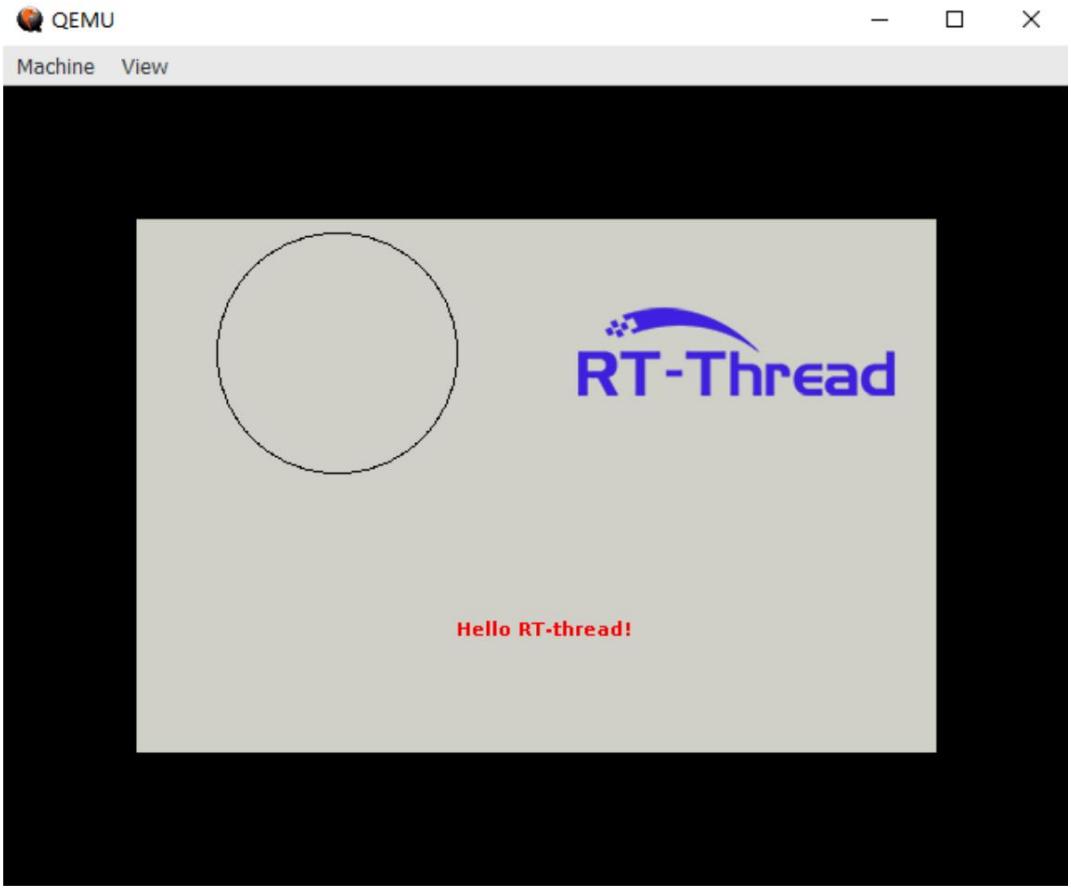

Figure 27: Virtual screen *GUI* Example display

3. Run **RT-Thread** using **QEMU** on **Ubuntu**

3.1 Preparation

- Download RT-Thread source code, use command: git clone https://github.com/RT-Thread/rt-thread.git
- Install QEMU, use the command: sudo apt-get install qemu
- Install Scons using the command: sudo apt-get install scons
- Install the compiler. If the compiler version installed using the apt-get command is too old, compilation errors will occur. You can use the following steps in sequence:

  Run the command to download and install the new version. The download link and decompression folder name vary depending on the downloaded version:

1. wget https://armkeil.blob.core.windows.net/developer/Files/downloads/gnu-rm/6-2016q4/gcc-arm-none-eabi-6_2-2016q4-20161216-linux.tar.bz2

2. cd /opt

3. sudo tar xf ~/Downloads/ gcc-arm-none-eabi-6_2-2016q4-20161216-linux.tar.
   bz2

• Install the ncurses library using the command: sudo apt-get install libncurses5-dev

After the compiler is installed, you need to modify the rtconfig.py file under the qemu-vexpress-a9 BSP and change the corresponding path to the bin directory of the compiler unzipped to the opt directory. Refer to the figure below. The directory name varies depending on the downloaded compiler version:

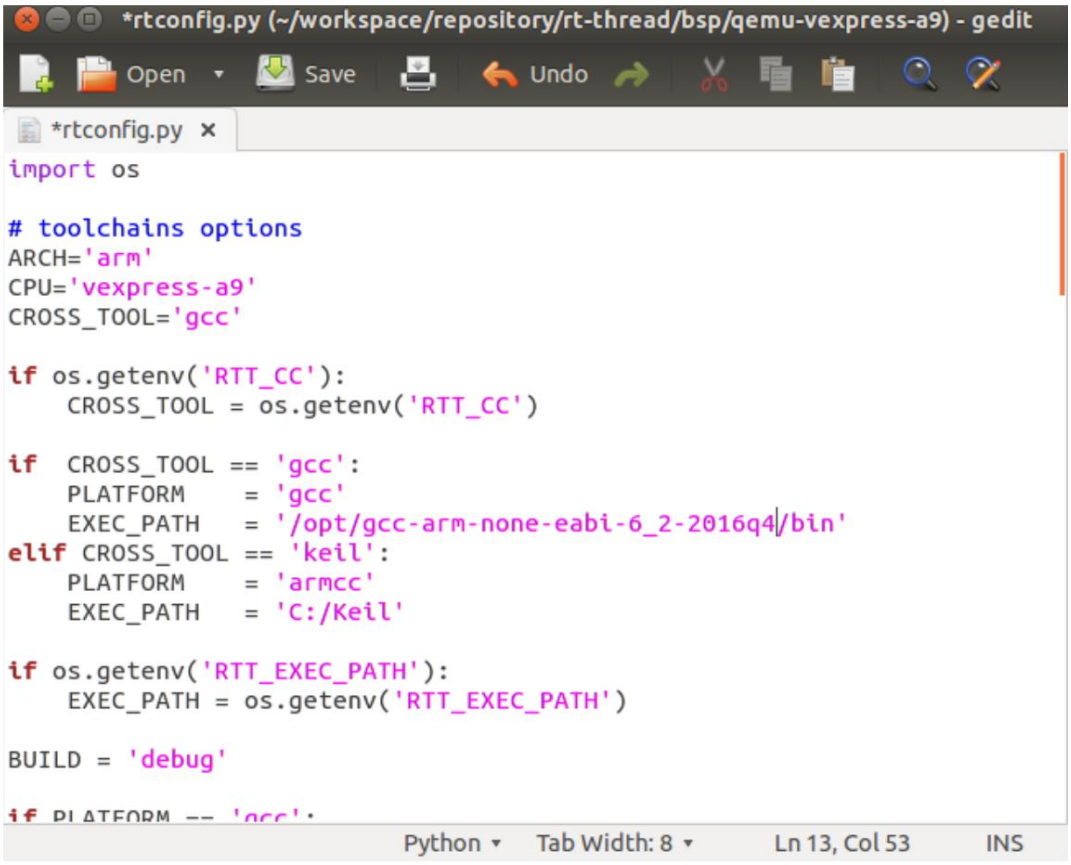

Figure **28:** Compiler path modification

3.2 Use **menuconfig** to configure the project

1. Enter scons --menuconfig in the root directory of qemu-vexpress-a9 BSP to open the configuration interface and configure the operation

The operation is the same as on Windows platform:

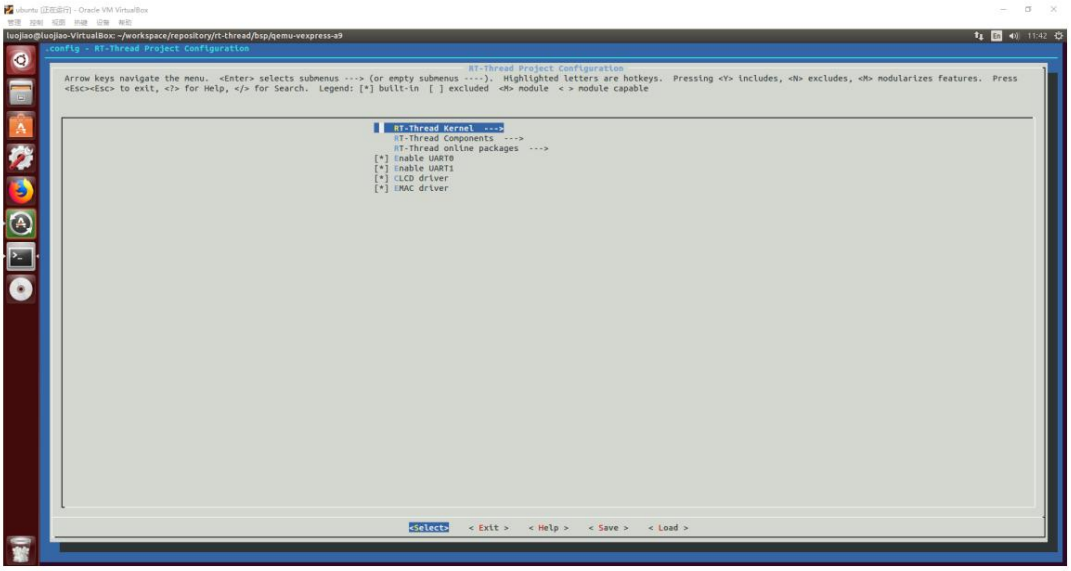

Figure **29:** *menuconfig* Configuration interface

2. Use the scons --menuconfig command to install and initialize the Env tool and create it in the home directory.

Generate a ".env" folder, which is a hidden folder. Switch to the home directory and use the la command to view all

Directories and files. The env.sh file is the file that needs to be executed. It will configure the environment variables so that we can use pkgs

To update the software package, enter the source ~/.env/env.sh command to execute. If you have selected an online software package,

You can use the pkgs --update command to download the software package to the packages folder under the BSP directory:

Figure **30: .env** folder

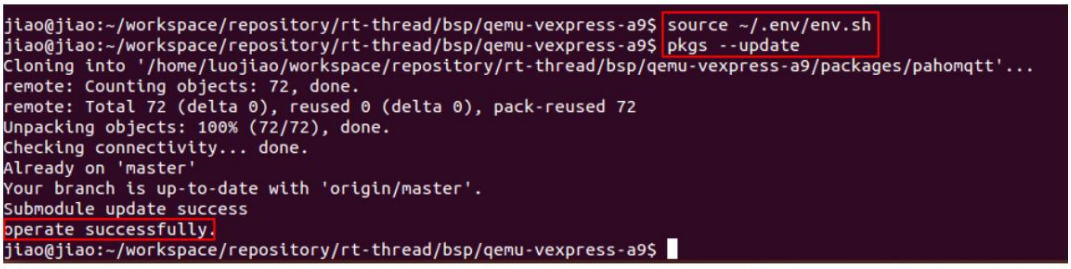

Figure **31:** *pkgs –update* Command to download the software package

3.3 Compile and run **RT-Thread**

1. Enter the scons command in the qemu-vexpress-a9 BSP directory to compile the project:

```
jiao@jiao:~/workspace/repository/rt-thread/bsp/qemu-vexpress-a9$ scons
scons: Reading SConscript files ...
scons: done reading SConscript files.
scons: Building targets ...
scons: building associated VariantDir targets: build
CC build/applications/lcd_init.o
CC build/applications/mnt.o
CC build/cpu/cpu.o
CC build/cpu/gic.o
CC build/cpu/interrupt.o
CC build/cpu/mmu.o
CC build/cpu/pmu.o
CC build/cpu/stack.o
CC build/cpu/trap.o
CC build/drivers/board.o
CC build/drivers/drv_clcd.o
CC build/drivers/drv_keyboard.o
CC build/drivers/drv_mouse.o
CC build/drivers/drv_sdio.o
CC build/drivers/drv_smc911x.o
```

Figure **32:** *scons* Command to compile the project

2. Enter the ls command to view the file details under the BSP. The files displayed in green are files with execution permissions.

We need to add execution permissions to the qemu.sh file, enter the chmod +x qemu.sh command:

```
jiao@jiao:~/workspace/repository/rt-thread/bsp/qemu-vexpress-a9$ ls
applications  drivers   packages      qemu-nographic.sh  README.md    rtconfig.py~  rtthread.elf
build         Kconfig   qemu.bat      qemu.sh            rtconfig.h   rtconfig.pyc  rtthread.map
cpu           link.lds  qemu-dbg.bat  qemu.sh~           rtconfig.py  rtthread.bin  SConscript
jiao@jiao:~/workspace/repository/rt-thread/bsp/qemu-vexpress-a9$ chmod +x qemu.sh
jiao@jiao:~/workspace/repository/rt-thread/bsp/qemu-vexpress-a9$ ls
applications  drivers   packages      qemu-nographic.sh  README.md    rtconfig.py~  rtthread.elf
build         Kconfig   qemu.bat      qemu.sh            rtconfig.h   rtconfig.pyc  rtthread.map
cpu           link.lds  qemu-dbg.bat  qemu.sh~           rtconfig.py  rtthread.bin  SConscript
jiao@jiao:~/workspace/repository/rt-thread/bsp/qemu-vexpress-a9$
```

Figure **33:** *qemu.sh* Add execution permissions to the file

3. Enter the ./qemu.sh command to execute the script file. The virtual machine will start running, as shown in the figure below.

The lines show the relevant information printed during the startup process of the RT-Thread operating system, and the white window is a virtual LCD screen.

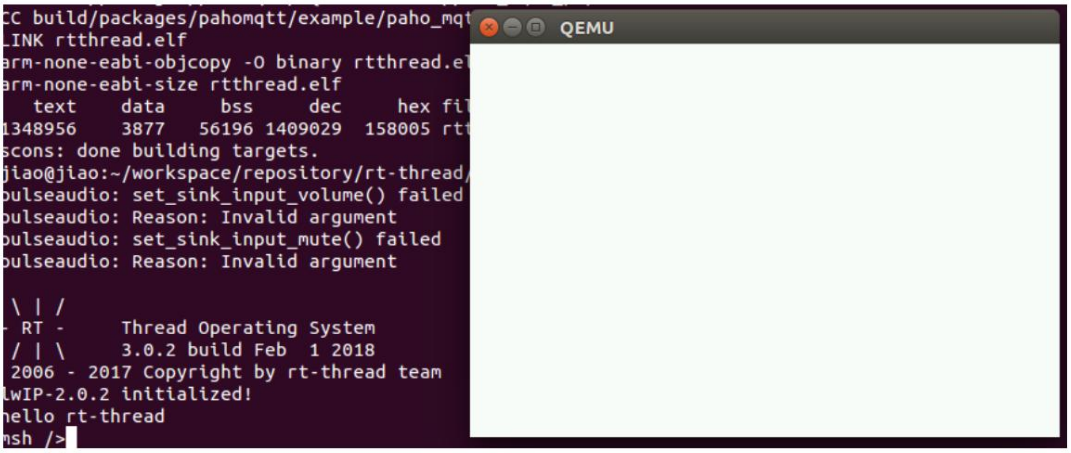

Figure **34:** Virtual machine operation interface

4 References

- Env tool user manual
- File System Application Notes

5 Frequently Asked Questions

- For Env tool related issues, please refer to the Common Documentation Links section of the Env tool user manual.
- When compiling a project, it prompts fatal error: rtgui/driver.h: No such file or directory
- Solution: After using menuconfig to enable “Enable GUI Engine”, you need to use the command pkgs --update Download the GUI package.