DevKit8000 User Manual

Version 3.0

Release: 2009-09-08

TimLL®

Revision history

Rev	Date	Description
1.0	2009-01-16	Initial version
2.0	2009-04-28	Second Edition
3.0	2009-09-08	Third Edition

For additional information, please visit: **http://www.timll.com**

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Chapter one: Overview

I System Overview

1.1 Introduction

DevKit8000 is an evaluation kit issued by Timll Technic Inc. (Timll) based on processor OMAP35x of Texas Instrument (TI). Processor OMAP35x is integrated with 600MHz ARM Cortex™-A8 core and 412MHz DSP core which can process and calculate the digital signals. Multiple interfaces are provided too. DevKit8000 provides network port, S-VIDEO interface, Audio input and output interface, USB OTG, USB HOST, SD/MMC interface, series port, SPI interface, IIC interface, JTAG interface, CAMERA interface, TFT interface, interface for touch screen and keyboard, bus interface as well as HDMI interface.
DevKit8000 has provided a completed software development platform for developers to evaluate processor OMAP35x. It supports linux-2.6.28 operating system and contains completed basic drivers in order to provide users a quick way to assess the processor OMAP35x, design drivers for Linux system and customize application software. Moreover, the release version of the mature operating system google android and angstrom (GPE), and the DVI output reaches the display standard of 720P, letting users experience the powerful data processing and calculation of processor OMAP35x.

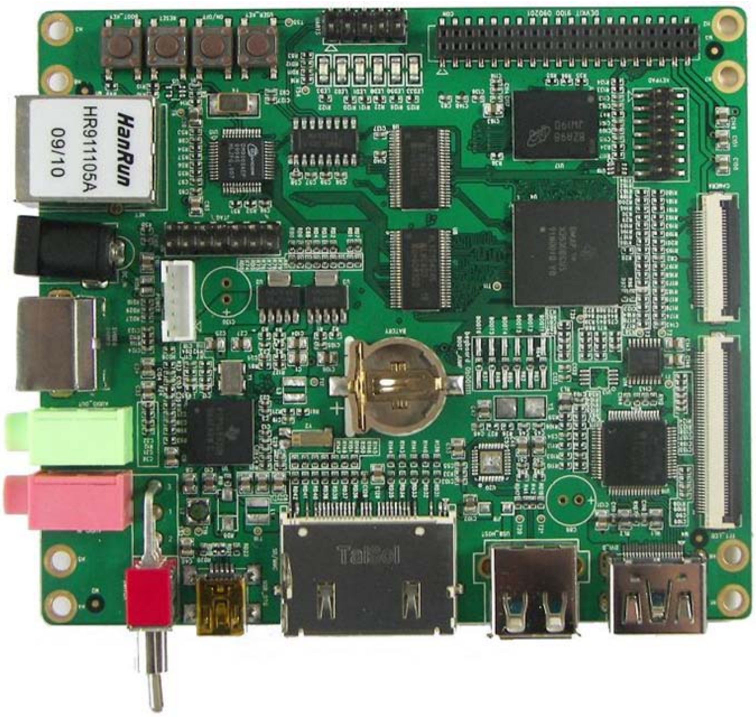


Fig 1.1 Product photo

1.2 Define

HDMI : High Definition Multimedia Interface
DVI : Digital Visual Interface

1.3 Accessories

DevKit8000 Evaluation Kit contains:

- One DevKit8000 Evaluation board
- One 4.3" LCD(contain touch panel)
- One SD card
- One serial cable(IDC10-to-DB9)
- One 5V@2A Power adapter
- One Touch Pen
- One USB cable(Type A Male to Type Mini-B Male)
- One USB cable(Type A Female to Type Mini-A Male)
- One USB HUB
- One cross Ethernet cable
- One HDMI to DVI-D cable
- One S-Video cable

Chapter Two: Hardware system

II Hardware Overview

2.1 Architecture diagram

Figure 2.1 is the architecture map for DevKit8000 and Peripheral equipment of this board is also shown.

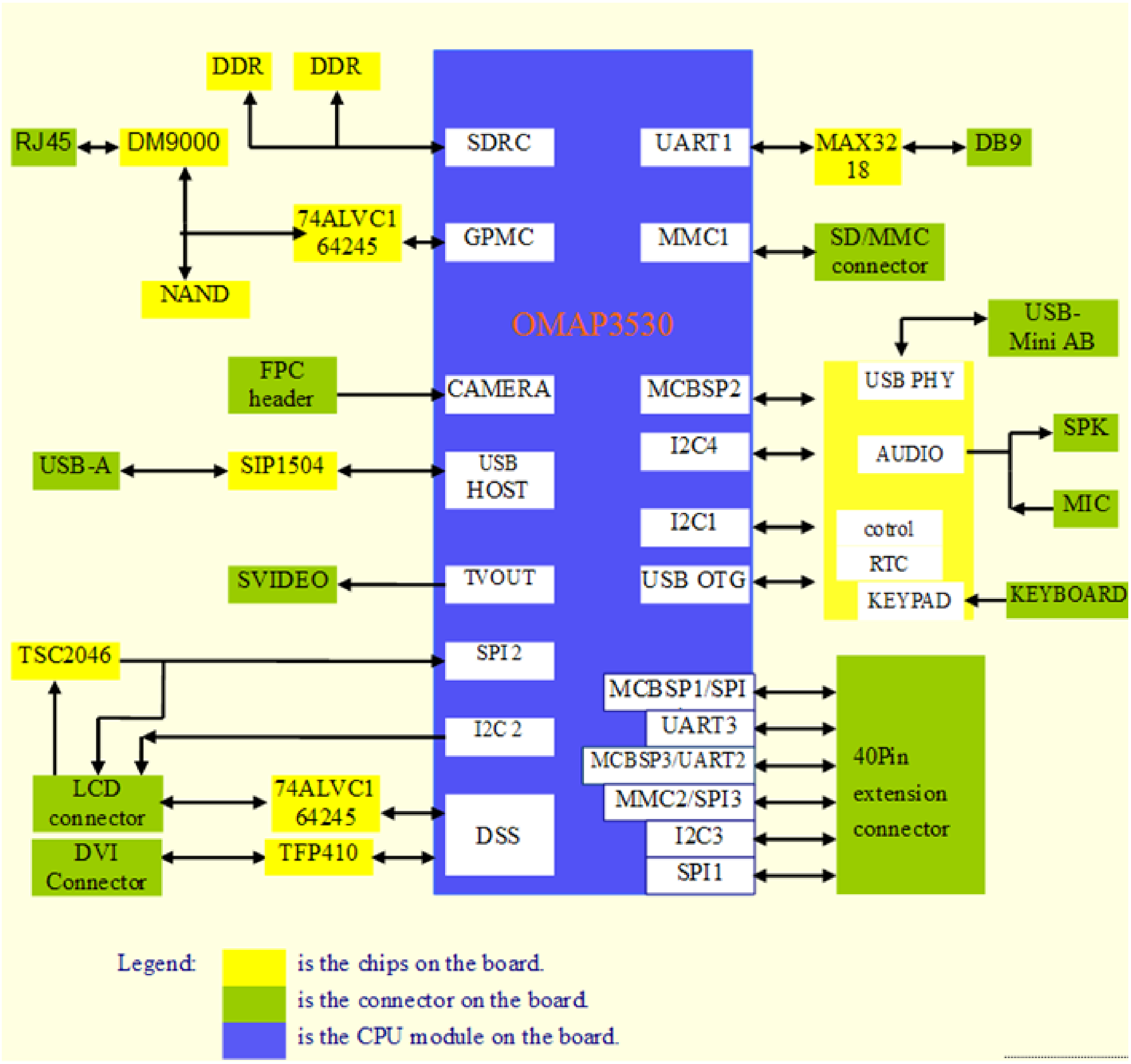


Figure 2.1 Architecture diagram

2.2 Features

The DevKit8000 Evaluation board is based on OMAP3530 processor and takes full features of the processor. This board is characterized as follows:

Processor

- OMAP3530 processor (pin-to-pin compatible with OMAP35x families)
- 600-MHz ARM Cortex™-A8 Core
- 412-MHz TMS320C64x+™ DSP Core
- Integrated L1 memory for ARM CPU (16kB I-Cache, 16kB D-Cache, 256kB L2) and On-Chip memory (64kB SRAM, 112kB ROM)

Memory

- 128MByte DDR SDRAM, 166MHz
- 128MByte NAND Flash, 16bit
- Audio/Video Interfaces
- A 4 line S-VIDEO interface
- An HDMI interface (High Definition Multimedia Interface)
- A audio input interface
- A two-channel audio output interface

LCD/Touch screen

- Resolution: 480 (W) x 272 (H) dots
- RGB, 391680 colors
- Brightness: Typical 350 cd/m2 (min 300 cd/m2)
- 4 line Touch Screen

Data Transfer Interface

- Serial port:
  1 x 3 line serial port, RS232 voltage
  1 x 5 line serial port, TTL voltage
- USB port:
  1 x USB2.0 OTG, High-speed, 480Mbps
- SD/MMC port:
  1 channel SD/MMC port, support 3.3V and 1.8V logic voltage
  1 channel SD/MMC port, support 1.8V logic voltage
- Ethernet: 10/100Mbps, RJ45 connector
- 1 channel McSPI Interface (Multichannel Serial Port Interface)
- 1 channel McBSP interface (Multi-Channel Buffered Serial Port)
- 1 channel I2C interface
- 1 channel HDQ interface (HDQ/1-Wire)

Input Interface

- 1 Camera interface (support CCD or CMOS camera)
- 6*6 keyboard interface
- One 14-pin JTAG interface
- One BOOT button
- One RESET button
- One USER button

- One ON/OFF button

Mechanical Parameters

- Dimensions: 110 mm x 95 mm
- Input Voltage: +5V
- Power Consumption: 0.5A @ 5V
- Temperature Range: 0 `℃ ~ 70 `C
- Humidity Range: 20% ~ 90%

2.3 Hardware interface diagram

Figure 2.2 show the hardware interface of DevKit8000.

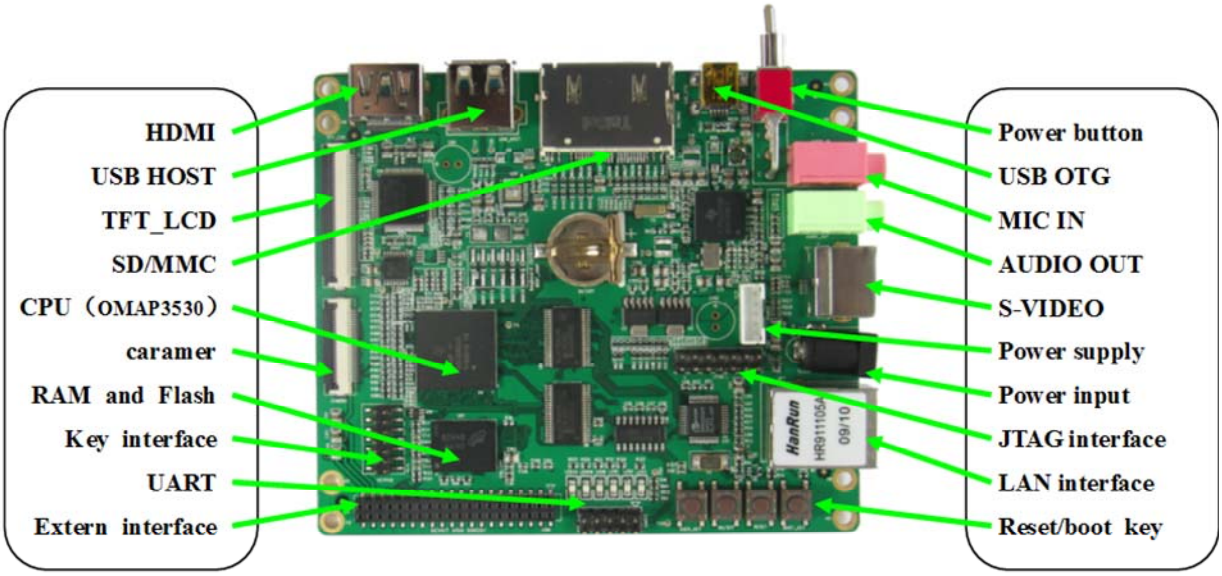


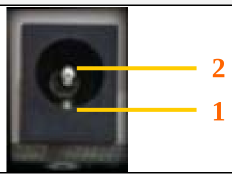
Figure 2.2 interface diagram

III Hardware specification

3.1 Power input interface

Function: to provide 5V voltage for DevKit8000.
Description of interface: please see table 3-1.

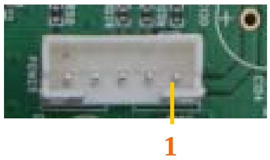
Table 3-1 power input interface

Pin	Signal	Function	Pin out
1	GND	Power input (+5V)	
2	+5V	Power supply (+5V) 2A (Type)	

3.2 Power output interface

Function: to provide power output for peripheral equipment.
Description of interface: please see table 3-2

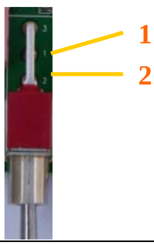
Table 3-2 power output interface

Pin	Signal	Function	Pin out
1	VDD50	5V output	
2	VDD42	4.2V output	
3	VDD33	3.3V output	
4	ADCIN	ADC input	
5	GND	GND	

3.3 Power switch

Function: +5V power switch
Description of interface: please see table 3-3.

Table 3-3 power switch

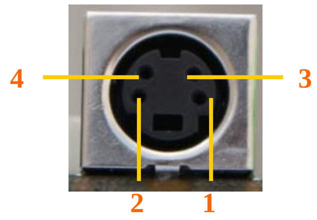
Pin	Signal	Function	Pin out
1	DC IN	VDD Input	
2	VDD50	+5V	
3	NC	NC	

3.4 S-VIDEO interface

Function: A standard 4-line S-VIDEO interface.

Description of interface: please see table 3-4.

Table 3-4 S-VIDEO interface

Pin	Signal	Function	Pin out
1	GND	GND	
2	GND	GND	
3	OUTPUT1	VIDEO Y	
4	OUTPUT2	VIDEO C	

3.5 HDMI Interface

Function: a standard HDMI interface.

Description of interface: please see table 3-5

Table 3-5 HDMI interface

Pin	Signal	Function	Pin out
1	DAT2+	TMDS data 2+	
2	DAT2_S	TMDS data 2 shield	
3	DAT2-	TMDS data 2-	
4	DAT1+	TMDS data 1+	
5	DAT1_S	TMDS data 1 shield	
6	DAT1-	TMDS data 1-	
7	DAT0+	TMDS data 0+	
8	DAT0_S	TMDS data 0 shield	
9	DAT0-	TMDS data 0-	
10	CLK+	TMDS data clock+	
11	CLK_S	TMDS data clock shield	
12	CLK-	TMDS data clock-	
13	CEC	Consumer Electronics Control	
14	NC	NC	
15	SCL	IIC master serial clock	
16	SDA	IIC serial bidirectional data	
17	GND	GND	
18	5V	5V	
19	HPLG	Hot plug and play detect	

3.6 TFT_LCD interface

Function: TFT_LCD interface

Description of interface: please see table 3-6

Table 3-6 TFT_LCD interface

Pin	Signal	Function	Pin out
1	DSS_D0	LCD Pixel data bit 0	
2	DSS_D1	LCD Pixel data bit 1	
3	DSS_D2	LCD Pixel data bit 2	
4	DSS_D3	LCD Pixel data bit 3	
5	DSS_D4	LCD Pixel data bit 4	
6	DSS_D5	LCD Pixel data bit 5	
7	DSS_D6	LCD Pixel data bit 6	
8	DSS_D7	LCD Pixel data bit 7	
9	GND	GND	
10	DSS_D8	LCD Pixel data bit 8	
11	DSS_D9	LCD Pixel data bit 9	
12	DSS_D10	LCD Pixel data bit 10	
13	DSS_D11	LCD Pixel data bit 11	
14	DSS_D12	LCD Pixel data bit 12	
15	DSS_D13	LCD Pixel data bit 13	
16	DSS_D 14	LCD Pixel data bit 14	
17	DSS_D15	LCD Pixel data bit 15	
18	GND	GND	
19	DSS_D16	LCD Pixel data bit 16	
20	DSS_D17	LCD Pixel data bit 17	
21	DSS_D18	LCD Pixel data bit 18	
22	DSS_D19	LCD Pixel data bit 19	
23	DSS_D20	LCD Pixel data bit 20	
24	DSS_D21	LCD Pixel data bit 21	
25	DSS_D22	LCD Pixel data bit 22	
26	DSS_D23	LCD Pixel data bit 23	
27	GND	GND	
28	DEN	AC bias control (STN) or pixel data enable (TFT)	
29	HSYNC	LCD Horizontal Synchronization	
30	VSYNC	LCD Vertical Synchronization	
31	GND	GND	

32	CLK	LCD Pixel Clock	
33	GND	GND	
34	X+	X+ Position Input	
35	X-	X- Position Input	
36	Y+	Y+ Position Input	
37	Y-	Y- Position Input	
38	SPI_CLK	SPI clock	
39	SPI_MOSI	Slave data in, master data out	
40	SPI_MISO	Slave data out, master data in	
41	SPI_CS	SPI enable	
42	IIC_CLK	IIC master serial clock	
43	IIC_SDA	IIC serial bidirectional data	
44	GND	GND	
45	VDD18	1.8V	
46	VDD33	3.3V	
47	VDD50	5V	
48	VDD50	5V	
49	RESET	Reset	
50	PWREN	Power on enable	

3.7 AUDIO OUT interface

Function: A standard Audio out interface.

Description of interface: please see table 3-7

Table 3-7 Audio out interface

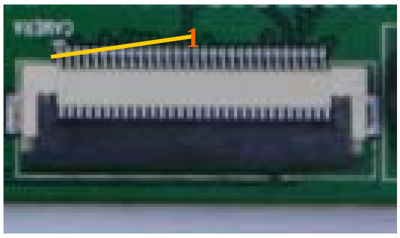
Pin	Signal	Function	Pin out
1	GND	GND	
2	NC	NC	
3	Right	Right output	
4	NC	NC	
5	Left	Left output	

3.8 Camera interface

Function: Camera image sensor interface

Description of interface: please see table 3-8

Table 3-8 camera interface

Pin	Signal	Function	Pin out
1	GND	GND	
2	D0	Digital image data bit 0	
3	D1	Digital image data bit 1	
4	D2	Digital image data bit 2	
5	D3	Digital image data bit 3	
6	D4	Digital image data bit 4	
7	D5	Digital image data bit 5	
8	D6	Digital image data bit 6	
9	D7	Digital image data bit 7	
10	D8	Digital image data bit 8	
11	D9	Digital image data bit 9	
12	D10	Digital image data bit 10	
13	D11	Digital image data bit 11	
14	GND	GND	
15	PCLK	Pixel clock	
16	GND	GND	
17	HS	Horizontal synchronization	
18	VDD50	5V	
19	VS	Vertical synchronization	
20	VDD33	3.3V	
21	XCLKA	Clock output a	
22	XCLKB	Clock output b	
23	GND	GND	
24	FLD	Field identification	
25	WEN	Write Enable	
26	STROBE	Flash strobe control signal	
27	SDA	IIC master serial clock	
28	SCL	IIC serial bidirectional data	
29	GND	GND	
30	VDD18	1.8V	

3.9 MIC IN interface

Function: A standard MIC IN interface

Description of interface: please see table 3-9

Table 3-9 MIC IN interface

Pin	Signal	Function	Pin out
1	GND	GND	
2	NC	NC	
3	MIC MAIN P	Right input	
4	NC	NC	

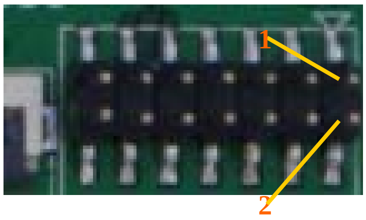
5	MIC MAIN N	Left input	

3.10 Keyboard interface

Function: 6X6 keyboard interface

Description of interface: please see table 3-10

Table 3-10 keyboard interface

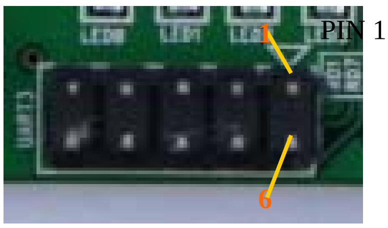
Pin	Signal	Function	Pin out
1	KC0	Keypad matrix column 0 output	
2	KR0	Keypad matrix row 0 input	
3	KC1	Keypad matrix column 1 output	
4	KR1	Keypad matrix row 1 input	
5	KC2	Keypad matrix column 2 output	
6	KR2	Keypad matrix row 2 input	
7	KC3	Keypad matrix column 3 output	
8	KR3	Keypad matrix row 3 input	
9	KC4	Keypad matrix column 4 output	
10	KR4	Keypad matrix row 4 input	
11	KC5	Keypad matrix column 5 output	
12	KR5	Keypad matrix row 5 input	
13	VDD18	1.8V	
14	GND	GND	

3.11 Series ports

Function 3-line series port

Description of interface: please see table 3-11

Table 3-11 series port

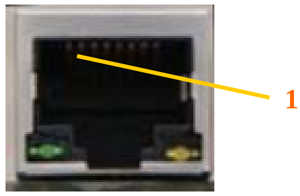
Pin	Signal	Function	Pin out
1	NC	NC	
2	TXD	Transit data	
3	RXD	Receive data	
4	NC	NC	
5	GND	GND	
6	NC	NC	
7	NC	NC	
8	NC	NC	
9	NC	NC	

3.12 LAN interface

Function: to provide a network interface.

Description of interface: please see table 3-12.

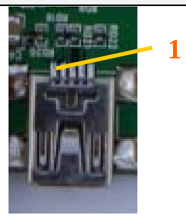
Table 3-12 LAN interface

Pin	Signal	Function	Pin out
1	TX+	TX+ output	
2	TX-	TX- output	
3	RX+	RX+ input	
4	VDD25	2.5V Power for TX/RX	
5	VDD25	2.5V Power for TX/RX	
6	RX-	RX- input	
7	NC	NC	
8	NC	NC	
9	VDD	3.3V Power for LED	
10	LED1	Speed LED	
11	LED2	Link LED	
12	VDD	3.3V Power for LED	

3.13 USB OTG interface

Function: A mini USB A interface.
Description of interface: please see table 3-13

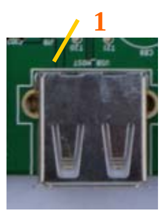
Table 3-13 USB OTG interface

Pin	Signal	Function	Pin out
1	VBUS	+5V	
2	DN	USB Data-	
3	DP	USB Data+	
4	ID	USB ID	
5	GND	GND	

3.14 USB HOST interface

Function: A standard USB interface
Description of interface: please see table 3-14

Table 3-14 USB HOST interface

Pin	Signal	Function	Pin out
1	VBUS	+5V	
2	DN	USB Data-	
3	DP	USB Data+	
4	GND	GND	

3.15 SD/MMC Card interface

Function: A standard SD/MMC Card interface which employs design for automatic detection for insertion, protection.

Description of interface: please see table 3-15

Table 3-15 SD/MMC Card interface

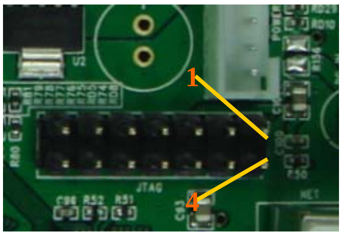
Pin	Signal	Function	Pin out
1	MINISD_CD1	Mini SD Card detect 1	 1
2	MINISD_CD2	Mini SD Card detect 2	
3	DAT2	MMC card data 2	
4	DAT3	MMC card data 3	
5	DAT4	MMC card data 4	
6	MINISD_DAT2	Mini SD card data 2	
7	GND	GND	
8	MINISD_DAT3	Mini SD card data 3	
9	DAT5	MMC card data 5	
10	MINISD_CMD	Mini SD card command	
11	VSS	GND	
12	MINISD_VSS	GND	
13	NC	NC	
14	VDD	VDD	
15	NC	NC	
16	MINISD_VDD	VDD	
17	CLK	MMC card clock	
18	MINISD_CLK	Mini SD card clock	
19	DAT6	MMC card data 6	
20	MINISD_VSS	GND	
21	VSS	GND	
22	MINISD_DAT0	Mini SD card data 0	
23	DAT7	MMC card data 7	
24	MINISD_DAT1	Mini SD card data 1	
25	DAT0	MMC card data 0	
26	DAT1	MMC card data 1	
27	SD_CD	SD Card detect	
28	SD_WP	SD write protect	
29	GND	GND	
30	GND	GND	

3.16 JTAG interface

Function: JTAG interface

Description of interface: please see table 3-16

Table 3-16 JTAG interface

Pin	Signal	Function	Pin out
1	TMS	Test mode select	
2	NTRST	Test system reset	
3	TDI	Test data input	
4	GND	GND	
5	VIO	1.8V	
6	NC	NC	
7	TDO	Test data output	
8	GND	GND	
9	RTCK	Receive test clock	
10	GND	GND	
11	TCK	Test clock	
12	GND	GND	
13	EMU0	Test emulation 0	
14	EMU1	Test emulation 1	

3.17 Expansion interface

Function: various expansion interfaces can be customized

Description of interface: please see table 3-17

Table 3-17 expansion interface

Pin	Signal	Function	Pin out
1	GND	GND	
2	BSP1_DX	Transmitted serial data 1	
3	BSP1_DR	Received serial data 1	
4	BSP1_CLKR	Received clock 1	
5	BSP1_FSX	Transmit frame synchronization 1	
6	BSP1_CLKX	Transmit clock 1	
7	BSP1_CLKS	External clock input 1	
8	BSP1_FSR	Receive frame synchronization 1	
9	UART1_CTS	UART1 clear to send	
10	UART1_RTS	UART1 request to send	
11	UART1_RX	UART1 receive data	
12	UART1_TX	UART1 transmit data	
13	GND	GND	
14	MMC2_CLK	MMC2 card clock	
15	MMC2_CMD	GND	
16	MMC2_D0	MMC2 card data 0	

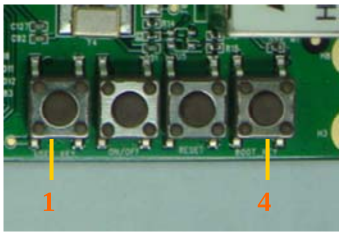
17	MMC2_D1	MMC2 card data 1	
18	MMC2_D2	MMC2 card data 2	
19	MMC2_D3	MMC2 card data 3	
20	MMC2_D4	MMC2 card data 4	
21	MMC2_D5	MMC2 card data 5	
22	MMC2_D6	MMC2 card data 6	
23	MMC2_D7	MMC2 card data 7	
24	BSP3_DX	Transmitted serial data 3	
25	BSP3_DR	Received serial data 3	
26	BSP3_CLKX	Transmit clock 3	
27	BSP3_FSX	Transmit frame synchronization 3	
28	GND	GND	
29	IIC3_SCL	IIC3 master serial clock	
30	IIC3_SDA	IIC3 serial bidirectional data	
31	SPI1_SIMO	Slave data in, master data out	
32	SPI1_SOMI	Slave data out, master data in	
33	SPI1_CLK	SPI1 clock	
34	SPI1_CS0	SPI enable 0	
35	SPI1_CS3	SPI enable 3	
36	HDQ_SIO	Bidirectional HDQ	
37	VDD33	3.3V	
38	VDD18	1.8V	
39	VDD50	5V	
40	VDD50	5V	

3.18 KEY

Function: button

Description of interface: please see table 3-18

Table 3-18 KEY

Pin	Signal	Function	Pin out
1	USER-KEY	User-defined key	
2	ON/OFF	System ON/OFF key	
3	RESET	System reset key	
4	BOOT-KEY	System boot configuration	

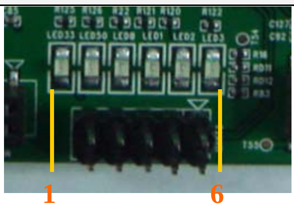
4

3.19 LED

Function: the LED in the board

Description of interface: please see table 3-19

Table 3-19 LED

Pin	Signal	Function	Pin out
1	LED33	3.3V Power led	
2	LED50	4.2V Power led	
3	LEDB	User LED	
4	LED1	User LED	
5	LED2	User LED	
6	LED3	User LED	

Chapter Three: Linux System

IV Linux system Overview

This chapter provides an overview of software system of DevKit8000, including the introduction of pre-installed software, specifications of DevKit8000 BSP package and various specifications contained in DevKit8000 CD.

DevKit8000 software system includes: pre-compiled images, application system source code, cross compilation tools, auxiliary tools for development. Images, applications, source code and auxiliary tools of DevKit8000 can be found in the release CD DevKit8000.

The SD card of DevKit8000 has the following software:

- x-loader--------------------------(x-load.bin.ift_for_NAND)
- u-boot-----------------------------(flash-uboot.bin)
- 2.6 kernel--------------------------(uImage)
- rootfs-------------------------------(ubi.img)

In addition, the CD provides the following programs and software:

- The image files for burning
- Cross compilation tools
- Source code for each part of system
- User testing program and development demonstration
- Some tools that may be used by users when operating DevKit8000

4.1 Pre-installed software

Software image has been contained in FLASH before the delivery. A completed system consists of four parts: i.e. x-loader, u-boot, kernel and rootfs. The Figure 4.1 shows the structure of the system:

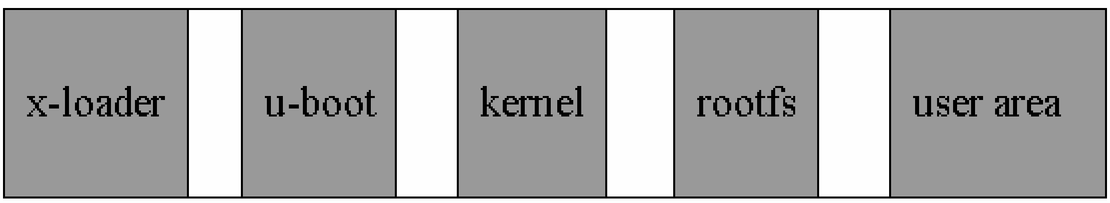


Figure 4.1 System compose map

Features and functions of each part of the system are:

1. x-loader is a first level bootstrap program. After the system start-up, the ROM inside the CPU will copy the x-loader to internal RAM and perform work. Its main function is to initialize the CPU,

copy u-boot into the memory and give the control power to u-boot;

2. u-boot is a second level bootstrap program. It is used for interacting with users and updating images and leading the kernel;

3. The latest 2.6.x kernel is employed and can be customized based on DevKit8000;

4. Rootfs employs Open-source system. It is small in capacity and powerful.

4.2 BSP features

DevKit8000 BSP is used for customizing and generating the Linux operating system applicable to DevKit8000 hardware platform. Users can conduct a secondary development on the basis of this BSP. The BSP in the CD attached in DevKit8000 contains the following showed in table 3-1.

Table 3-1 BSP specifications

Item		Note
BIOS	x-loader	NAND / ONENAND
		MMC/SD
		FAT
	u-boot	NAND / ONENAND
		MMC/SD
		FAT
		NET
Kernel	Linux-2.6.x	Supports ROM/CRAM/EXT2/EXT3/FAT/NFS/ JFFS2/UBIFS and various file systems
Device Driver	serial	Series driver
	rtc	Hardware clock driver
	net	10/100M Ethernet card DM8000 driver
	flash	nand flash driver (supports nand boot)
	lcd	TFT LCD driver
	touch screen	Touch screen controller ads7846 driver
	mmc/sd	mmc/sd controller driver
	usb otg	Usb otg 2.0 driver (can be configured as master/slave device)
	dvi	Supports dvi-d signal output
	s-video	Supports s-video signal output
	keypad	6x6 matrix keyboard driver
	led	User led lamp driver
GUI	Angstrom	release version for embedded devices' desktop environment
	Android	google android system

V Linux system quick start

5.1 system boot

Note: When you boot the board and operate the system, you may use the terminal, Please open PC Window Hyper terminal software and set the following:

- Baud rate: 115200
- Data bit: 8
- Parity check: no
- Stop bit: 1
- Flow control: no

5.1.1 Boot from Nand Flash

The board will boot from the NAND Flash by default, the user need to link the serial cable from the PC to the board, and power on the board, then the board will boot from NAND Flash.

Note: the method to update the image from the NAND Flash will be show in <7.2 Update the image for NAND Flash>

5.1.2 Boot from SD card

If the board need be booting from SD card, it should press the BOOT_KEY button (the botton position: refer the <3.18 KEY>) when power on the board, the system will boot from the SD card.

Note: the method to update the image from the SD card will be show in <7.1 Update the image for SD card>

5.2 choose the display device

System supports a wide range of display mode; the default display mode was the 4.3”LCD, and the user can change the display mode by change the U-Boot configure param.

5.2.1 Display with the 4.3”LCD

It should change the param by run the command as follow in the U-boot command mode.

1. NAND Flash boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 ubi.mtd=4 root=ubi0:rootfs rootfstype=ubifs video=omapfb:mode:4.3inch_LCD**

OMAP3 DevKit8000 # **setenv bootcmd nand read.i 80300000 280000 200000\;bootm 80300000**

OMAP3 DevKit8000 # **saveenv**

2. SD card boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 root=/dev/ram initrd=0x81600000,40M video=omapfb:mode:4.3inch_LCD**

OMAP3 DevKit8000 # **setenv bootcmd 'mmcinit;fatload mmc 0 80300000 uImage;fatload mmc 0 81600000 ramdisk.gz;bootm 80300000'**

OMAP3 DevKit8000 # **saveenv**

5.2.2 Display with the 5.6"LCD

It should change the param by run the command as follow in the U-boot command mode.

1、NAND Flash boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 ubi.mtd=4 root=ubi0:rootfs rootfstype=ubifs video=omapfb:mode:5.6inch_LCD**

OMAP3 DevKit8000 # **setenv bootcmd nand read.i 80300000 280000 200000\;bootm 80300000**

OMAP3 DevKit8000 # **saveenv**

2、SD card boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 root=/dev/ram initrd=0x81600000,40M video=omapfb:mode:5.6inch_LCD**

setenv bootcmd 'mmcinit;fatload mmc 0 80300000 uImage;fatload mmc 0 81600000 ramdisk.gz;bootm 80300000'

OMAP3 DevKit8000 # **saveenv**

5.2.3 Display with the 7"LCD

It should change the param by run the command as follow in the U-boot command mode.

1. NAND Flash boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 ubi.mtd=4 root=ubi0:rootfs rootfstype=ubifs video=omapfb:mode:7inch_LCD**

OMAP3 DevKit8000 # **setenv bootcmd nand read.i 80300000 280000 200000\;bootm 80300000**

OMAP3 DevKit8000 # **saveenv**

2. SD card boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 root=/dev/ram initrd=0x81600000,40M video=omapfb:mode:7inch_LCD**

setenv bootcmd 'mmcinit;fatload mmc 0 80300000 uImage;fatload mmc 0 81600000 ramdisk.gz;bootm 80300000'

OMAP3 DevKit8000 # **saveenv**

5.2.4 Display with the DVI-D

It should change the param by run the command as follow in the U-boot command mode.

1. NAND Flash boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 ubi.mtd=4 root=ubi0:rootfs rootfstype=ubifs video=omapfb:mode:720p60**

OMAP3 DevKit8000 # **setenv bootcmd nand read.i 80300000 280000 200000\;bootm 80300000**

OMAP3 DevKit8000 # **saveenv**

2. SD card boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 root=/dev/ram initrd=0x81600000,40M video=omapfb:mode:720p60**

setenv bootcmd 'mmcinit;fatload mmc 0 80300000 uImage;fatload mmc 0 81600000 ramdisk.gz;bootm 80300000'

OMAP3 DevKit8000 # **saveenv**

5.2.5 Display with the VGA

It should change the param by run the command as follow in the U-boot command mode.

1、NAND Flash boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 ubi.mtd=4 root=ubi0:rootfs rootfstype=ubifs video=omapfb:mode:VGA**

OMAP3 DevKit8000 # **setenv bootcmd nand read.i 80300000 280000 200000\;bootm 80300000**

OMAP3 DevKit8000 # **saveenv**

2、SD card boot mode

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 root=/dev/ram initrd=0x81600000,40M video=omapfb:mode:VGA**

setenv bootcmd 'mmcinit;fatload mmc 0 80300000 uImage;fatload mmc 0 81600000 ramdisk.gz;bootm 80300000'

OMAP3 DevKit8000 # **saveenv**

5.3 Test

5.3.1 Test on LED

LEDB, LED1, LED2 and LED3 in the board is user' led lamp (the LED postion: refer the <3.20 LED>), of which LED1 indicates the running status of the system and LED2 indicates whether there is data transmission with SD card.

The following show how to use the user's led lamp LED3:

1. Please enter the following command in the terminal end to illumine the lamp led2

```
root@DevKit8000:~#  echo -n 1 >/sys/class/leds/led3/brightness
```

2. Please enter the following command in the terminal end to extinguish the lamp led2

```
root@DevKit8000:~#  echo -n 0 >/sys/class/leds/led3/brightness
```

The lamp LED3 will illumine and extinguish in accordance with user's command.

5.3.2 Test on KEYPAD

The development board provides a 6x6 interface for connecting matrix keyboard. The tool evtest can be used to test whether the matrix keyboard is in normal operation:

```
root@DevKit8000:~#  evtest /dev/input/event0
```

Please press a random key in the matrix keyboard, for example, press "1", the terminal end will show the following:

```
Event: time 946684837.310027, type 1 (Key), code 2 (1), value 1
Event: time 946684837.402160, type 1 (Key), code 2 (1), value 0
```

Of which “type 1 (Key), code 2 (1), value 1” indicates button has been pressed, button value is “2” (corresponds to “1” key for full-button keyboard), status is “Pressed” (“0” represents button is released).

Notes: Press CONTROL+C to quit the test

5.3.3 Test on touch screen

1. Run the command to test the touch screen.

```
root@DevKit8000:~#  ts_calibrate
```

Then follow the LCD prompt, click the "+" icon 5 times to complete the calibration

2. Calibration is complete, enter the following commands for Touch Panel Test:

```
root@DevKit8000:~#  ts_test
```

Follow the LCD prompts to choose draw point, draw line test.

Notes: Press CONTROL+C to quit the test

5.3.4 Test on RTC

The development board contains hardware clock for save and synchronize the system time. Test can be made with the following steps:

1. Set the system time as 8:00 PM, August, 8, 2008

```
root@DevKit8000:~#  date 080820002008
Fri Aug    8 20:00:00 UTC 2008
```

2. Write the system clock into RTC

```
root@DevKit8000:~#   hwclock –w
```

3. Read the RTC

```
root@DevKit8000:~#  hwclock
Fri Aug    8 20:00:21 2008    0.000000 seconds
```

We can see that the RTC clock has been set as August, 8, 2008; the system clock will be saved in the hardware clock.

4. Restart the system; enter the following commands to renew the system clock

```
root@DevKit8000:~#   hwclock -s
root@DevKit8000:~#   date
Fri Aug    8 20:01:45 UTC 2008
```

We can see the system time is set as hardware time.

5.3.5 Test on MMC/SD Card

Insert the MMC/SD card, the system will automatically detect and set the MMC/SD card under the /media directory.

```
root@DevKit8000:~#  cd /media/
root@DevKit8000:/media#  ls
card        hdd        mmcblk0p1   ram        union
cf          mmc1       net         realroot
root@DevKit8000:/media#  cd mmcblk0p1/
```

5.3.6 Test on USB OTG

1. USB OTG used as devices:

1) After booting the system, please use the USB Line (USB mini B to USB A) to connect the development board and PC; USB mini B connects the development board, USB A connect the PC.

Notes: For the installation of driver Linux USB Ethernet/RNDIS Gadget, please see the description in Appendix 1.

2) After successful connection, PC will show a virtual network card as displayed in Figure 5.1

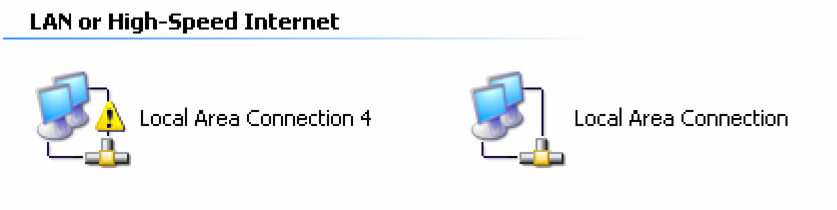


Figure 5.1 virtual network card

3) Set the IP address of the virtual network card, for example:

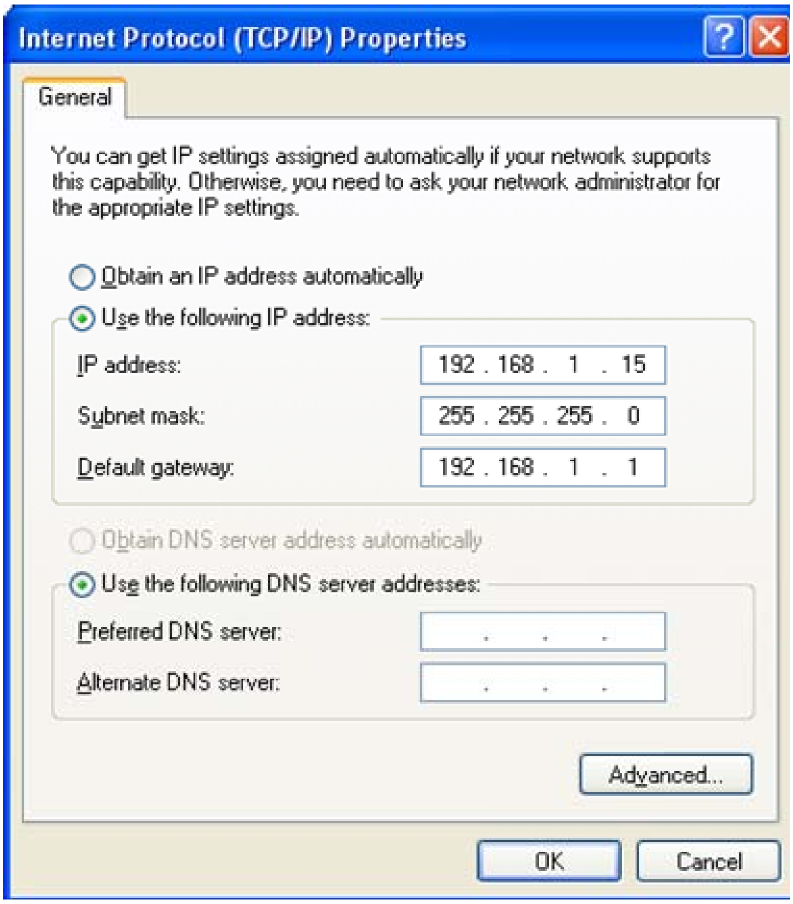


Figure 5.2 IP setting

4)Set the IP address of development board and virtual network card as in the same network segment. For example:

```
root@DevKit8000:~#  ifconfig usb0 192.168.1.115
root@DevKit8000:~#  ifconfig
lo          Link encap:Local Loopback
            inet addr:127.0.0.1   Mask:255.0.0.0
            UP LOOPBACK RUNNING   MTU:16436   Metric:1
            RX packets:26 errors:0 dropped:0 overruns:0 frame:0
            TX packets:26 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:0
            RX bytes:2316 (2.2 KiB)   TX bytes:2316 (2.2 KiB)

usb0        Link encap:Ethernet   HWaddr 5E:C5:F6:D4:2B:91
            inet addr:192.168.1.115   Bcast:192.168.1.255   Mask:255.255.255.0
            UP BROADCAST RUNNING MULTICAST   MTU:1500   Metric:1
            RX packets:253 errors:0 dropped:0 overruns:0 frame:0
            TX packets:43 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:35277 (34.4 KiB)   TX bytes:10152 (9.9 KiB)
```

5 Test:

```
root@DevKit8000:~#  ping 192.168.1.15
PING 192.168.1.15 (192.168.1.15): 56 data bytes
64 bytes from 192.168.1.15: seq=0 ttl=128 time=0.885 ms
64 bytes from 192.168.1.15: seq=1 ttl=128 time=0.550 ms
```

2. USB OTG used as HOST

Please use the USB Line (USB mini B to USB A) to connect the development board and PC; USB mini A connects the development board, USB B connect the PC.

```
root@DevKit8000:~#  cd /media/
root@DevKit8000:/media#  ls
card        hdd         mmcblk0p1   ram         sda1
cf          mmc1        net         realroot    union
root@DevKit8000:/media#  cd sda1
```

The system will automatically detect and set the USB device under the /media directory.

Notes: Some USB flash disks may be identified as sda

5.3.7 Test on Audio

The board has audio input and output interface, and we have alsa-utils audio test tools in the filesystem, users can enter the following commands for a test:

1、Recording Test：

```
[root@OMAP3EVM /tmp]# arecord -t wav -c 2 -r 44100 -f S16_LE -v k
Recording WAVE 'k' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
Plug PCM: Hardware PCM card 0 'omap3evm' device 0 subdevice 0
Its setup is:
  stream        : CAPTURE
  access        : RW_INTERLEAVED
  format        : S16_LE
  subformat     : STD
  channels      : 2
  rate          : 44100
  exact rate    : 44100 (44100/1)
  msbits        : 16
  buffer_size   : 22052
  period_size   : 5513
  period_time   : 125011
  tstamp_mode   : NONE
  period_step   : 1
  avail_min     : 5513
  period_event : 0
  start_threshold   : 1
```

```
  stop_threshold      : 22052
  silence_threshold: 0
  silence_size : 0
  boundary          : 1445199872
  appl_ptr          : 0
  hw_ptr            : 0
```

Plug in a microphone, you can test recording.

Notes: Press CONTROL+C to quit the test.

2、Playback Testing：

```
[root@OMAP3EVM /tmp]# aplay -t wav -c 2 -r 44100 -f S16_LE -v k
Playing WAVE 'k' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
Plug PCM: Hardware PCM card 0 'omap3evm' device 0 subdevice 0
Its setup is:
  stream            : PLAYBACK
  access            : RW_INTERLEAVED
  format            : S16_LE
  subformat         : STD
  channels          : 2
  rate              : 44100
  exact rate        : 44100 (44100/1)
  msbits            : 16
  buffer_size       : 22052
  period_size       : 5513
  period_time       : 125011
  tstamp_mode       : NONE
  period_step       : 1
  avail_min         : 5513
  period_event : 0
  start_threshold     : 22052
  stop_threshold      : 22052
  silence_threshold: 0
  silence_size : 0
  boundary          : 1445199872
  appl_ptr          : 0
  hw_ptr            : 0
```

Plug in the headphones, you can hear what you have just recorded.

5.3.8 Test on network

The board has a 10/100M self-adapting network card DM8000; users can connect the board to the LAN and enter the following commands for a test:

```
root@DevKit8000:~# ifconfig eth0 192.192.192.200
```

```
eth0: link down
root@DevKit8000:~# eth0: link up, 100Mbps, full-duplex, lpa 0x41E1

root@DevKit8000:~# ping 192.192.192.90
PING 192.192.192.90 (192.192.192.90): 56 data bytes
64 bytes from 192.192.192.90: seq=0 ttl=128 time=1.007 ms
64 bytes from 192.192.192.90: seq=1 ttl=128 time=0.306 ms
64 bytes from 192.192.192.90: seq=2 ttl=128 time=0.397 ms
64 bytes from 192.192.192.90: seq=3 ttl=128 time=0.367 ms

--- 192.192.192.90 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.306/0.519/1.007 ms
```

Notes: The ip address in the network card of development board and PC should be in the same network segment, for example: 192.192.192.x. Press CONTROL+C to quit the test.

5.3.9 Test on camera

If you have DevKit8000 camera module in hand, please connect camera module and CCD camera well, and execute below command to test:

```
root@DevKit8000:~# saMmapLoopback
tvp514x 2-005d: tvp5146m2 found at 0xba (OMAP I2C adapter)

Capture: Opened Channel
Capture: Current Input: COMPOSITE
Capture: Current standard: PAL
Capture: Capable of streaming
Capture: Number of requested buffers = 3
Capture: Init done successfully


Display: Opened Channel
Display: Capable of streaming
Display: Number of requested buffers = 3
Display: Init done successfully

Display: Stream on...
Capture: Stream on...
```

You can see the CCD camera image int the LCD.

5.4 DevKit8000 Demo

5.4.1 The demonstration of angstrom(GPE) desktop release version

1. Famat the SD card and divided into 2 areas in accordance with appendix 2. Reload the SD card and execute the following commands.

```
    cp /media/cdrom/linux/demo/angstrom/MLO /media/LABEL1
    cp /media/cdrom/linux/demo/angstrom/u-boot.bin /media/LABEL1
    cp /media/cdrom/linux/demo/angstrom/uImage /media/LABEL1
    rm -rf /media/LABEL2/*
    sudo tar jxvf
linux/demo/angstrom/Angstrom-DevKit8000-demo-image-glibc-ipk-2008.1-test-2
0080111-DevKit8000.rootfs.tar.bz2 -C /media/LABEL2
    sync
    umount /media/LABEL1
    umount /media/LABEL2
```

2. Insert the SD card into the development board, boot from SD card, and it will enter into Angstrom system, using DVI output as default.

Notes: When entering into the desktop system for the first time, the system will conduct considerable configuration, please wait for a few minutes. Later, users can directly enter into the desktop after start-up.

5.4.2 The demonstration of google android system

1. Famat the SD card and divided into 2 areas in accordance with appendix 2. Reload the SD card and execute the following commands.

For the 4.3"LCD:

```
cp /media/cdrom/linux/demo/android/MLO /media/LABEL1
cp /media/cdrom/linux/demo/android/u-boot.bin_4.3 /media/LABEL1/u-boot.bin
cp /media/cdrom/linux/demo/android/uImage_4.3 /media/LABEL1/uImage
rm -rf /media/LABEL2/*
sudo tar jxvf linux/demo/ android/RFS.tar.bz2 -C /media/LABEL2
sync
umount /media/LABEL1
umount /media/LABEL2
```

For the 5.6"LCD:

```
cp /media/cdrom/linux/demo/android/MLO /media/LABEL1
cp /media/cdrom/linux/demo/android/u-boot.bin_5.6 /media/LABEL1/u-boot.bin
cp /media/cdrom/linux/demo/android/uImage_5.6 /media/LABEL1/uImage
rm -rf /media/LABEL2/*
sudo tar jxvf linux/demo/ android/RFS.tar.bz2 -C /media/LABEL2
```

```
sync
umount /media/LABEL1
umount /media/LABEL2
```

For the 7"LCD:

```
cp /media/cdrom/linux/demo/android/MLO /media/LABEL1
cp /media/cdrom/linux/demo/android/u-boot.bin_7 /media/LABEL1/u-boot.bin
cp /media/cdrom/linux/demo/android/uImage_7 /media/LABEL1/uImage
rm -rf /media/LABEL2/*
sudo tar jxvf linux/demo/ android/RFS.tar.bz2 -C /media/LABEL2
sync
umount /media/LABEL1
umount /media/LABEL2
```

2. Insert the SD card into the development board; the boot the board, the board will enter the Android system.

5.4.3 DVSDK Demo

1. Famat the SD card and divided into 2 areas in accordance with appendix 2. Reload the SD card and execute the following commands.

For the 4.3"LCD:

```
    cp /media/cdrom/linux/demo/dvsdk/MLO /media/LABEL1
    cp /media/cdrom/linux/demo/dvsdk/u-boot.bin /media/LABEL1
    cp /media/cdrom/linux/demo/dvsdk/uImage_4.3 /media/LABEL1/uImage
    rm -rf /media/LABEL2/*
    sudo tar jxvf linux/demo/dvsdk/DVSDK.tar.bz2 -C /media/LABEL2
    sync
    umount /media/LABEL1
    umount /media/LABEL2
```

For the 5.6"LCD:

```
    cp /media/cdrom/linux/demo/dvsdk/MLO /media/LABEL1
    cp /media/cdrom/linux/demo/dvsdk/u-boot.bin /media/LABEL1
    cp /media/cdrom/linux/demo/dvsdk/uImage_5.6 /media/LABEL1/uImage
    rm -rf /media/LABEL2/*
    sudo tar jxvf linux/demo/dvsdk/DVSDK.tar.bz2 -C /media/LABEL2
    sync
    umount /media/LABEL1
    umount /media/LABEL2
```

For the 7"LCD:

```
    cp /media/cdrom/linux/demo/dvsdk/MLO /media/LABEL1
    cp /media/cdrom/linux/demo/dvsdk/u-boot.bin /media/LABEL1
    cp /media/cdrom/linux/demo/dvsdk/uImage_7 /media/LABEL1/uImage
    rm -rf /media/LABEL2/*
    sudo tar jxvf linux/demo/dvsdk/DVSDK.tar.bz2 -C /media/LABEL2
    sync
    umount /media/LABEL1
```

```
umount /media/LABEL2
```

2. Insert the SD card into the development board; the boot the board, the board will enter the system and then it will display the 2D/3D video.

VI Linux System Development

This section will introduce how to establish a Linux system development platform run on DevKit8000 hardware platform with the use of DevKit8000 BSP. Details to be provided contain the formation of cross compilation environment, the generation of system image and demonstrate how to customize the system.

Notes: The Linux said thereof is ubuntu 7.10 which will be referred as ubuntu.

6.1 Install the cross compilation environment

User must well form an arm Linux cross compilation environment before developing the DevKit8000. We will take ubuntu operating system as the example to introduct the formation of cross compilation environment. The operation in Linux is similar with that in ubuntu system.

6.1.1 The installation of cross compilation tool

Insert the CD, ubuntu will put the CD under /media/cdrom directory, and the cross compilation tool will be put under /media/cdrom/linux/tools directory.

Users can execute the following commands to start up the installation of cross compilation tool:

```
cd /media/cdrom/linux/tools
tar xvjf arm-2007q3-51-arm-none-linux-gnueabi-i686.tar.bz2 -C /home/embest
```

Notes: The manual takes /home/embest as default installation directory. Users may change the path.

6.1.2 The installation of other tools

Other tools included in linux/tools directory of CD may be used for source code. Users can execute the following commands for installation:

```
mkdir /home/embest/tools
cp /media/cdrom/linux/tools/mkimage /home/embest/tools
cp /media/cdrom/linux/tools/signGP /home/embest/tools
cp /media/cdrom/linux/tools/mkfs.ubifs /home/embest/tools
cp /media/cdrom/linux/tools/ubinize /home/embest/tools
cp /media/cdrom/linux/tools/ ubinize.cfg /home/embest/tools
```

6.1.3 Adding environment variable

After installation of the above tools, those tools can be added into environment variable with the following commands:

```
export PATH=/home/embest/arm-2007q3/bin:/home/embest/tools:$PATH
```

Notes: Users can put it into the barsrc file, and the adding of environment variable can be *finished as the system starts.*

6.2 system complie

6.2.1 Preparation

The source code of each part of the system is under the linux/source of CD. Users can copy it to the system and unzip it before developing. For example:

```
mkdir /home/embest/work
cd /home/embest/work
tar xvf /media/cdrom/linux/source/x-load-1.41.tar.bz2
tar xvf /media/cdrom/linux/source/u-boot-1.3.3.tar.bz2
tar xvf /media/cdrom/linux/source/linux-2.6.28-omap.tar.bz2
sudo tar xvf /media/cdrom/linux/source/rootfs.tar.bz2
```

When the above steps are finished, the current directory will generate linux-2.6.22-omap, u-boot-1.3.3 and x-load-1.41 these three directories.

6.2.2 x-loader image generated

DevKit8000 supports MMC/SD boot or NAND boot. The burned x-loader image files are different with the different boot modes, and the corresponding methods for mapping will differ too.

We will introduce the generation of x-loader image file under different boot modes.

1. To generate x-loader image file MLO used for SD card start-up

When the above steps are finished, the current directory will generate the file MLO we need.

```
cd x-load-1.41
make distclean
make omap3devkit8000_config
make
signGP x-load.bin
mv x-load.bin.ift MLO
```

2. To generate the x-load.bin.ift_for_NAND start-up

1) To alter the file x-loader-1.4.1/include/configs/omap3DevKit8000.h and annotate the following:

```
//#define CFG_CMD_MMC           1
```

2) Cross compilation

```
cd x-load-1.41
make distclean
make omap3devkit8000_config
make
signGP x-load.bin
mv x-load.bin.ift x-load.bin.ift_for_NAND
```

When the above steps are finished, the current directory will generate the file x-load.bin.ift_for_NAND we need.

6.2.3 u-boot image generated

```
cd u-boot-1.3.3
make distclean
make omap3devkit8000_config
make
```

When the above steps are finished, the current directory will generate the file u-boot.bin we need.

6.2.4 kernel image generated

```
cd linux-2.6.28-omap
make distclean
make omap3_devkit8000_defconfig
make uImage
```

When the above steps are finished, the arch/arm/boot directory will generate the file uImage we need.

6.2.5 ubifs image generated

```
cd /home/embest/work
sudo mkfs.ubifs -r rootfs -m 2048 -e 129024 -c 812 -o ubifs.img
sudo ubinize -o ubi.img -m 2048 -p 128KiB -s 512   /home/embest/tools/ubinize.cfg
```

When the above steps are finished, the current directory will generate the file ubi.img we need.

6.3 System Customization

Actually, Linux kernel has many options for configuring the kernel. According to the default configuration, users can add or delete some configuration to suit different need. The following example illustrates the general process of system customization.

6.3.1 Alteration of kernel configuration

Kernel source code provides the default configuration file:

arch/arm/configs/omap3_DevKit8000_defconfig

Users can customize the system on the basis of this file

```
cd linux-2.6.28-omap
cp arch/arm/configs/omap3_devkit8000_defconfig .config
make menuconfig
```

The example that we use usb gadget to simulate usb mass storage device will be taken to introduce the system customization:

1. Select Device drivers

```
    General setup  --->
[*] Enable loadable module support  --->
[*] Enable the block layer  --->
    System Type  --->
    Bus support  --->
    Kernel Features  --->
    Boot options  --->
    CPU Power Management  --->
    Floating point emulation  --->
    Userspace binary formats  --->
    Power management options  --->
[*] Networking support  --->
    Device Drivers  --->
    File systems  --->
    Kernel hacking  --->
    Security options  --->
-*- Cryptographic API  --->
    Library routines  --->
---
    Load an Alternate Configuration File
    Save an Alternate Configuration File

          <Select>    < Exit >    < Help >
```

2. Select USB support

```
[ ] ISDN support  --->
    Input device support  --->
    Character devices  --->
<*> I2C support  --->
[*] SPI support  --->
-*- GPIO Support  --->
< > Dallas's 1-wire support  --->
< > Power supply class support  --->
< > Hardware Monitoring support  --->
< > Generic Thermal sysfs driver  --->
[ ] Watchdog Timer Support  --->
    Sonics Silicon Backplane  --->
    Multifunction device drivers  --->
    Multimedia devices  --->
    Graphics support  --->
<*> Sound card support  --->
[*] HID Devices  --->
[*] USB support  --->
<*> MMC/SD/SDIO card support  --->
< > Sony MemoryStick card support (EXPERIMENTAL)  --->
[ ] Accessibility support  --->
[*] LED Support  --->
<*> Real Time Clock  --->
[ ] DMA Engine support  --->
[ ] Voltage and Current Regulator Support  --->
< > Userspace I/O drivers  --->
    CBUS support  --->

          <Select>    < Exit >    < Help >
```

3. Select USB Gadget Support

```
< >   EMI 6|2m USB Audio interface support
< >   EMI 2|6 USB Audio interface support
< >   ADU devices from Ontrak Control Systems
< >   USB 7-Segment LED Display
< >   USB Diamond Rio500 support
< >   USB Lego Infrared Tower support
< >   USB LCD driver support
< >   USB BlackBerry recharge support
< >   USB LED driver support
< >   Cypress CY7C63xxx USB driver support
< >   Cypress USB thermometer driver support
< >   USB Phidgets drivers
< >   Siemens ID USB Mouse Fingerprint sensor support
< >   Elan PCMCIA CardBus Adapter USB Client
< >   Apple Cinema Display support
< >   USB 2.0 SVGA dongle support (Net2280/SiS315)
< >   USB LD driver
< >   PlayStation 2 Trance Vibrator driver support
< >   IO Warrior driver support
< >   USB testing driver
< >   iSight firmware loading support
< >   USB VST driver
<*>   USB Gadget Support  --->
      *** OTG and related infrastructure ***
< >   GPIO based peripheral-only VBUS sensing 'transceiver'
< >   Philips ISP1301 with OMAP OTG
<*>   TWL4030 USB Transceiver Driver

              <Select>    < Exit >    < Help >
```

4. The configuration of USB Gadget Support can be changed as showed in the following

```
--- USB Gadget Support
[ ]   Debugging messages (DEVELOPMENT)
[ ]   Debugging information files (DEVELOPMENT)
(2)   Maximum VBUS Power usage (2-500 mA)
      USB Peripheral Controller (Inventra HDRC USB Peripheral (TI, ADI, ...))  --->
<M>   USB Gadget Drivers
< >     Gadget Zero (DEVELOPMENT)
< >     Ethernet Gadget (with CDC Ethernet support)
< >     Gadget Filesystem (EXPERIMENTAL)
<M>     File-backed Storage Gadget
[ ]       File-backed Storage Gadget testing version (NEW)
< >     Serial Gadget (with CDC ACM and CDC OBEX support)
< >     MIDI Gadget (EXPERIMENTAL)
< >     Printer Gadget
< >     CDC Composite Device (Ethernet and ACM)

              <Select>    < Exit >    < Help >
```

6.3.2 Compilation

Save the configuration and execute the following command to recompile the kernel:

```
make
make uImage
```

After the above steps are finished, arch/arm/boot directory will generate a new kernel image zImage; drivers/usb/gadget directory will generate a new module file g_file_storage.ko.

6.3.3 Test

Update kernel image file zImage in SD card, copy file g_file_storage.ko to the SD card and reboot the system. Execute the following commands to stimulate the sd card into usb mass storage device for PC's visit:

```
root@DevKit8000:~# cd /media/mmcblk0p1/
root@DevKit8000:/media/mmcblk0p1# insmod g_file_storage.ko file=/dev/mmcblk0p1 stall=0 removable=1
g_file_storage gadget: File-backed Storage Gadget, version: 7 August 2007
g_file_storage gadget: Number of LUNs=1
g_file_storage gadget-lun0: ro=0, file: /dev/mmcblk0p1
musb_hdrc musb_hdrc: MUSB HDRC host driver
musb_hdrc musb_hdrc: new USB bus registered, assigned bus number 2
usb usb2: configuration #1 chosen from 1 choice
hub 2-0:1.0: USB hub found
hub 2-0:1.0: 1 port detected
```

Use the USB line (USB mini B to USB A) to connect the development board and PC, PC will give a hint that usb mass storage device is found; a new mobile hard disk is found and users can perform operation for it.

Notes: Please make sure that the kernel image has been updated, otherwise, module g_file_storage.ko will fail to load and the similar tips will show:
insmod: cannot insert '/media/mmcblk0p1/g_file_storage.ko': Device or resource busy

VII Linux image update

DevKit8000 supports MMC/SD boot or NAND boot; different start-up modes will have different method for updating the image. We will introduce the update of image under different start-up modes.

7.1 Update the image for SD card

7.1.1 The formatting of MMC/SD card

HP USB Disk Storage Format Tool 2.0.6 is recommended:
http://selfdestruct.net/misc/usbboot/SP27213.exe

1. Insert MMC/SD card into the card reader in PC
2. Open the HP USB Disk Storage Format Tool, the following tips will show:

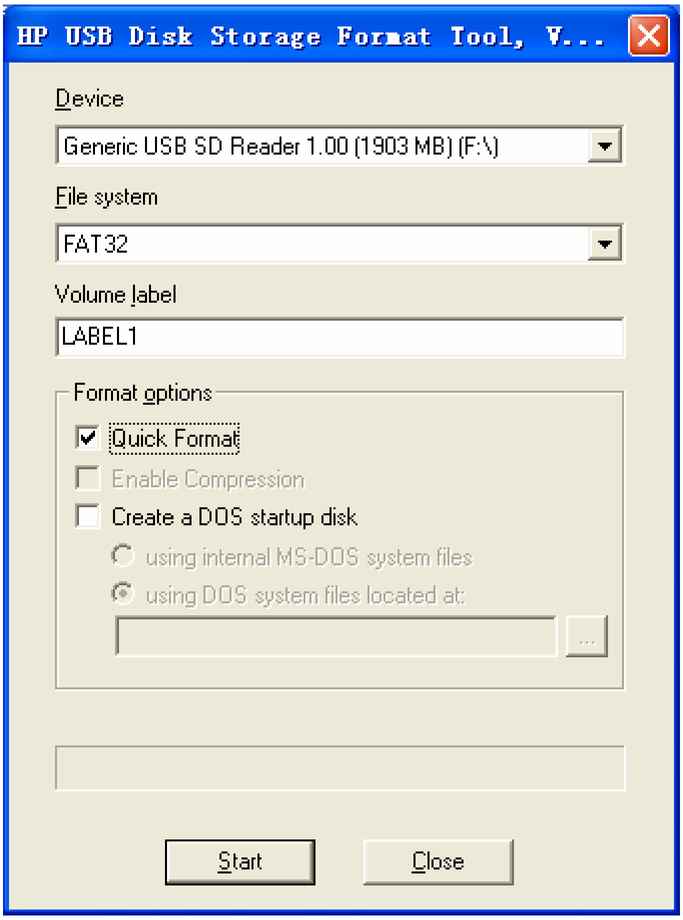


Figure 7.1 Formatting tool of HP USB Disk

3. Select “FAT32”
4. Click “Start”
5. When formatting is completed, click “OK”

7.1.2 Image update

Copy the system image to SD card. Then you can use the SD card for the new image.

Note: the image contains: MLO, u-boot.bin, uImage, ramdisk.gz

7.1.3 u-boot param configure

The user can change the U-boot param for defaut mode by running the following command.

OMAP3 DevKit8000 # **setenv bootargs console=ttyS2,115200n8 root=/dev/ram initrd=0x81600000,40M**

OMAP3 DevKit8000 # **setenv bootcmd 'mmcinit;fatload mmc 0 80300000 uImage;fatload mmc 0 81600000 ramdisk.gz;bootm 80300000'**

OMAP3 DevKit8000 # **saveenv**

7.2 Update the image for NAND Flash

The U-boot can update the NAND Flash image; you can update the U-boot via SD card as follow method.

When you enter the U-boot commad mode by SD card booting method, and then run the follow command to update the image.

7.2.1 The update of x-loader boot image

```
OMAP3 DevKit8000 #  mmcinit
OMAP3 DevKit8000 #  fatload mmc 0:1 80000000 x-load.bin.ift_for_NAND
reading x-load.bin.ift_for_NAND

9664 bytes read
OMAP3 DevKit8000 #  nand unlock
device 0 whole chip
nand_unlock: start: 00000000, length: 134217728!
NAND flash successfully unlocked
OMAP3 DevKit8000 #  nand ecc hw
OMAP3 DevKit8000 #  nand erase 0 80000

NAND erase: device 0 offset 0x0, size 0x80000
Erasing at 0x60000 -- 100% complete.
OK
OMAP3 DevKit8000 #  nand write.i 80000000 0 80000

NAND write: device 0 offset 0x0, size 0x80000

Writing data at 0x7f800 -- 100% complete.
 524288 bytes written: OK
```

7.2.2 The update of u-boot boot image

```
OMAP3 DevKit8000 #  mmcinit
OMAP3 DevKit8000 #  fatload mmc 0:1 80000000 flash-uboot.bin
reading flash-uboot.bin

1085536 bytes read
OMAP3 DevKit8000 #  nand unlock
device 0 whole chip
nand_unlock: start: 00000000, length: 134217728!
NAND flash successfully unlocked
OMAP3 DevKit8000 #  nand ecc sw
OMAP3 DevKit8000 #  nand erase 80000 160000

NAND erase: device 0 offset 0x80000, size 0x160000
Erasing at 0x1c0000 -- 100% complete.
OK
OMAP3 DevKit8000 #  nand write.i 80000000 80000 160000

NAND write: device 0 offset 0x80000, size 0x160000

Writing data at 0x1df800 -- 100% complete.
 1441792 bytes written: OK
```

7.2.3 The update of kernel image

```
OMAP3 DevKit8000 #   mmcinit
OMAP3 DevKit8000 #   fatload mmc 0:1 80000000 uImage
reading uImage

1991900 bytes read
OMAP3 DevKit8000 #   nand unlock
device 0 whole chip
nand_unlock: start: 00000000, length: 268435456!
NAND flash successfully unlocked
OMAP3 DevKit8000 #   nand ecc sw
OMAP3 DevKit8000 #   nand erase 280000 200000

NAND erase: device 0 offset 0x280000, size 0x200000
Erasing at 0x460000 -- 100% complete.
OK
OMAP3 DevKit8000 #   nand write.i 80000000 280000 200000

NAND write: device 0 offset 0x280000, size 0x200000
```

```
Writing data at 0x47f800 -- 100% complete.
 2097152 bytes written: OK
```

7.2.4 The update of filesystem image

```
OMAP3 DevKit8000 #   mmcinit
OMAP3 DevKit8000 #   fatload mmc 0:1 80000000 ubi.img
reading ubi.img

12845056 bytes read
OMAP3 DevKit8000 #   nand unlock
device 0 whole chip
nand_unlock: start: 00000000, length: 268435456!
NAND flash successfully unlocked
OMAP3 DevKit8000 #   nand ecc sw
OMAP3 DevKit8000 #   nand erase 680000 7980000

NAND erase: device 0 offset 0x680000, size 0x7980000
Erasing at 0x7fe0000 -- 100% complete.
OK
OMAP3 DevKit8000 #   nand write.i 80000000 680000 $(filesize)

NAND write: device 0 offset 0x680000, size 0xc40000

Writing data at 0x12bf800 -- 100% complete.
 12845056 bytes written: OK
```

7.2.5 u-boot param configure

```
OMAP3 DevKit8000 # setenv bootargs console=ttyS2,115200n8 ubi.mtd=4 root=ubi0:rootfs rootfstype=ubifs
OMAP3 DevKit8000 # setenv bootcmd nand read 80300000 280000 210000\;bootm 80300000
OMAP3 DevKit8000 # saveenv
```

VIII The development of application

This section will introduce how to conduct the development of application on the DevKit8000 hardware platform, including the formation of DevKit8000 software environment. Examples will be taken to show the general process of the development of DevKit8000 application.

8.1 LED application development

8.1.1 Coding

led_acc.c source code, The three led lamps in the development board will flash in the form of accumulator

```
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/ioctl.h>
#include <fcntl.h>

#define LED0 "/sys/class/leds/led0/brightness"
#define LED1 "/sys/class/leds/led1/brightness"
#define LED2 "/sys/class/leds/led2/brightness"

int main(int argc, char *argv[])
{
        int f_led0, f_led1, f_led2;
        unsigned char i = 0;
        unsigned char dat0, dat1, dat2;
        if((f_led0 = open(LED0, O_RDWR)) < 0){
                printf("error in open %s",LED0);
                return -1;
        }
        if((f_led1 = open(LED1, O_RDWR)) < 0){
                printf("error in open %s",LED1);
                return -1;
        }
        if((f_led2 = open(LED2, O_RDWR)) < 0){
                printf("error in open %s",LED2);
                return -1;
        }
        for(;;){
                i++;
                dat0 = i&0x1 ? '1':'0';
                dat1 = (i&0x2)>>1 ? '1':'0';
```

```
            dat2 = (i&0x4)>>2 ? '1':'0';
            write(f_led0, &dat0, sizeof(dat0));
            write(f_led1, &dat1, sizeof(dat1));
            write(f_led2, &dat2, sizeof(dat2));
            usleep(300000);
        }
    }
```

8.1.2 Cross compilation

```
arm-none-linux-gnueabi-gcc led_acc.c –o led_acc
```

8.1.3 Download and run

Resources can be put into the system in the way of SD card or U flash card or download. Then enter the directory that file led_acc exists, and input the following commands and enter, then the led_acc will run in the background.

```
./led_acc &
```

Chapter Four: WinCE System

IX WinCE system Overview

DevKit8000 software system includes: pre-compiled images and applications and their corresponding static library, dynamic link library, header file and source code; cross compilation tools, auxiliary tools for development. Images, applications, Cross compilation tools used for generating image and application can be downloaded from Microsoft. Image, application, source code and auxiliary tools of DevKit8000 can be found in the release CD or SD card of DevKit8000 .

The SD card of DevKit8000 has the following software:

- X-Loader image(MLO)
- Ethernet Bootloader(EBOOT)image(EBOOTSD.nb0)
- Windows Embedded CE 6.0 sample OS image(NK.bin)
- Test programmer(DevKit8000.exe)

The CD of DevKit8000 includes:

- Windows Embedded CE 6.0 DevKit8000 Board Support Package(BSP)source code for TI OMAP35X
- Windows Embedded CE 6.0 project for DevKit8000 BSP
- DevKit8000 application development example(source code)
- Auxiliary development tools

This section mainly introduces and DevKit8000 software system and covers description of pre-compiled images and BSP and test kit, some functions and features of various images and applications in the CD.

9.1 Pre-compiled image

The pre-compiled images include boot image X-Loader and EBOOT and sample OS image. X-Loader is a first level guidance code. After the start-up of system, the ROM inside the CPU will copy the x-loader to internal RAM and perform work. Its main function is to initialize the CPU, and copy EBOOT to DDR memory and execute EBOOT. EBOOT is a second level guidance code, by default, it will copy system image to DDR memory and hand the control right to the operating system. EBOOT also can provide related functions to manage the basic hardware and set the shared data in operating system.

Taking Mobile Handheld as an example, the pre-compiled images support the following:

Image	Feature
X-Loader	To boot EBOOT
EBOOT	To boot the operating system from the network (network card or RNDIS)
	To boot the operating system with SD card
	To boot the operating system from the

	NAND Flash
Demonstrated operating system	Windows Explorer
	Console Window
	CAB File Installer/Uninstaller
	Internet Explorer 6.0
	ActiveSync
	Power Management (Full)
	.NET Compact Framework 3.5
	Hive-based Registry
	RAM and ROM File System
	Device Drivers

9.2 Board Support Package(BSP)

DevKit8000 BSP is used to customize the boot image and Windows Embedded CE 6.0 OS image run on DevKit8000 hardware platform. It supports the following:

Module	Feature
X-Loader module	NAND
	ONENAND
	SD
EBOOT module	NAND
	ONENAND
	SD
OAL module	ILT
	REBOOT
	Watchdog
	RTC
KITL module	RNDIS KITL
Driver module	NLED driver
	GPIO/I2C/SPI/MCBSP driver
	Series port driver
	6X6 keyboard driver
	Audio driver
	NAND(K9F1G08)driver
	Display driver(LCD/DVI. S end/TV)/ TOUCH driver
	SD/MMC/SDIO driver
	DM9000 network card driver
	USB OTG driver
	USB EHCI driver
	VRFB driver
	DSPLINKK/CMEMK driver
	GPIO keyboard driver

	PWM(TPS65930)driver
	ADC(TPS65930)driver
	ONENAND driver
	SMSC911X network card driver
Power management module	Backlight driver
	Battery driver
	Sleep / wake-up button driver
	Expansion of power management
Application module	Flash Plug-in and Flash player
	MP3/MPEG4/H264 DSP Hardware decoder
	BSPINFO(control panel)
	CETK

Note:
DevKit8000 hardware platform may not support some modules
Some library and source code provided by BSP may subject to third-party copyright

X WinCE system quick start

10.1 system boot

Note: When you boot the board and operate the system, you may use the terminal, Please open PC Window Hyper terminal software and set the following:

- *Baud rate: 115200*
- *Data bit: 8*
- *Parity check: no*
- *Stop bit: 1*
- *Flow control: no*

10.1.1 Boot from Nand Flash

The board will boot from the NAND Flash by default, the user need to link the serial cable from the PC to the board, and power on the board, then the board will boot from NAND Flash.

Note: the method to update the image from the NAND Flash will be show in <12.2 Update the image for NAND Flash>

10.1.2 Boot from SD card

If the board need be booting from SD card, it should press the BOOT_KEY button (the botton position: refer the <3.18 KEY>) when power on the board, the system will boot from the SD card.

Note: the method to update the image from the SD card will be show in <12.1 Update the image for SD card>

10.2 Test

10.2.1 introduce

DevKit8000 board test kit is the application of Windows Embedded CE 6.0 and is used to test DevKit8000 software and hardware platform. It supports the following features:

- Automatic test on SD card
- Automatic test on NAND Flash disk
- Automatic test on network
- Manual test on keyboard
- Automatic test on RTC
- Semi-automatic test on NLED
- Semi-automatic test on audio output and input
- Semi-automatic test on LCD display

10.2.2 Test on software and hardware system

Note: you should link the serial cable from PC to the board, and link the LCD, key, audio out and audio in device to the board, if you don't link the device, it should impact the test results.

Open PC Window Hyper terminal software and set the following:

- Baud rate: 115200
- Data bit: 8
- Parity check: no
- Stop bit: 1
- Flow control: no

Please shut down the PC firewall or enable the LAN data communication and set the following:

- IP address: 192.168.1.2
- Subnet mask: 255.255.255.0

1. Windows Embedded CE 6.0. Insert the SD card and boot the system, hyper terminal will show start-up information. After a while, you can enter the system and experience Windows Embedded CE 6.0
2. If the touch screen is not accurate, please calibrate it (Stylus Properties window, Calibration property page [My Device\Control Panel\Stylus])
3. Run the test program ADevKit8000.exe[\Storage Card].
4. Click "Start" and the test will begin.
5. Keypad window will show, test the keyboard, press ESC button or click "Quit" to quit the test.
6. LED will be blinking, and waiting for users to judge.
7. Boot sound can be heard.
8. The screen will show RGB three primary colors in turn; touch the screen to quit the test.
9. After the test is completed, the results will show in test edit box: "SUCCESS" means the test is passed; "FAILED" means the test is not passed.

Notes:

If the file system in the SD card is damaged, Please recover the image referring to "6.3 The update of the image.

XI Linux System Development

11.1 Install the cross compilation environment

11.1.1 The installation of cross compilation tool

The development of Windows Embedded CE 6.0 is based on the integrated development environment of Visual Studio 2005(VS2005).

Developing applications need installing software and updating:

- Visual Studio 2005
- Visual Studio 2005 SP1
- Visual Studio 2005 SP1 Update for Vista (if applicable)
- ActiveSync 4.5

The development of Windows Embedded CE 6.0 requires sequential installation of software and updating:

- Visual Studio 2005
- Visual Studio 2005 SP1
- Visual Studio 2005 SP1 Update for Vista (if applicable)
- Windows Embedded CE 6.0 Platform Builder
- Windows Embedded CE 6.0 SP1
- Windows Embedded CE 6.0 R2
- Windows Embedded CE 6.0 Product Update Rollup 12/31/2008

Notes:

If there is an old CE development environment in the system, the use of Windows Embedded CE 6.0 development platform may be influenced. Uninstalling the old one and then installing the new one is recommended.

11.2 system complie

If the sample Windows Embedded CE 6.0 OS image in the CD of DevKit8000 satisfies your applications, you just need to add it into your application and get the authorization of Microsoft Corporation. Otherwise, you will need to re-customize the system and rebuild the image. This section describes how to use DevKit8000 Board Support Package(BSP)to create the Windows Embedded CE 6.0 system image run on DevKit8000 hardware platform.

11.2.1 Preparation

The following preparations should be made:

Decompress [\wince_6\bsp\SBC8100.rar] to obtain SBC8100 directory.

- Copy CD directory [\SBC8100\bsp\SBC8100] to [C:\WINCE600\PLATFORM] directory。
- Copy CD directory [\SBC8100\bsp_prj\SBC8100] to [C:\WINCE600\OSDesigns] directory。

For the 4.3” LCD

Modify platform/SBC8100/src/drivers/lcd/vga/lcd_vga.c

```
#define LCD_4_3_INCH    1
```

```
//#define LCD_5_6_INCH  1
//#define LCD_7_INCH    1
```

For the 5.6" LCD

Modify platform/SBC8100/src/drivers/lcd/vga/lcd_vga.c

```
//#define LCD_4_3_INCH  1
#define LCD_5_6_INCH    1
//#define LCD_7_INCH    1
```

For the 7" LCD

Modify platform/SBC8100/src/drivers/lcd/vga/lcd_vga.c

```
//#define LCD_4_3_INCH  1
//#define LCD_5_6_INCH  1
#define LCD_7_INCH      1
```

For VGA Model

Modify DevKit8000.bat

```
set BSP_DVI_1024W_768H=1
```

Notes:

If user needs to use DevKit8000 BS to develop Windows Embedded CE 6. operating system, the construction of Windows Embedded CE 6.0 development platform is required.

This manual takes the default installation path for Windows Embedded CE 6.0 software, i.e. its default path is [C:\WINCE600].

11.2.2 system complie

1. Open the file DevKit8000.sln[C:\WINCE600\OSDesigns\DevKit8000] or take the following steps to create a new project:
   a) Open Visual Studio 2005.
   b) Select the menu: File[New->Project].
   c) Select template type of Platform Builder for CE 6.0
   d) Select a file name and open Windows Embedded CE 6.0 OS Design Wizard
   e) Set the Embest DevKit8000 BSP into the BSP list.
   f) Continue to finish the Wizard.
2. Select submenu [Build-> Global Build Settings]
   - Copy Files to Release Directory After Build
   - Make Run-Time Image After build
3. If KITL is needed, set Enable Kernel Debugger and Enable KITL into Build Options page [Project-> Properties].
4. Select [Build-> Build Solution] to build BSP. These operations cover the whole compilation including sysgen operating system's components. After a entire compilation process is completed, the build commands under Solution Explorer window can be used to save the build time.

Images including NK.bin, EBOOTSD.nb0 and MLO and so on will be generate;

Copy the files MLO, EBOOTSD.nb0 and NK.bin under [C:\WINCE600\OSDesigns\DevKit8000\DevKit8000\RelDir\DevKit8000_ARMV4I_Release] to the SD card. Insert the SD card into the device and boot the device for a test.

11.2.3 System Customization

Windows Embedded CE 6.0 consists of a number of independent modules. Each module provides specific functions, of which some modules can be divided into several components. Each component has specific feature, making OEM/ODM customize a stable and efficient version according to specific application.

Taking Mobile Handheld as a template, sample DevKit8000 OS image adds features of components including:

Component	Path
CAB File Installer/Uninstaller	Core OS->CEBASE->Application – End User
.NET Compact Framework 3.5	Core OS->CEBASE->Applications and Services Development->.NET Compact Framework 3.5
OS Dependencies for .NET Compact Framework 3.5	Core OS->CEBASE->Applications and Services Development->.NET Compact Framework 3.5-> OS Dependencies for .NET Compact Framework 3.5
Point-to-Point Protocol over Ethernet (PPPoE)	Core OS->CEBASE->Communication Services and Networking->Networking – Wide Area Network (WAN)
USB Function Driver	Core OS->CEBASE->Core OS Services->USB Host Support
USB Host Support	Core OS->CEBASE->Core OS Services->USB Host Support
USB Human Input Device (HID) Class Driver	Core OS->CEBASE->Core OS Services->USB Host Support
USB HID Keyboard and Mouse	Core OS->CEBASE->Core OS Services->USB Host Support-> USB Human Input Device (HID) Class Driver
USB Storage Class Driver	Core OS->CEBASE->Core OS Services->USB Host Support
RAM and ROM File System	Core OS->CEBASE->File Systems and Data Store->File System – Internal (Choose 1)
Hive-based Registry	Core OS->CEBASE->File Systems and Data Store->Registry Storage – Internal (Choose 1)
exFAT File System	Core OS->CEBASE->File Systems and Data Store->Storage Manager
FAT File System	Core OS->CEBASE->File Systems and Data Store->Storage Manager
Storage Manager Control Panel Applet	Core OS->CEBASE->File Systems and Data Store->Storage Manager
Transaction-Safe FAT File System (TFAT)	Core OS->CEBASE->File Systems and Data Store->Storage Manager

Video/Image Compression Manager	Core OS->CEBASE->Graphics and Multimedia Technologies->Media->Video Codecs and Renderers
Console Window	Core OS->CEBASE->Shell and User Interface->Shell->Command Shell
SD Memory	Device Drivers->SDIO->SDIO Memory
serial	Device Drivers->USB Function->USB Function Clients
Windows Embedded CE Test Kit	Device Drivers

Components can be added or deleted in window Catalog Items View of Visual Studio 2005(VS2005) integrated development environment.

XII WinCE image update

12.1 Update the image for SD card

(1)Run the software of HP Disk Storage Format Tool and format the SD card for FAT or FAT32 filesystem.
(2) Copy the image file(MLO, EBOOTSD.nb0, NK.bin, ADevKit8000.exe) in CD:\wince_6\image\ lcd480X272 to SD card.
(3) Then you can boot the system with the SD for the new image.

You have to format the nand flash before boot the system from SD card, cause the system use the hive register by default. The format procedure please refer to the (1),(2) and (3) of chapter 12.2. eboot would format the nand flash when your flash is first time used by wince operation system. Once you complete the format operation, you don't need to perform this procedure anymore unless you destroy the nand flash format partition.

Note:
1) You can download the software HP USB Disk Storage Format Tool 2.0.6 from the follow website: http://selfdestruct.net/misc/usbboot/SP27213.exe
2) The folder of dvi1280X720 was corresponding DVI output image file, and the lcd480X272 was LCD output image.

12.2 Update the image for NAND Flash

(1)Run the software of HP Disk Storage Format Tool and format the SD card for FAT or FAT32 filesystem.
(2) Copy the image file(MLO, EBOOTNAND.nb0, NK.bin, ADevKit8000.exe) from CD:\wince_6\image\ lcd480X272 to SD card, then change the name from EBOOTNAND.nb0 to EBOOTSD.nb0 in the SD card.
(3) Insert the SD card to the board, press the BOOT button and then power on the board again; HyperTerminal will start printing the output information, at the same time press [SPACE] to enter the EBOOT menu.
(4) Press [5] to enter the Flash manage menu.
(5) Press [a], [b], [c] separately to write the image(XLDR, EBOOT, NK) to flash.
(6) Press [0] to return to the main menu, and press [2], [4], [7], [y] to change the boot device.
(7) Power on the system again, and then the board will boot from the NAND flash.

XIII The development of application

This section introduces how to develop the application run on DevKit8000 hardware platform on the basis of Windows Embedded CE 6.0 operating system. The following preparations should be made:

• Run the installation package DevKit8000 Software Development Kit(SDK)(DevKit8000_SDK.msi)under CD directory [\wince_6\sdk], and finish the SDK installation in accordance with hints.

Notes:

1. *If user needs to use DevKit8000 BS to develop Windows Embedded CE 6. operating system, the construction of Windows Embedded CE 6.0 development platform is required.*
2. *The installation of Windows Mobile 6 Professional SDK other than DevKit8000 SDK is advised. You can obtain this software through [http://www.microsoft.com/downloads/details.aspx?familyid=06111A3A-A651-4745-88EF-3D48091A390B&displaylang=en].*
3. *The development example of this manual is based on the development of Windows Mobile 6 Professional SDK.*

13.1 The interface and demonstration of application

The Application Programming Interface(API)used by DevKit8000 application development employs the standard application interface of Windows Embedded CE 6.0. DevKit8000 just has an additional GPIO interface based on standard API.

Note:

1. *For interface definition of Windows Embedded CE 6.0 standard application, please refer to related help documents of MSDN Windows Embedded CE 6.0 API.*
2. *The example of the use of standard API is provided in the section of " 7.2 The development demonstration of interface application".*
3. *Some interfaces are just used for drivers. They can't be used by the application programmer..*

13.1.1The definition and demonstration of GPIO interface

GPIO device name L"GIO1:", to expand DeviceIoControl interface definition, corresponding IOCTL code includes:

IOCTL Code	Description
IOCTL_GPIO_SETBIT	Set GPIO pin as 1
IOCTL_GPIO_CLRBIT	Set GPIO pin as 0
IOCTL_GPIO_GETBIT	Read GPIO pin
IOCTL_GPIO_SETMODE	Set the working mode of GPIO pin

IOCTL_GPIO_GETMODE	Read the working mode of GPIO pin
IOCTL_GPIO_GETIRQ	Read the corresponding IRQ of GPIO pin

Operation example is showed below:

1. Open GPIO device

```
    HANDLE hFile = CreateFile(_T("GIO1:"), (GENERIC_READ|GENERIC_WRITE),
(FILE_SHARE_READ|FILE_SHARE_WRITE), 0, OPEN_EXISTING, 0, 0);
```

2. Set/read the working mode of GPIO

```
    DWORD id = 0, mode = 0;
```

Set the working mode of GPIO:

```
    DWORD pInBuffer[2];
    pInBuffer[0] = id;
    pInBuffer[1] = mode;
    DeviceIoControl(hFile, IOCTL_GPIO_SETMODE, pInBuffer, sizeof(pInBuffer), NULL, 0, NULL, NULL);
```

Read the working mode of GPIO:

```
    DeviceIoControl(hFile, IOCTL_GPIO_GETMODE, &id, sizeof(DWORD), &mode, sizeof(DWORD), NULL, NULL);
```

"id" is GPIO Pin number, "mode" is GPIO mode, including:

Mode definition	Description
GPIO_DIR_OUTPUT	Output mode
GPIO_DIR_INPUT	Input mode
GPIO_INT_LOW_HIGH	Rising edge trigger mode
GPIO_INT_HIGH_LOW	Falling edge trigger mode
GPIO_INT_LOW	low level trigger mode
GPIO_INT_HIGH	high level trigger mode
GPIO_DEBOUNCE_ENABLE	Jumping trigger enable

1. The operation of GPIO Pin

```
    DWORD id = 0, pin = 0;
```

Output high level:

```
    DeviceIoControl(hFile, IOCTL_GPIO_SETBIT, &id, sizeof(DWORD), NULL, 0, NULL, NULL);
```

Output low level:

```
    DeviceIoControl(hFile, IOCTL_GPIO_CLRBIT, &id, sizeof(DWORD), NULL, 0, NULL, NULL);
```

Read the pin state

```
    DeviceIoControl(hFile, IOCTL_GPIO_GETBIT, &id, sizeof(DWORD), &pin, sizeof(DWORD), NULL, NULL);
```

"id" is GPIO pin number, "pin" returns to pin state

2. Other optional operation

Read the corresponding IRQ number of GPIO pin

```
    DWORD id = 0, irq = 0;
    DeviceIoControl(hFile, IOCTL_GPIO_GETIRQ, &id, sizeof(DWORD), &irq, sizeof(DWORD), NULL, NULL);
```

"id" is GPIO pin number, "irq" returns IRQ number

3. Close GPIO device

```
    CloseHandle(hFile);
```

Notes:

1. GPIO pin definition: 0~191 MPU Bank1~6 GPIO pin, 192~209 TPS65930 GPIO 0~17.

2. *GPIO interrupt mode is used for drivers, application cannot set this mode.*
3. *For definition of IOCTL code and GPIO mode, please refer to CD file [\wince_6\inc\gpio.h] User should include the header file.*

13.2 The development demonstration of interface application

This section mainly covers the development process of the said ADevKit8000 test program.

13.2.1 New solution

1. Open Visual Studio 2005.
2. Select File [New->Project].
3. Select MFC Smart Device Application template [Visual C++->Smart Device].
4. Select a file name and open MFC Smart Device Application Wizard.
5. In Platforms page, just select Windows Mobile 6 Professional SDK.
6. In Application Type page, select properties of Dialog based.
7. Continue to finish the Wizard.

13.2.2 Edit the resources and code

Please refer to the source code project in the CD:\wince_6\app\ADevKit8000.

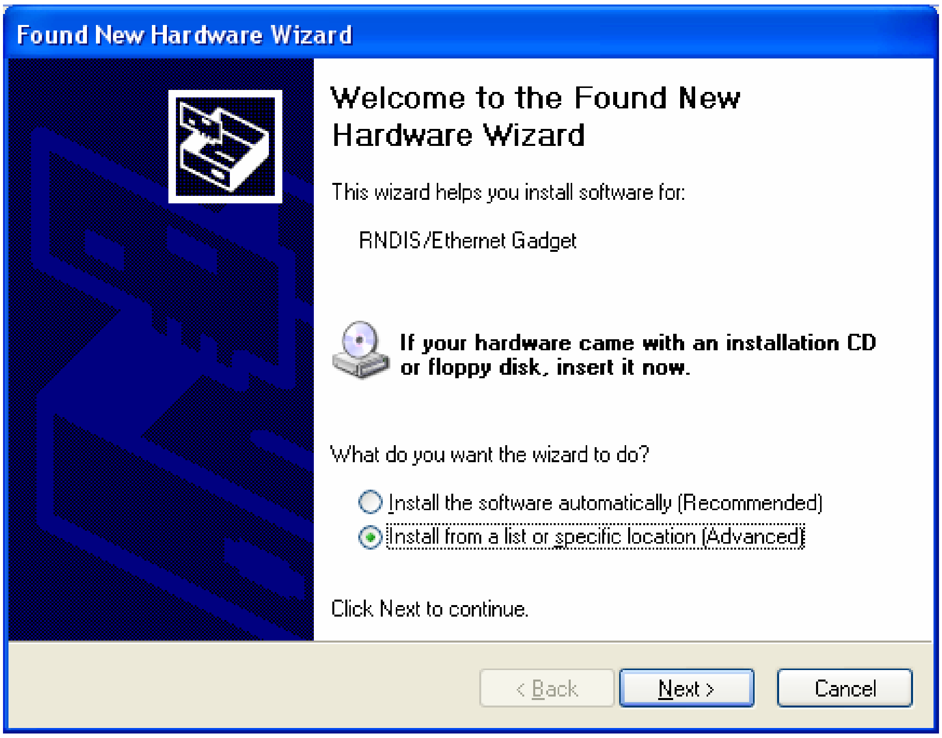
13.2.3 Build solution

1. Select [Build-> Build Solution] to generate a solution(ADevKit8000.exe).
2. Download the test program. For details, please refer to the description about the test in section of software and hardware system.

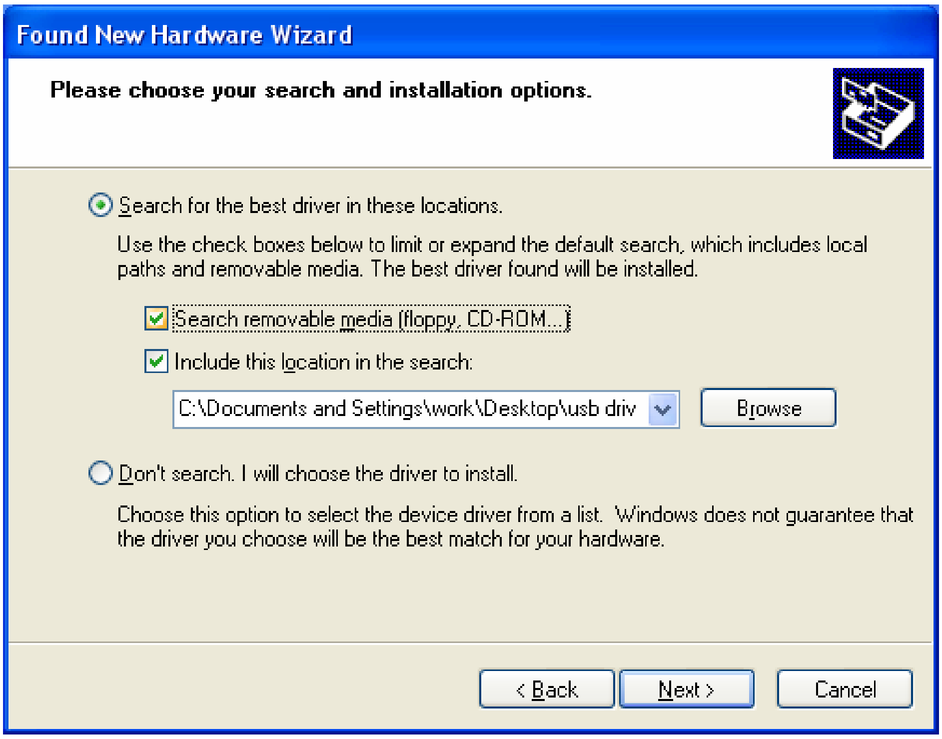
Appendix

Appendix I Driver installation of Linux USB Ethernet/RNDIS Gadget

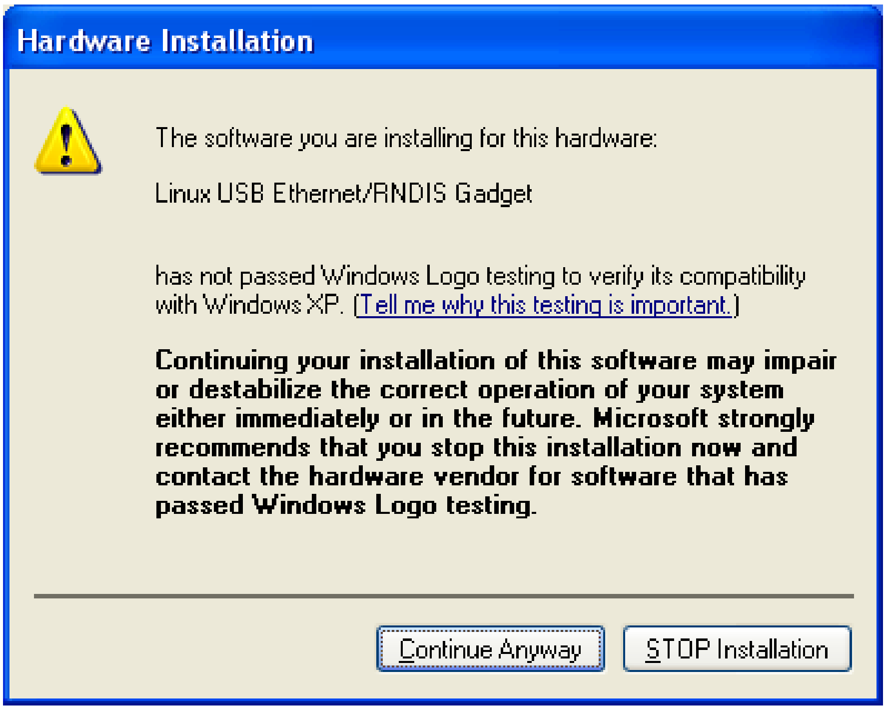
1. If you don't install driver of Linux USB Ethernet/RNDIS Gadget, PC will find the new hardware and give you a hint on the screen, please select "From list or designated location", then click "Next"



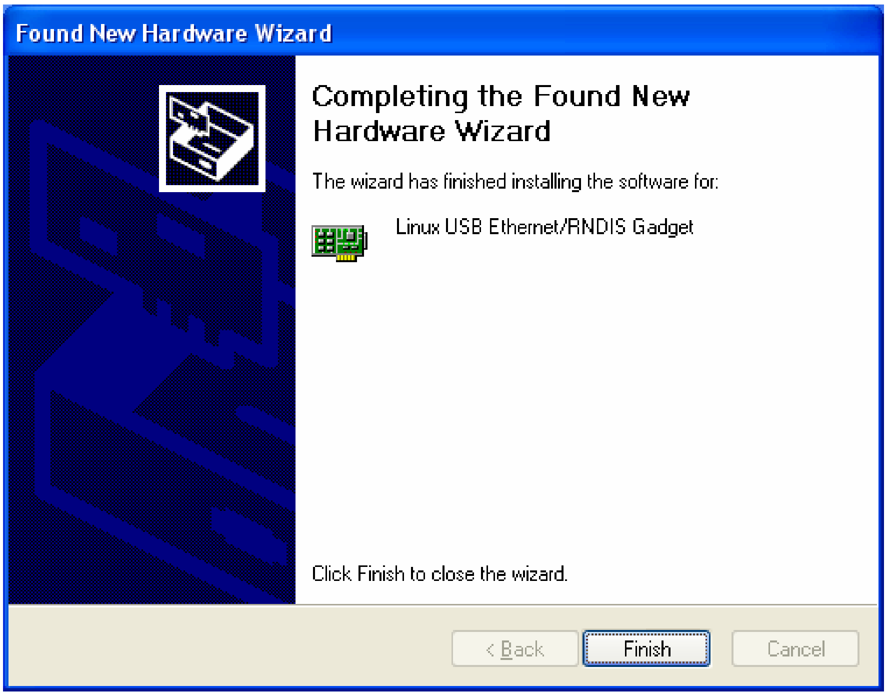
2. Designate a path for the usb driver, then click "Next"



3. When the following appears, select “Continue”



4. Please wait until the installation is completed


Found New Hardware Wizard
Completing the Found New Hardware Wizard
The wizard has finished installing the software for:
Linux USB Ethernet/RNDIS Gadget
Click Finish to close the wizard.
< Back
Finish
Cancel

Appendix II Linux Boot Disk Format

How to create a dual-partition card for DevKit8000 to boot Linux from first partition and have root file system at second partition

Introduction

This guide is meant for those looking to create a dual-partition card, booting from a FAT partition that can be read by the OMAP3 ROM bootloader and Linux/Windows, then utilizing an ext3 partition for the Linux root file system.

Details

Text marked with [] shows user input.

1. Determine which device the SD Card Reader is on your system

Plug the SD Card into the SD Card Reader and then plug the SD Card Reader into your system. After doing that, do the following to determine which device it is on your system.

```
$ [dmesg | tail]
...
[ 6854.215650] sd 7:0:0:0: [sdc] Mode Sense: 0b 00 00 08
[ 6854.215653] sd 7:0:0:0: [sdc] Assuming drive cache: write through
[ 6854.215659]   sdc: sdc1
[ 6854.218079] sd 7:0:0:0: [sdc] Attached SCSI removable disk
[ 6854.218135] sd 7:0:0:0: Attached scsi generic sg2 type 0
...
```

In this case, it shows up as /dev/sdc (note sdc inside the square brackets above).

2. Check to see if the automounter has mounted the SD Card

Note there may be more than one partition (only one shown in the example below).

```
$ [df -h]
Filesystem            Size   Used Avail Use% Mounted on
...
/dev/sdc1             400M    94M   307M   24% /media/disk
...
```

Note the "Mounted on" field in the above and use that name in the umount commands below.

3. If so, unmount it

```
$ [umount /media/disk]
```

4. Start fdisk

Be sure to choose the whole device (/dev/sdc), not a single partition (/dev/sdc1).

```
$ [sudo fdisk /dev/sdc]
```

5. Print the partition record

So you know your starting point. Make sure to write down the number of bytes on the card (in this example, 2021654528).

```
Command (m for help): [p]

Disk /dev/sdc: 2021 MB, 2021654528 bytes
255 heads, 63 sectors/track, 245 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
   Device Boot      Start         End      Blocks   Id  System
/dev/sdc1   *           1         246     1974240+   c  W95 FAT32 (LBA)
Partition 1 has different physical/logical endings:
     phys=(244, 254, 63) logical=(245, 200, 19)
```

6. Delete any partitions that are there already

```
Command (m for help): [d]
Selected partition 1
```

7. Set the Geometry of the SD Card

If the print out above does not show 255 heads, 63 sectors/track, then do the following expert mode steps to redo the SD Card:

1). Go into expert mode.

```
Command (m for help): [x]
```

2). Set the number of heads to 255.

```
Expert Command (m for help): [h]
Number of heads (1-256, default xxx): [255]
```

3)Set the number of sectors to 63.

```
Expert Command (m for help): [s]
Number of sectors (1-63, default xxx): [63]
```

4)Now Calculate the number of Cylinders for your SD Card.

```
#cylinders = FLOOR (the number of Bytes on the SD Card (from above) / 255 / 63 / 512 )

So for this example:   2021654528 / 255 / 63 / 512 = 245.79.   So we use 245 (i.e. truncate, don't round).
```

5)Set the number of cylinders to the number calculated.

```
Expert Command (m for help): [c]
Number of cylinders (1-256, default xxx): [enter the number you calculated]
```

6)Return to Normal mode.

```
Expert Command (m for help): [r]
```

8. Print the partition record to check your work

```
Command (m for help): [p]

Disk /dev/sdc: 2021 MB, 2021654528 bytes
255 heads, 63 sectors/track, 245 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes

   Device Boot      Start         End      Blocks   Id  System
```

9. Create the FAT32 partition for booting and transferring files from Windows

```
Command (m for help): [n]
Command action
   e   extended
   p   primary partition (1-4)
[p]
Partition number (1-4): [1]
First cylinder (1-245, default 1): [(press Enter)]
Using default value 1
Last cylinder or +size or +sizeM or +sizeK (1-245, default 245): [+5]

Command (m for help): [t]
Selected partition 1
Hex code (type L to list codes): [c]
Changed system type of partition 1 to c (W95 FAT32 (LBA))
```

10. Mark it as bootable

```
Command (m for help): [a]
Partition number (1-4): [1]
```

11. Create the Linux partition for the root file system

```
Command (m for help): [n]
Command action
   e   extended
   p   primary partition (1-4)
[p]
Partition number (1-4): [2]
First cylinder (52-245, default 52): [(press Enter)]
Using default value 52
Last cylinder or +size or +sizeM or +sizeK (52-245, default 245): [(press Enter)]
Using default value 245
```

12. Print to Check Your Work

```
Command (m for help): [p]

Disk /dev/sdc: 2021 MB, 2021654528 bytes
```

```
255 heads, 63 sectors/track, 245 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sdc1   *           1          51      409626    c  W95 FAT32 (LBA)
/dev/sdc2              52         245     1558305   83  Linux
```

13. Save the new partition records on the SD Card

This is an important step. All the work up to now has been temporary.

```
Command (m for help): [w]
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table.
The new table will be used at the next reboot.

WARNING: If you have created or modified any DOS 6.x
partitions, please see the fdisk manual page for additional
information.
Syncing disks.
```

14. Format the partitions

The two partitions are given the volume names LABEL1 and LABEL2 by these commands. You can substitute your own volume labels.

```
$ [sudo mkfs.msdos -F 32 /dev/sdc1 -n LABEL1]
mkfs.msdos 2.11 (12 Mar 2005)

$ [sudo mkfs.ext3 -L LABEL2 /dev/sdc2]
mke2fs 1.40-WIP (14-Nov-2006)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
195072 inodes, 389576 blocks
19478 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=402653184
12 block groups
32768 blocks per group, 32768 fragments per group
16256 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912
```

```
Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information:
```

Notes: After formatting and dividing into FAT and EXT3 under ubuntu system, the FAT needs reformatting under windows system, otherwise, start-up with SD card can be realized.

Appendix III The setup of tftp server

1. Install client

```
$>sudo apt-get install tftp-hpa
$>sudo apt-get install tftpd-hpa
```

2. Install inet

```
$>sudo apt-get install xinetd
$>sudo apt-get install netkit-inetd
```

3. Configure the server

First, create tftpboot under root directory, and set the properties as "a random user can write and read"

```
$>cd /
$>sudo mkdir tftpboot
$>sudo chmod 777 tftpboot
```

Secondly, add in /etc/inetd.conf:

```
$>sudo  vi  /etc/inetd.conf      //copy the follow word to this file
tftpd dgram udp wait root /usr/sbin/in.tftpd /usr/sbin/in.tftpd -s /tftpboot
```

Then, reload inetd process:

```
$>sudo /etc/init.d/inetd reload
```

Finally, enter directory /etc/xinetd.d/, and create a new file tftp and put the designated content into file tftp:

```
$>cd /etc/xinetd.d/
$>sudo touch tftp
$>sudo vi tftp          ////copy the follow word to tftp file
service tftp
{
   disable = no
   socket_type   = dgram
   protocol      = udp
   wait          = yes
   user          = root
   server        = /usr/sbin/in.tftpd
   server_args   = -s /tftpboot -c
   per_source    = 11
   cps           = 100 2
}
```

4. Reboot the server:

```
$>sudo /etc/init.d/xinetd restart
$>sudo in.tftpd -l /tftpboot
```

5. Test the server

Conduct a test; create a file under folder /tftpboot

```
$>touch abc
```

Enter into another folder

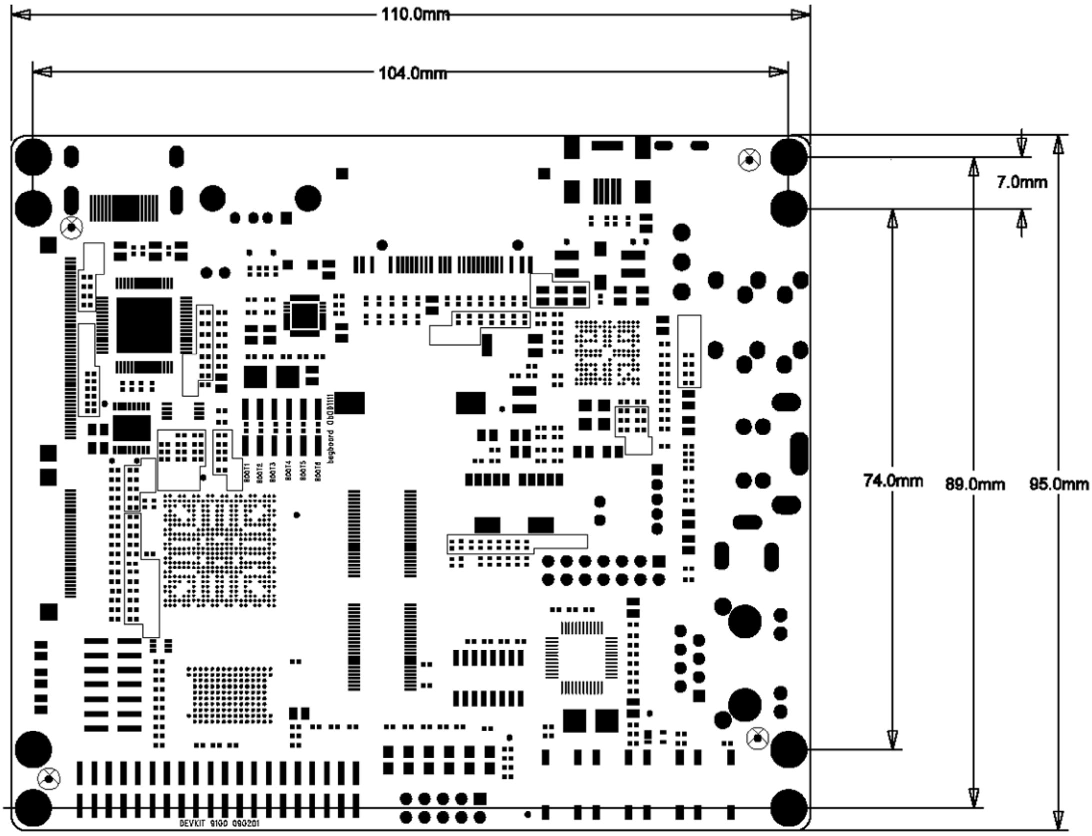
```
$>tftp 192.168.1.15  (192.168.1.15was the server IP)
$>tftp> get abc
```

That download can be made means the server has been installed.

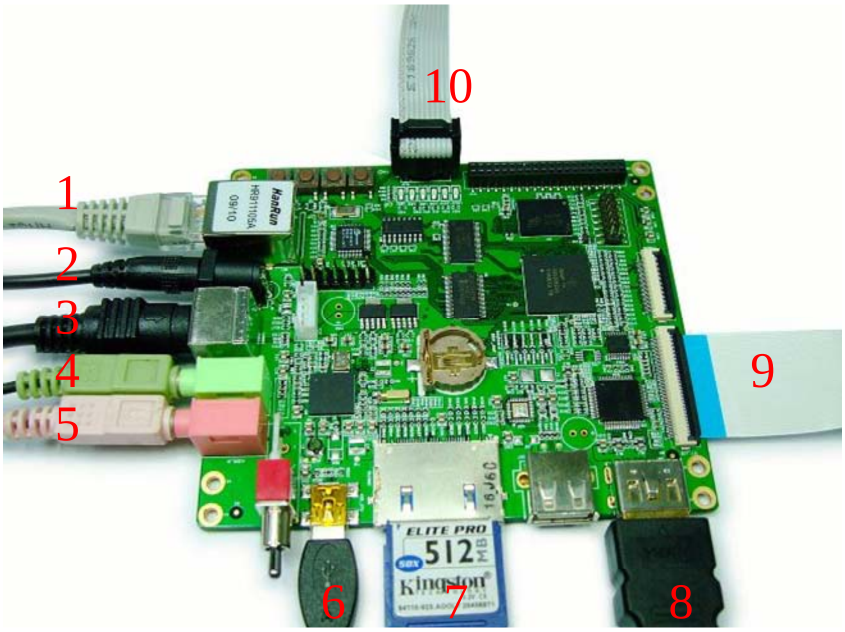
Appendix IV WinCE source

1. Windows Embedded CE 6.0 Platform Builder Service Pack 1
http://www.microsoft.com/downloads/details.aspx?familyid=BF0DC0E3-8575-4860-A8E3-290ADF242678&displaylang=en
2. Windows Embedded CE 6.0 R2
http://www.microsoft.com/downloads/details.aspx?FamilyID=f41fc7c1-f0f4-4fd6-9366-b61e0ab59565&displaylang=en
3. Embedded CE 6.0 Platform Builder - Cumulative Product Update Rollup Package (through 12/31/2008)
http://www.microsoft.com/downloads/details.aspx?FamilyID=b478949e-d020-465e-b451-73127b30b79f&DisplayLang=en

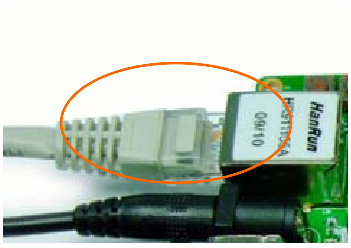
Appendix V Dimensions



Appendix VI Peripheral connection

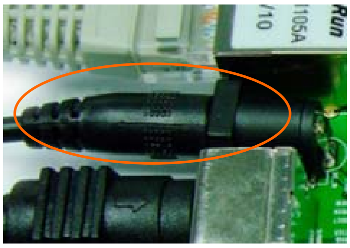


Peripheral connection of DevKit8000



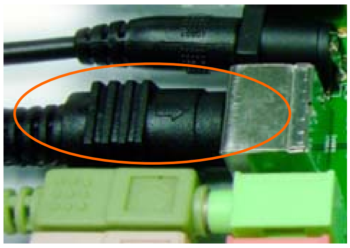
1 NET

Connect an Ethernet cable to the NET jace on the board, Connect the other end to a router or Ethernet switch.



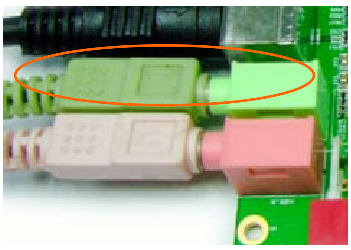
2 Power

Connect the power cable to the DC_IN jace on the board.



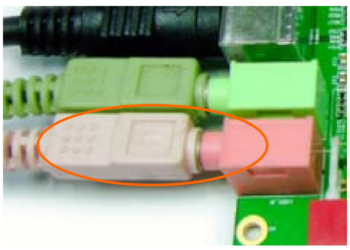
3 S-Video

Connect the S-Video cable to the SVIDEO jack on the board, Connect the other end to a S-video device.



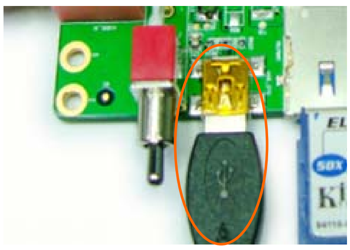
4 Audio Out

Connect AUDIO_OUT to an audio source such as a MP3 player.



5 Mic in

Connect an Mic to the AUDIO_OUT jack on the board.

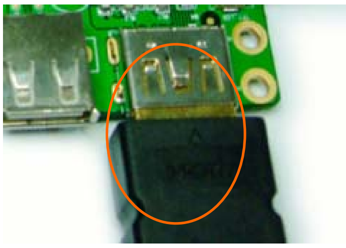


6 USB OTG

Connect the USB cable to the USB_OTG jack on the board, Connect the other end to USB device or USB HOST device.

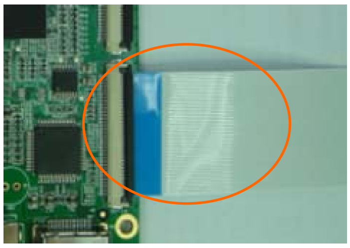
7 SD Card

Insert the SD card to the SD?MMC jace on the board.



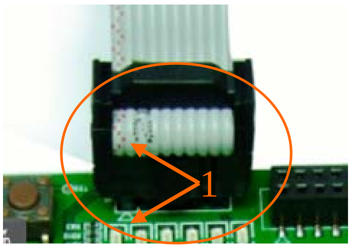
8 HDMI

Connect the HDMI to DVI_D cable to the DVI_D jack on the board, Connect the other end to a DVI_D monitor.



9 LCD

Connect the LCD cable to the TFTT_LCD jack on the board, Connect the other end to a LCD module.



10 serial

Connect the serial cable to the UART3 jack on the board, Connect the other end to a PC or workstation.