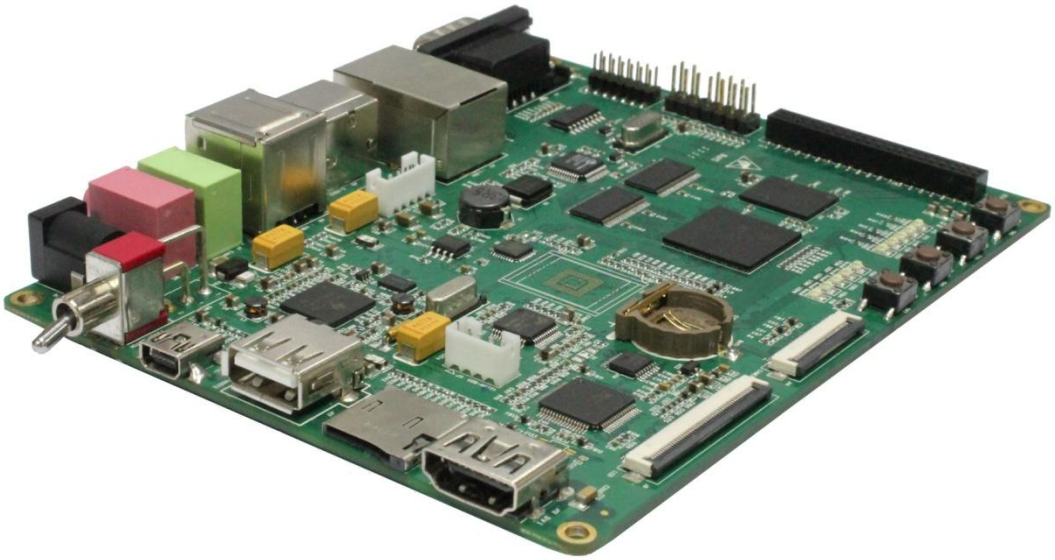
DM3730-EVK

Integrated with LCD, USB, CCD/COMS, Audio input/output, S-video, Ethernet, Serial port, TF card interface based on 32-bit microcontroller



User Manual

Version updates record:

Rev	Date	Description
1.0	2011.6.20	Initial version
1.1	2011.8.5	Parts of contents have been amended to avoid ambiguity

Contents

Chapter 1 Overview

1.1 Product introduction

DM3730-EVK is based on TI DM3730 processor. The processor integrates ARM Cortex™-A8 kernel at 1GHz and DSP core (DM3730 only) running at 800MHz with high-level digital signal processing functions, and provides rich peripheral interfaces. DM3730-EVK expands LAN port, S-VIDEO interface, audio input/output interface, USB, TF interface, serial port, SPI interface, IIC interface, JTAG interface, CAMERA interface, TFT interface, touch screen interface, keyboard interface and HDMI interface.

DM3730-EVK can be used in the following applications:

- Portable Data Terminals
- Navigation
- Auto Infotainment
- Gaming
- Medical Equipment
- Home Automation
- Human Interface
- Industrial Control
- Test and Measurement
- Single board Computers

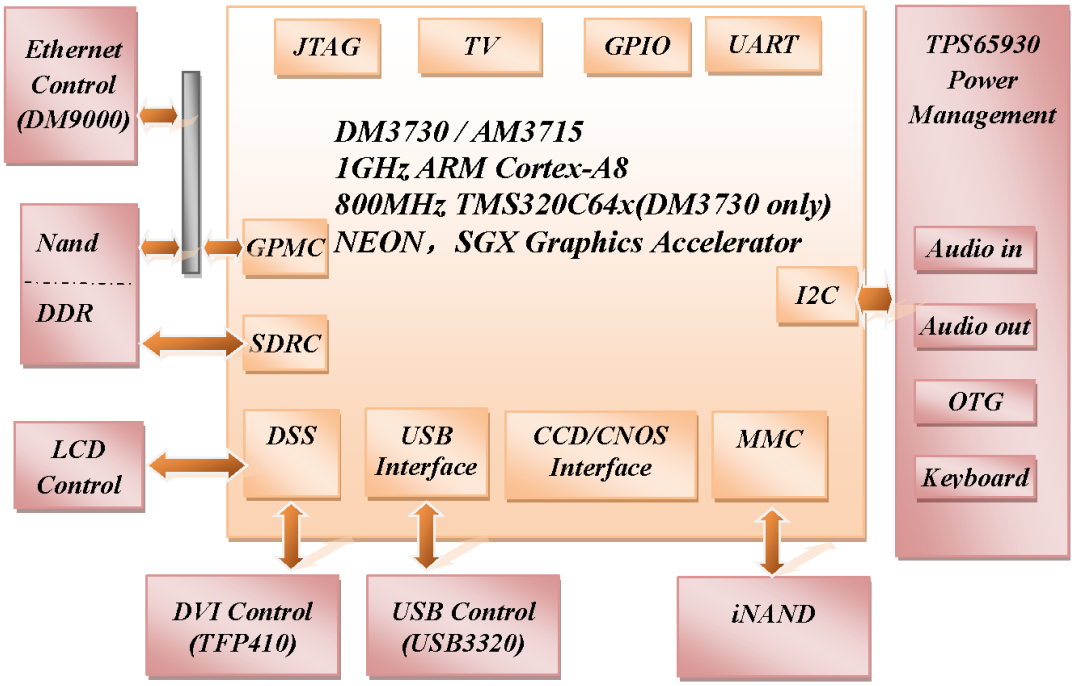


Figure 1.1 DM3730-EVK function block diagram

1.2 Features

DM3730-EVK evaluation board is based on DM3730 processor and it integrates all the functions and features of this IC's. The features of this board are as follows:

Mechanical Parameters

- Working temperature: -30°C ~ 70°C
- Humidity Range: 20% ~ 90%
- Dimensions: 136.2mm*105.3mm
- Input Voltage: +5V

Processor

- 1GHz ARM Cortex™-A8 Core
- 800-MHz TMS320C64x+™ DSP Core (DM3730 only)
- NEON™ SIMD Coprocessor
- POWERVR SGX™ Graphics Accelerator
- ARM: 32 KB I-Cache; 32 KB D-Cache; 256KB L2 Cache
- On Chip: 64KB RAM; 32KB ROM

Memory

- 512MB 32bit DDR SDRAM

- 512MB 16bit NAND Flash
- 2GB 4bit iNAND (Default: not soldered, optional, reserved for soldering)

Audio/Video Interfaces

- An S-VIDEO interface
- An HDMI (DVI-D) interface
- An audio input interface (3.5mm audio jack)
- A two-channel audio output interface (3.5mm audio jack)

LCD/Touch screen

- RGB, 24 bit colors
- Resolution up to 2048*2048
- 4 line Touch Screen

Data Transfer Interface

- Serial port:
  - UART1, 5 line serial port, TTL based voltage
  - UART2, 5 line serial port, TTL based voltage
  - UART3, 5 line serial port, RS232 based voltage
- USB port:
  - 1 x USB2.0 OTG, High-speed, 480Mbps
  - 4 x USB2.0 HOST, High-speed, 480Mbps
- TF card interface
- 10/100Mbps Ethernet Interface (RJ45 jack)
- 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 channel Camera interface (Support CCD or CMOS camera)
- 6*6 keyboard interface
- 14-pin JTAG interface
- 4 buttons (2 USER buttons, 1 RESET button, 1 ON/OFF button)

LED

- 1 Power LED
- 2 System LEDs
- 2 User LEDs
- 4 USB Host LEDs
- 1 USB Hub LED

Chapter 2 Hardware System

2.1 CPU

2.1.1 CPU Introduction

As a high-performance processor for enhanced digital media, DM37x employs TI 45nm advanced industrial technology; this architecture has the advantage of low power consumption at the same time of being designed for ARM and graphical demonstration.

The Texas Instruments' DM3730 DaVinci™ digital media processor is powered by up to 1-GHz (also supports 300, 600, and 800-MHz operation) ARM Cortex-A8 and 800-MHz (also supports 250, 520 and 660-MHz operation) C64x+ DSP core, and has integrated 3D graphics processor, imaging and video accelerator (IVA), USB 2.0, MMC/SD memory card, UART and many more. DaVinci DM3730 video processor is pin-to-pin compatible with Sitara AM37x devices and software compatible with the OMAP35x processors. The C64x+ DSP and hardware video accelerator enable audio and HD 720p video decoding and encoding independent of the ARM processor. The programmable DSP engine allows multiple signal processing tasks such as image processing and analysis, digital filtering, and math functions. DaVinci DM3730 video processor is suitable for 720p HD (High Definition) video applications which require large amount of data processing.

2.1.2 CPU Features

Clock

The CPU clock includes sys_32k, sys_altclk, sys_clkout1, sys_clkout2, sys_xtalout, sys_xtalin, sys_clkreq.

The sys_32k 32-kHz clock is used for low frequency operation. It supplies the wake-up domain signals for operating in lowest power mode (off mode). This clock is provided through the sys_32k pin. The 32-kHz is generated by power management.

The sys_xtalin / sys_xtalout system input clock (26 MHz) is used to generate the main source clock for the device. It supplies the DPLLs as well to several other modules.

Reset

The function of reset is decided by the SYS_NRESPWRON signal on the CPU, Reset is enabled when LOW level signal (high to low) is given.

General-Purpose Interface

The general-purpose interface combines six general-purpose input/output (GPIO) banks.

Each GPIO bank provides 32 dedicated general-purpose pins with input and output capabilities; thus, it supports up to 192 (6 x 32) general-purpose interface pins.

These pins can be configured for the following applications:

- Data input (capture)/output (drive)
- Keyboard interface with a debounce cell
- Interrupt generation in active mode when external events are detected.

Display Subsystem

The display subsystem provides the logic to display a video frame from the memory frame buffer (either SDRAM or SRAM) on a liquid-crystal display (LCD) panel or a TV set. The display subsystem integrates the following elements:

- Display controller (DISPC) module
- Remote frame buffer interface (RFBI) module
- Display serial interface (DSI) complex I/O module and a DSI protocol engine
- DSI PLL controller that drives a DSI PLL and high-speed (HS) divider.
- NTSC/PAL video encoder

The display controller and the DSI protocol engine are connected to the L3 and L4 interconnect; the RFBI and the TV out encoder modules are connected to the L4 interconnect.

2D/3D Graphics Accelerator

The 2D/3D graphics accelerator (SGX) subsystem accelerates 2-dimensional (2D) and 3-dimensional (3D) graphics applications. The SGX subsystem is based on the POWERVR® SGX core from Imagination Technologies. SGX is a new generation of programmable POWERVR graphic cores. The POWERVR SGX530 v1.2.5 architecture is scalable and can target all market segments from mainstream mobile devices to high-end desktop graphics. Targeted applications

include feature phone, PDA, and hand-held games.

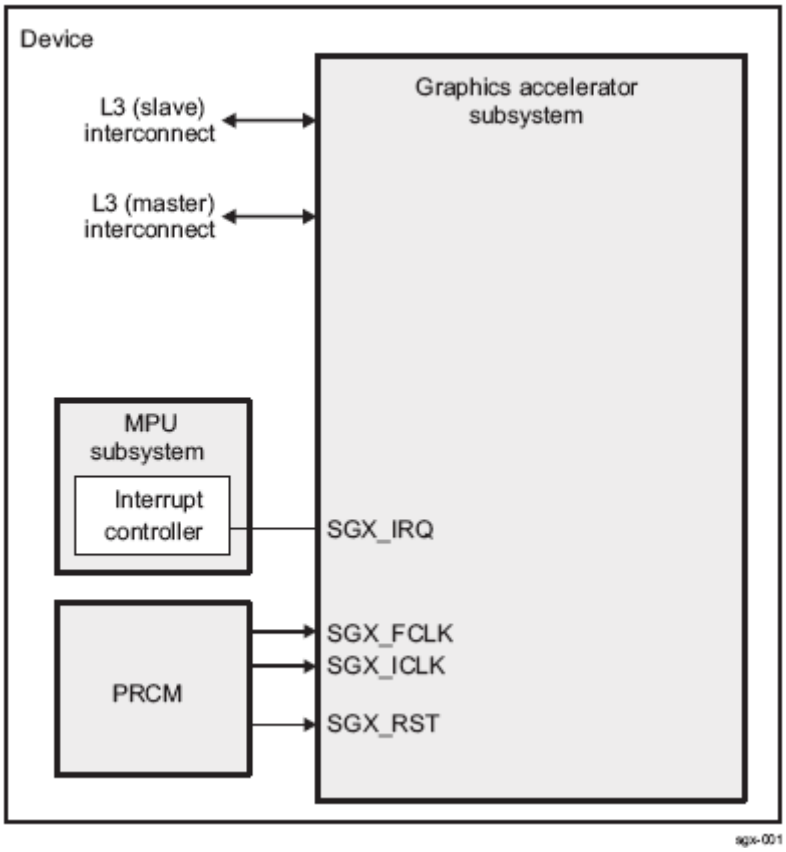


Figure 2-1-2

The SGX graphics accelerator can simultaneously process various multimedia data types:

- Pixel data
- Vertex data
- Video data
- General-purpose processing

This is achieved through a multithreaded architecture using two levels of scheduling and data partitioning enabling zero-overhead task switching.

2.2 Description of different IC blocks

2.2.1 TPS65930

The TPS65930 devices are power-management ICs for OMAP™ and other mobile applications. The devices include power-management, a universal serial bus (USB) high-speed (HS) transceiver, light-emitting diode (LED) drivers, an analog-to-digital converter (ADC), a real-time clock (RTC), and embedded power control (EPC). In addition, the TPS65930 includes a full audio

codec with two digital-to-analog converters (DACs) and two ADCs to implement dual voice channels, and a stereo downlink channel that can play all standard audio sample rates through a multiple format inter-integrated sound (I2S™)/time division multiplexing (TDM) interface.

TPS65930（U1）is communicated with CPU through I2C protocol, the main function of this is to provide 1.2V and 1.8V to CPU, to make CPU run normally. Besides, TPS65930 also has functions of Audio in, Audio out, OTG PHY, Keyboard, ADC and GPIO.

2.2.2 MT29C4G96MAZAPCJA-5

As the storage chip of DM3730-EVK, MT29C4G96MAZAPCJA-5 is a memory device used for storage, it is integrated with NAND Flash and SDRAM DDR, its memory size is 512MB. NAND Flash realizes data access through GPMC bus, while DDR realizes data access through SDRAM Controller（SDRC）.

2.2.3 DM9000

The DM9000A is a fully integrated and cost-effective low pin count single chip Fast Ethernet controller with a general processor interface, a 10/100M PHY and 4K Dword SRAM. It is designed with low power and high performance process that support 3.3V with 5V IO tolerance.

DM3730-EVK uses 10/100M adaptive network interface of DM9000, in which, the 10/100M Ethernet module is built-in and is compatible to IEEE 802.3 standard protocol. The cable interface is a standard RJ45, with a connection indicator and a transmission indicator.

DM3730-EVK can be connected to network hub through a direct cable, also can be directly connected with a computer through a crossover cable.

2.2.4 FE1.1 for USB 2.0 High Speed 4-Port Hub

The FE1.1 is a highly integrated, high quality, high performance, low power consumption, yet low cost solution for USB 2.0 High Speed 4-Port Hub.

It adopts Multiple Transaction Translator (MTT) architecture to explore the maximum possible throughput. Six, instead of two, non-periodic transaction buffers are used to minimize potential traffic jamming.

2.2.5 TFP410

The TFP410 is a Texas Instruments *PanelBus* flat panel display product, part of a comprehensive family of end-to-end DVI 1.0-compliant solutions, targeted at the PC and consumer electronics industry.

The TFP410 provides a universal interface to allow a glue-less connection to most commonly available graphics controllers. Some of the advantages of this universal interface include selectable bus widths, adjustable signal levels, and differential and single-ended clocking. The adjustable 1.1-V to 1.8-V digital interface provides a low-EMI, high-speed bus that connects seamlessly with 12-bit or 24-bit interfaces. The DVI interface supports flat panel display resolutions up to UXGA at 165 MHz in 24-bit true color pixel format.

2.2.6 MAX3232

The function of MAX3232 is mainly to translate TTL logic level signal into RS232 logic level, which helps in communicating the board with PC.

DM3730-EVK uses UART3 as debugging serial port; as the default voltage of UART3 is 1.8V, it is necessary to convert this voltage to 3.3V in order to connect to eternal world.

2.3 Hardware interface

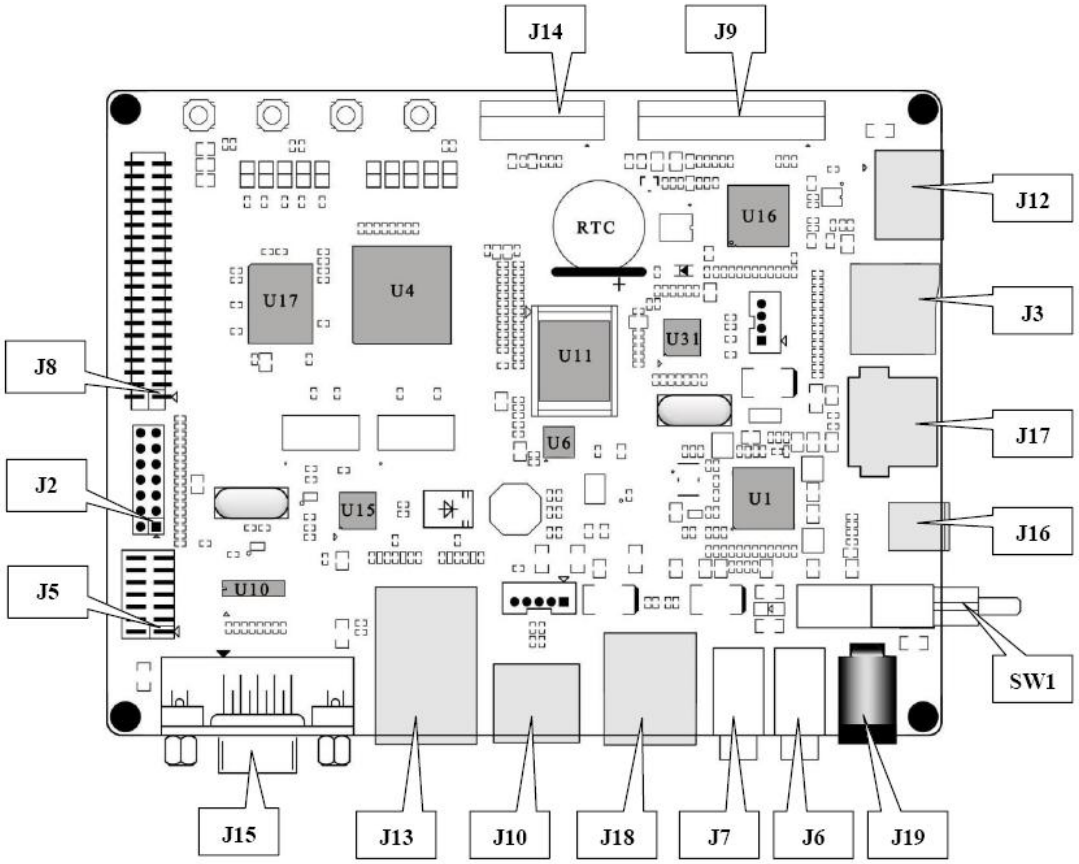


Figure 2.3 DM3730-EVK Hardware Interface Diagram

The following section gives in detail about the pin numbers and its function description of various different IC's blocks present in DM3730-EVK.

2.3.1 Power Input Jack

J19		
Pin	**Signal**	**Function**
1	GND	GND
2	+5V	Power supply (+5V) 2A (Type)

Table 2-3-1 power input interface

2.3.2 Power Output Interface

J4		
Pin	**Signal**	**Function**
1	VDD50	5V output
2	NC	NC
3	VDD33	3.3V output
4	ADCIN	ADC input
5	GND	GND

Table 2-3-2 power output interface

2.3.3 Power Switch

SW1		
Pin	**Signal**	**Function**
1	DC IN	VDD Input
2	VDD50	+5V
3	NC	NC

Table 2-3-3 power switch

2.3.4 S-VIDEO Interface

J4		
Pin	**Signal**	**Function**
1	GND	GND
2	GND	GND
3	OUTPUT1	VIDEO Y
4	OUTPUT2	VIDEO C

Table 2-3-4 S-VIDEO interface

2.3.5 HDMI Interface

J12		
Pin	**Signal**	**Function**
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

Table 2-3-5 HDMI interface

2.3.6 TFT_LCD Interface

J12		
Pin	**Signal**	**Function**
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
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

Table 2-3-6 TFT_LCD interface

2.3.7 AUDIO OUTPUT Jack

J7		
Pin	**Signal**	**Function**
1	GND	GND
2	NC	NC
3	Right	Right output
4	NC	NC
5	Left	Left output

Table 2-3-7 Audio out interface

2.3.8 Camera Interface

J14		
Pin	**Signal**	**Function**
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

Table 2-3-8 camera interface

2.3.9 MIC IN Jack

J6		
Pin	**Signal**	**Function**
1	GND	GND
2	NC	NC
3	MIC MAIN P	Right input
4	NC	NC
5	MIC MAIN N	Left input

Table 2-3-9 MIC IN interface

2.3.10 Keyboard Interface

J5		
Pin	**Signal**	**Function**
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

Table 2-3-10 keyboard interface

2.3.11 Serial Ports

J15		
Pin	**Signal**	**Function**
1	NC	NC
2	RXD	Receive data
3	TXD	Transit data
4	NC	NC
5	GND	GND
6	NC	NC
7	RTS	Request To Send
8	CTS	Clear To Send
9	NC	NC

Table 2-3-11 serial port

2.3.12 LAN Interface

J13		
Pin	**Signal**	**Function**
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

Table 2-3-12 LAN interface

2.3.13 USB OTG Interface

J16		
Pin	**Signal**	**Function**
1	VBUS	+5V
2	DN	USB Data-
3	DP	USB Data+
4	ID	USB ID
5	GND	GND

Table 2-3-13 USB OTG interface

2.3.14 USB HOST Interface

J17		
Pin	**Signal**	**Function**
1	VBUS	+5V
2	DN	USB Data-
3	DP	USB Data+
4	ID	USB ID

Table 2-3-14 USB HOST interface

2.3.15 TF Card Interface

J3		
Pin	**Signal**	**Function**
1	DAT2	Card data 2
2	DAT3	Card data 3
3	CMD	Command Signal
4	VDD	VDD
5	CLK	Clock
6	VSS	VSS
7	DAT0	Card data 0
8	DAT1	Card data 1
9	CD	Card detect

Table 2-3-15 TF interface

2.3.16 JTAG Interface

J2		
Pin	**Signal**	**Function**
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

Table 2-3-16 JTAG interface

2.3.17 Expansion Interface

J8		
Pin	**Signal**	**Function**
1	GND	GND
2	BSP1_DX	Transmitted serial data 1
3	BSP1_DR	Received serial data 1
4	BSP1_CLK	Received clock 1
5	BSP1_FSX	Transmit frame synchronization 1
6	BSP1_CLK	Transmit clock 1
7	BSP1_CLK	External clock input 1
8	BSP1_FSR	Receive frame synchronization 1
9	UART1_CT	UART1 clear to send
10	UART1_RT	UART1 request to send
11	UART1_RX	UART1 receive data
12	UART1_TX	UART1 transmit data
13	GND	GND

14	GPIO_136	GPIO_136
15	GPIO_126	GPIO_126
16	GPIO_137	GPIO_137
17	GPIO_129	GPIO_129
18	GPIO_138	GPIO_138
19	GPIO_55	GPIO_55
20	GPIO_139	GPIO_139
21	GPIO_56	GPIO_56
22	GPIO_61	GPIO_61
23	GPIO_65	GPIO_65
24	BSP3_DX	Transmitted serial data 3
25	BSP3_DR	Received serial data 3
26	BSP3_CLK	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	GND	GND

Table 2-3-17 expansion interface

2.3.18 KEY

J8		
Pin	**Signal**	**Function**
1	ON/OFF	System ON/OFF key
2	RESET	System reset key
3	USER1	User-defined key 1
4	USER2	User-defined key 2

Table 2-3-18 KEY

2.3.19 LED

LED 1-10		
Pin	**Signal**	**Function**
LED1	3V3	3.3V power indicator
LED 2	SYS	System LED
LED 3	LEDB	System LED
LED 4	LED1	User-defined key 1
LED 5	LED2	User-defined key 2
LED 6	USB1	USB indicator 1
LED 7	USB2	USB indicator 2
LED 8	USB3	USB indicator 3
LED 9	USB4	USB indicator 4
LED 10	HUB	USB HUB indicator

Table 2-3-19 LED

Chapter 3 Linux Operating System

3.1 Introduction

This section is intended to provide detailed instruction on Operating System Software development of DM3730-EVK board.

1) Describes the Software Resources provided by DM3730-EVK.

2) Describes the software feature.

3) Explains the software Development including how to set up the development environment, the building guidance of the boot loader, kernel and file system, and the development of device driver.

4) Provides flashing methods using boot loader commands.

5) Shows the usage of DM3730-EVK

6) Shows the application development.

In this part, it is suggested to:

1) Install Ubuntu Linux in advance, please refer to Appendix II for details;

2） Master relative embedded Linux development technology.

3.2 Software Resources

This chapter provides an overview of software system components of DM3730-EVK. A basic software system consists of four parts: x-loader, u-boot, kernel and rootfs. The Figure 3.2.1 shows the structure of the system:

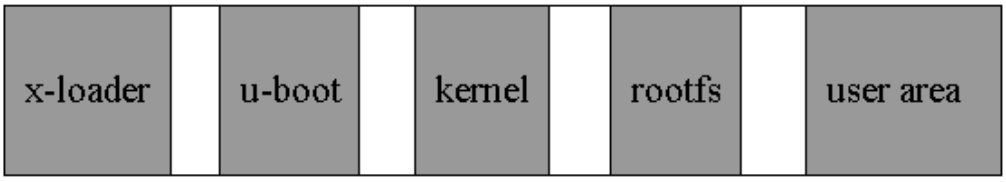


Figure 3.2.1

Features and functions of each part of the system are given below:

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 its routine work. Its main function is to initialize

the CPU, copy u-boot into the memory and give the control 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 here and it can be customized based on DM3730-EVK;

4) Rootfs employs Open-source system. It is small in capacity and powerful, very suitable for embedded systems;

3.3 Software Features

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 DM9000 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 slave device currently)
	USB EHCI	USB EHCI driver
	DVI	Supports dvi-d signal output

	s-video	Supports s-video signal output
	Audio	Audio driver
	Camera	Camera driver
	Keypad	6x6 matrix keyboard driver
	LED	User led lamp driver
Demo	Android	android 2.2 system
	DVSDK	DVSDK 4_00_00_22

Table 3-3-1

3.4 System Development

3.4.1 Establishing operating system development environment

Before executing software development on DM3730-EVK, the user has to establish a Linux cross development environment and install it in computer. How to establish a cross development environment will be introduced below by taking Ubuntu operating system as an example.

3.4.1.1 Installation of cross compilation tools

Installation of cross compilation tools is done by using the software CD provided along with this kit, to start the process insert the CD and allow it for autorun, Ubuntu will mount the disc under the directory /media/cdrom, the cross compilation tools are saved under the directory /media/cdrom/linux/tools.

The following instructions are executed at the Ubuntu terminal to decompress the cross compilation tools under the directory /home/embest:

```
cd /media/cdrom/linux/tools
tar xvf arm-eabi-4.4.0.tar.bz2 -C /home/embest
```

Some of the other development tools used for source code compilation are present in the directory linux/tools of the disc; the user can execute the following commands to copy them to local folder:

```
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
```

It is defaulted to install it under the user directory that is subject to /home/embest in the text; the user can change it to his directory properly.

3.4.1.2 Addition of environment variables

After all above tools are installed, it is necessary to use the following commands to add them in the temporary environment variables:

```
export PATH=/home/embest/arm-eabi-4.4.0/bin:/home/embest/tools:$PATH
```

The user can write it in the .barsrc file under the user directory, such that the addition of environment variables will be finished automatically when the system is booted; command echo $PATH can be used to check the path.

3.4.2 System compilation

3.4.2.1 Preparation

Source codes of all components of the system are under the directory linux/source in the disc; user has to decompress them to the Ubuntu system before executing development:

```
mkdir /home/embest/work
cd /home/embest/work
tar xvf /media/cdrom/linux/source/x-loader-03.00.02.07.tar.bz2
tar xvf /media/cdrom/linux/source/u-boot-03.00.02.07.tar.bz2
tar xvf /media/cdrom/linux/source/linux-2.6.32-dm3730_evk.tar.bz2
tar xvf /media/cdrom/linux/demo/Android/source/rowboat-android-froyo-dm3730_evk.tar.bz2
sudo tar xvf /media/cdrom/linux/source/rootfs.tar.bz2
```

When the above steps are finished, the current directory will generate linux-2.6.32-dm3730_evk, u-boot-03.00.02.07, x-loader-03.00.02.07, rootfs and rowboat-android-froyo-dm3730_evk directories.

3.4.2.2 X-loader image generation

DM3730-EVK supports TF Card boot or NAND boot. The burned x-loader image files are different with the different boot modes, and the corresponding methods for mapping are different 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

```
cd x-loader-03.00.02.07
make distclean
make dm3730_evk_config
make
signGP x-load.bin
mv x-load.bin.ift MLO
```

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

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

To alter the file **x-loader-03.00.02.07**/include/configs/dm3730_evk.h and annotate the following:

```
vi x-loader-03.00.02.07/include/configs/dm3730_evk.h
// #define CONFIG_MMC          1
```

Cross compilation:

```
cd x-loader-03.00.02.07
make distclean
make dm3730_evk_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 which we need.

3.4.2.3 U-boot image generated

```
cd u-boot-03.00.02.07
make distclean
make dm3730_evk_config
make
```

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

need.

3.4.2.4 Kernel compilation

Before kernel compilation, the user has to select correct display according to the customize menu of kernel:

For Linux system, the output operation is as follows:

```
cd linux-2.6.32-dm3730_evk
make distclean
make dm3730_evk_defconfig
make uImage
```

For Android system, the iutput operation is as follows:

```
cd linux-2.6.32-dm3730_evk
make distclean
make dm3730_evk_android_defconfig
make menuconfig
```

If an error occurs in the system when make menuconfig is input, it is necessary to install ncurse in the Ubuntu system; ncurse library is a character graphic library, used for make menuconfig of kernel; the specific installation instruction is:

sudo apt-get install ncurses-dev

Enter the kernel customize menu now, enter “PANEL_TYPE” according to the following pointing paths:

```
Location:
  -> Device Drivers
    -> Graphics support
      -> OMAP2/3 Display Subsystem support (EXPERIMENTAL)
        -> OMAP2/3 Display Device Drivers
          -> DM3730_EVK LCD Panel
            -> PANEL_TYPE (<choice> [=y])
```

Figure 2-4-2-4-1

Select under “PANEL_TYPE” according to actually displayed screen size:

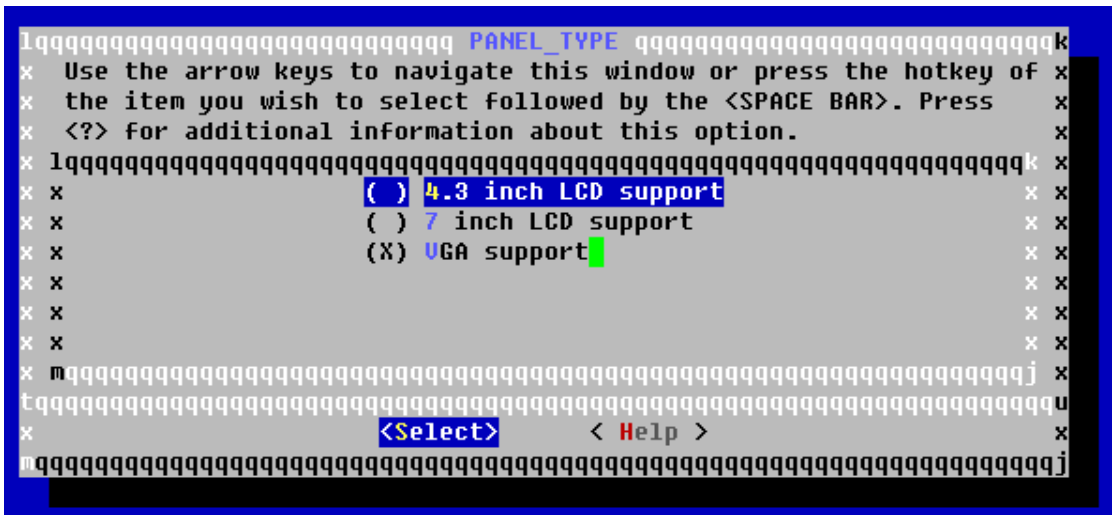


Figure 2-4-2-4-2

After determining “PANEL_TYPE”, jump to parent directory, select “Exit” to exit, until the following picture appears, then select “Yes”:

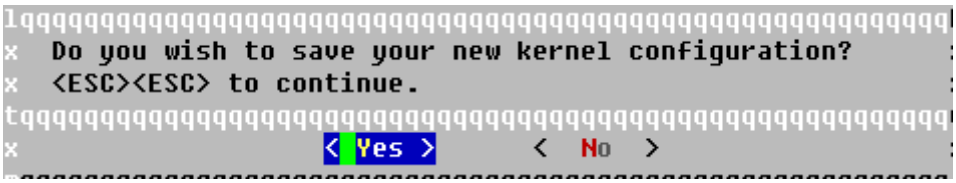


Figure 2-4-2-4-3

```
make uImage
```

After above operations are executed, the required uImage file will be generated under the directory arch/arm/boot.

3.4.2.5 Generation of file system

1) Ramdisk file making

For Ramdisk making, please refer to http://he3.dartmouth.edu/old/VME-Linux/RamDisk.html.

It will not be described in this document.

2) **UBI file making**

```
cd /home/embest/work
sudo /home/embest/tools/mkfs.ubifs -r rootfs -m 2048 -e 129024 -c 1996 -o ubifs.img
sudo /home/embest/tools/ubinize -o ubi.img -m 2048 -p 128KiB -s 512 /home/embest/tools/ubinize.cfg
```

After above operations are executed, the required ubi.img file will be generated under the current directory.

3.4.2.6 Android compilation

```
cd rowboat-android-froyo-dm3730_evk
make
```

3.4.3 System Customization

As Linux kernel has many kernel configuration options, the user can increase or reduce the driver or some kernel features based on the default configuration to meet the demands in better ways. The general process of system customization will be described with examples below.

3.4.3.1 Modification of kernel configuration

A default configuration file is provided in the factory kernel source codes:

arch/arm/configs/dm3730_evk_defconfig

User can carry out system customization on this basis:

```
cd linux-2.6.32-dm3730_evk
cp arch/arm/configs/dm3730_evk_defconfig .config
make menuconfig
```

The system customization will be described below by taking usb gadget and usb mass storage device as an example:

Select the configuration below:

-> Device Drivers

-> USB support

-> USB Gadget Support

-> USB Gadget Drivers

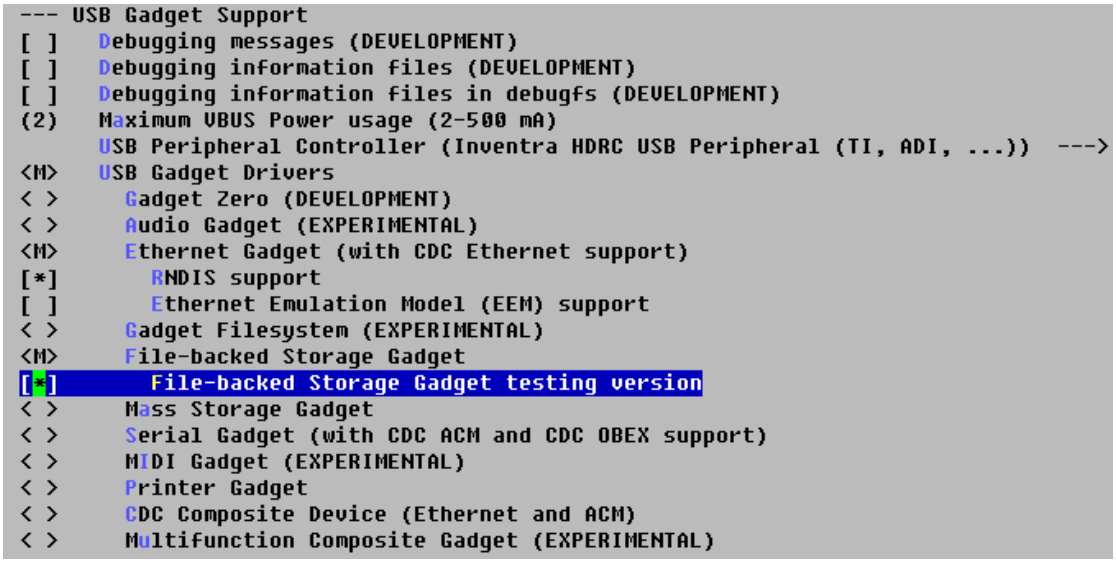


Figure 3-4-3-1

Select “File-backed Storage Gadget” as <M>, exit, and finally select Save to recompile kernel.

3.4.3.2 Compilation

Save configuration, execute the following commands to recompile kernel:

```
make uImage
make modules
```

After above operations are executed, a new kernel image uImage will be generated under the directory arch/arm/boot, and a module file g_file_storage.ko will be generated under the directory drivers/usb/gadget.

3.5 Introduction of driver

3.5.1 NAND

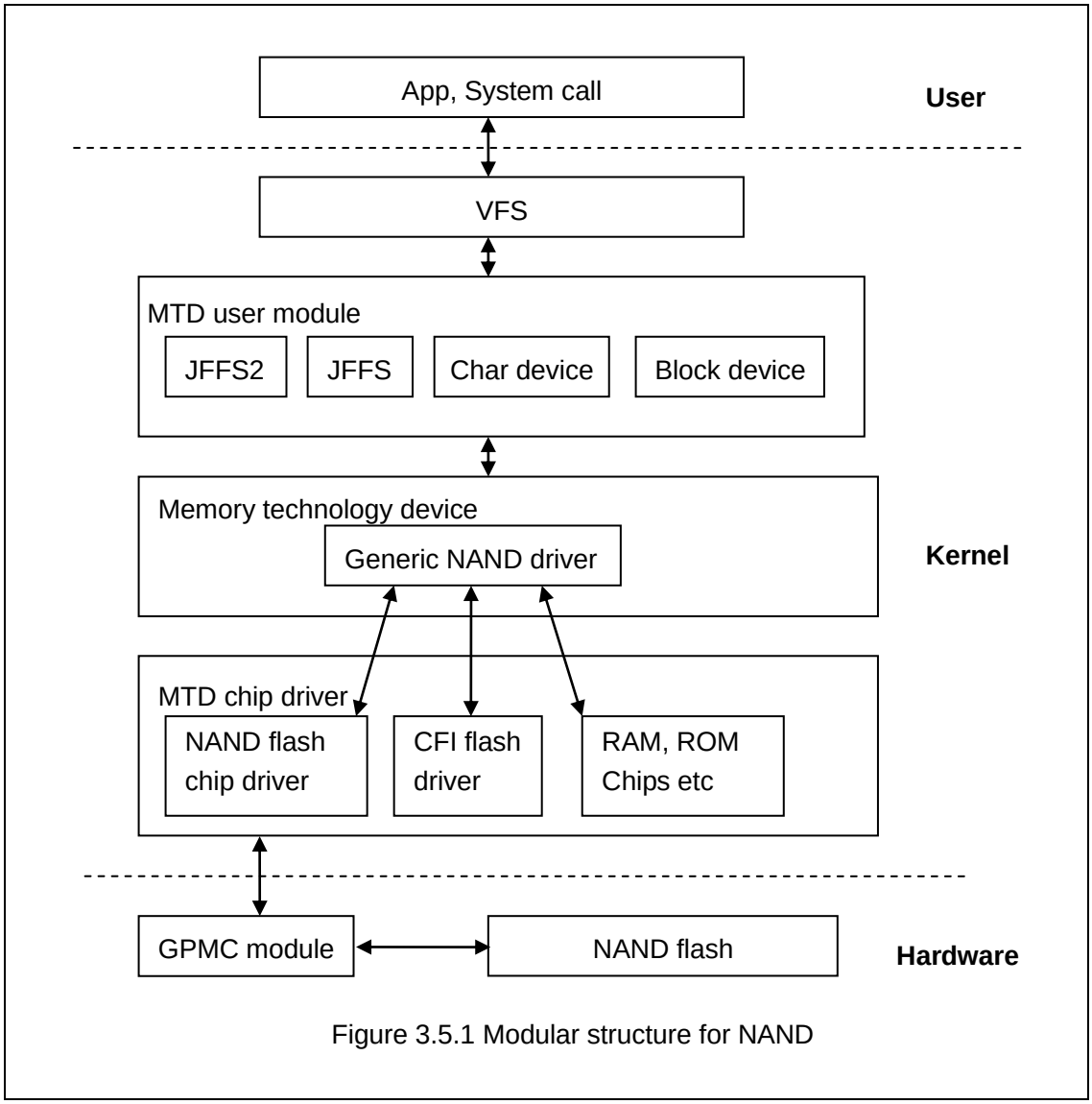


Figure 3.5.1 Modular structure for NAND

Solid-state memory used in embedded systems is mainly flash; it is NAND flash in this system. NAND flash is used as a block device, on which the file system is arranged; interaction between user and NAND flash is mainly realized by a specific file system. In order to shield difference in different flash memories, kernel inserts an MTD subsystem between the file system and the specific flash driver for management.

Therefore, the user accesses NAND flash through the following process:

User->System Call->VFS->Block Device Driver->MTD->NAND Flash Driver->NAND Flash.

Kernel Driver reference path:

linux-2.6.32-dm3730_evk/drivers/mtd/nand/

linux-2.6.32-dm3730_evk/drivers/mtd/nand/omap2.c

3.5.2 SD/MMC

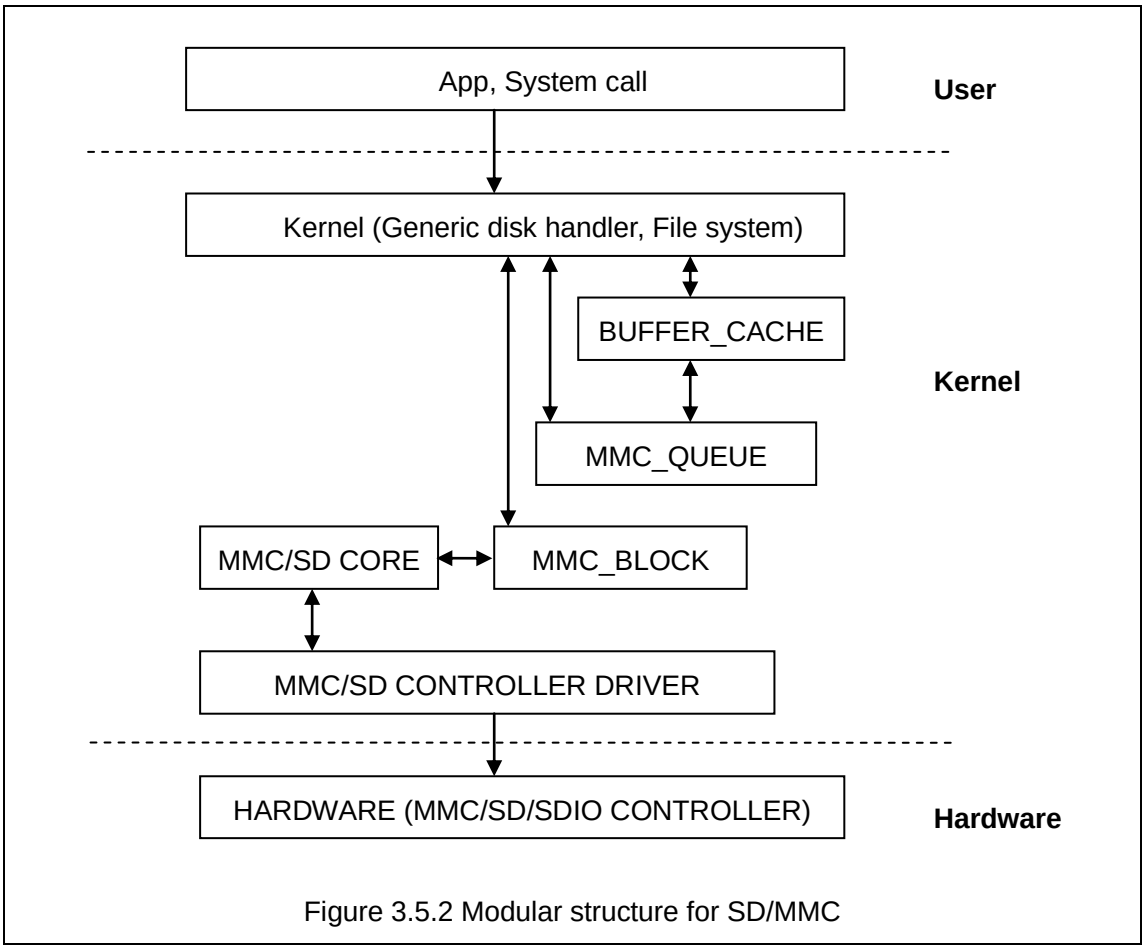


Figure 3.5.2 Modular structure for SD/MMC

SD/MMC card drivers under Linux mainly include SD/MMC core, mmc_block, mmc_queue and SD/MMC driver four parts:

1) SD/MMC core realizes core codes unlated to structure in the SD/MMC card operation.

2) mmc_block realizes driver structure when SD/MMC card is used as a block device.

3) mmc_queue realizes management of request queue.

4) SD/MMC driver realizes specific controller driver.

Kernel Driver reference path:

linux-2.6.32-dm3730_evk/drivers/mmc/

linux-2.6.32-dm3730_evk/drivers/mmc/host/omap_hsmmc.c

3.5.3 Display interface

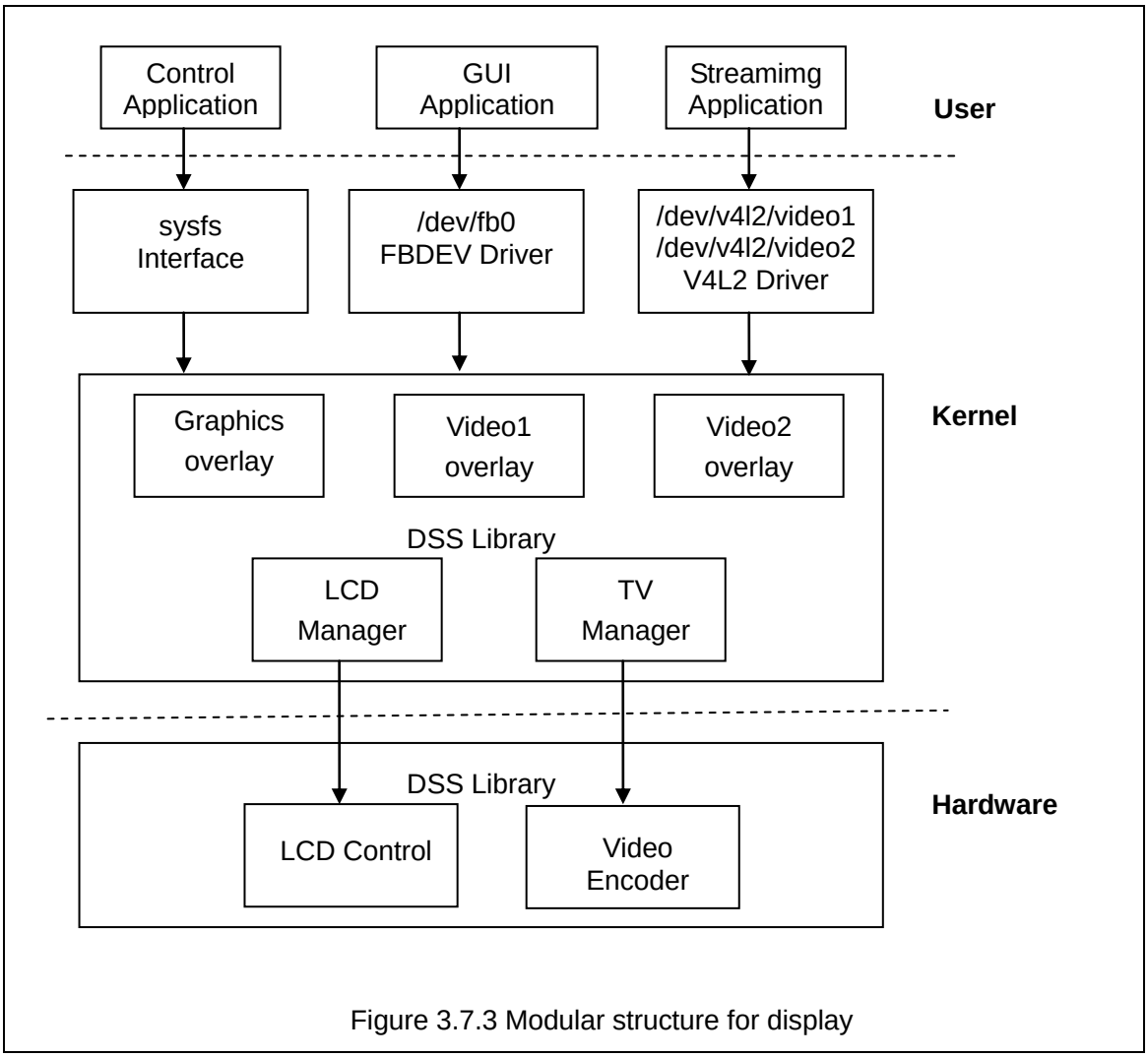


Figure 3.7.3 Modular structure for display

Display Sub-System hardware integrates one graphics pipeline, two video pipelines, and two overlay managers (one for digital and one for analog interface). Digital interface is used for LCD and DVI output and analog interface is used for TV out.

The primary functionality of the display driver is to provide interfaces to user level applications and managing of Display Sub-System hardware.

Kernel Driver reference path:

linux-2.6.32-dm3730_evk/drivers/video/omap2/

linux-2.6.32-dm3730_evk/drivers/video/omap2/omapfb/omapfb-main.c

3.5.4 Video capture

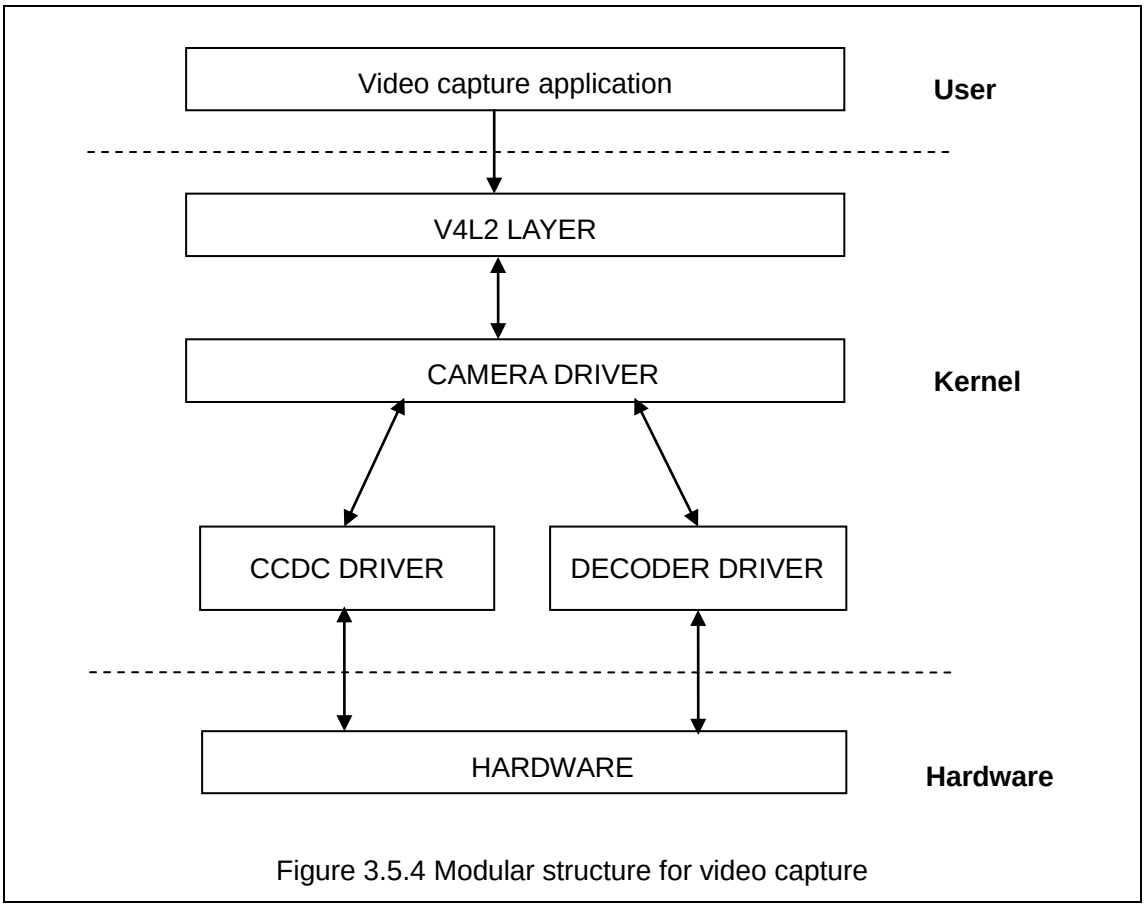


Figure 3.5.4 Modular structure for video capture

V4L2 Subsystem:

The Linux V4L2 subsystem is used as an infrastructure to support the operation of the Camera Driver. Camera applications mainly use the V4L2 API to access the Camera Driver functionality. A Linux 2.6 V4L2 implementation is used in order to support the standard features that are defined in the V4L2 specification.

Video Buffer Library:

This library comes with V4L2. It provides helper functions to cleanly manage the video buffers through a video buffer queue object.

Camera Driver:

The Camera Driver allows capturing video through an external decoder. The camera driver is registered to the V4L2 layer as a master device driver. Any slave decoder driver added to the V4L2 layer will be attached to this driver through the new V4L2 master-slave interface layer. The current implementation supports only one slave device.

Decoder Driver:

A decoder driver must implement the new V4L2 master-slave interface. It should register to the V4L2 layer as a slave device. Changing a decoder requires implementation of a new decoder driver; it does not require changing the Camera Driver. Each decoder driver exports a set of IOCTLs to the master device through function pointers.

CCDC library:

CCDC is a HW block in which acts as a data input port. It receives data from the sensor/decoder through parallel interface. The CCDC library exports API to configure CCDC module. It is configured by the master driver based on the sensor/decoder attached and desired output from the camera driver.

Kernel Driver reference path:

linux-2.6.32-dm3730_evk/drivers/media/video/

linux-2.6.32-dm3730_evk/drivers/media/video/omap34xxcam.c

linux-2.6.32-dm3730_evk/drivers/media/video/tvp514x-int.c

3.5.5 Audio in/out

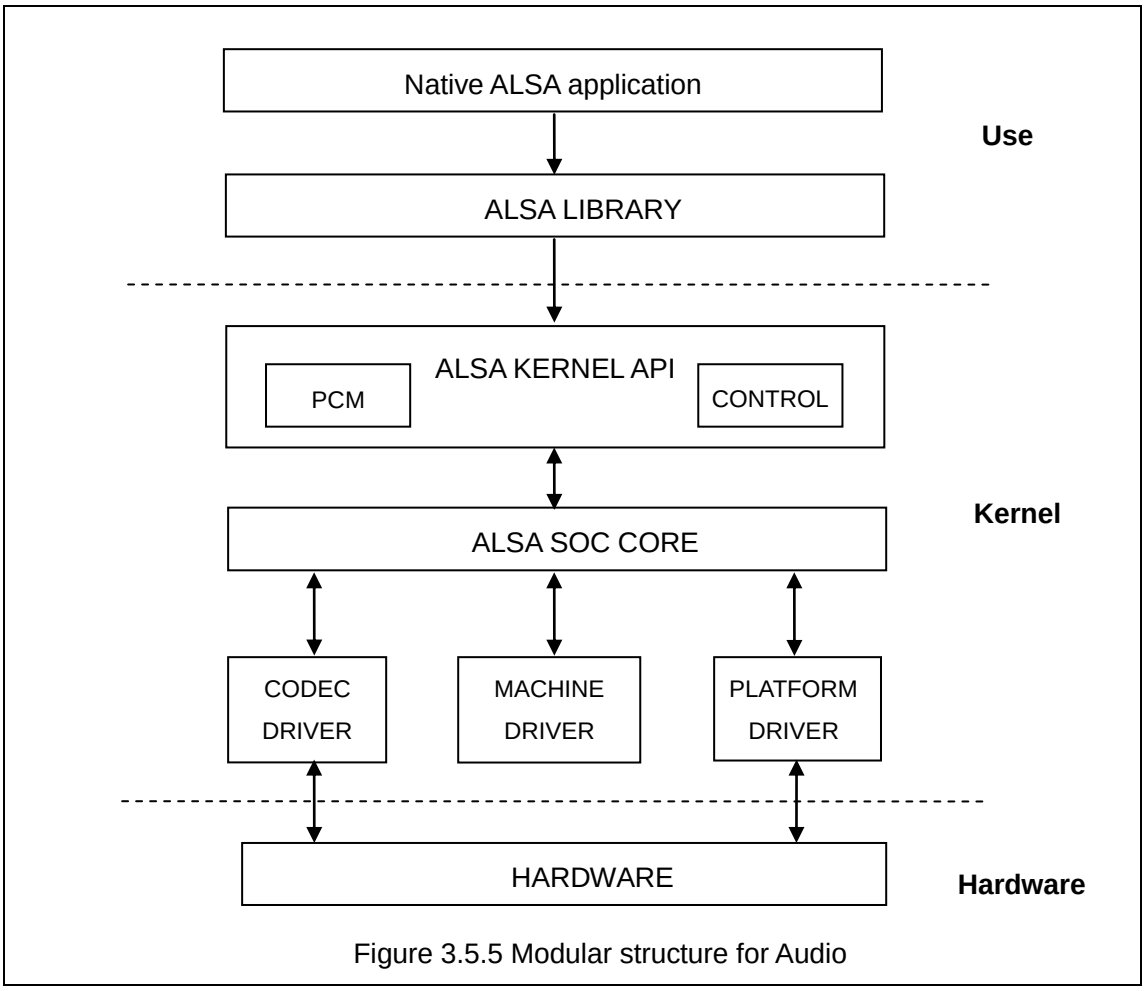


Figure 3.5.5 Modular structure for Audio

ASoC basically splits an embedded audio system into three components:

- Codec driver: The codec driver is platform independent and contains audio controls, audio interface capabilities, codec dapm definition and codec IO functions.
- Platform driver: The platform driver contains the audio dma engine and audio interface drivers (e.g. I2S, AC97, PCM) for that platform.
- Machine driver: The machine driver handles any machine specific controls and audio events i.e. turning on an amp at start of playback.

Kernel Driver reference path:

linux-2.6.32-dm3730_evk/sound/soc/

linux-2.6.32-dm3730_evk/sound/soc/omap/dm3730_evk.c

linux-2.6.32-dm3730_evk/sound/soc/codecs/twl4030.c

3.6 Driver Development

3.6.1 Driver For The gpio_keys

1) Device Definition

linux-2.6.32-dm3730_evk/arch/arm/mach-omap2/board-dm3730_evk.c

Setup GPIO 26 as “menu” key, return value as “KEY_F1”, triggered on low level; gpio 29 as”back”key, return value as ”KEY_ESC”, triggered on low level. The structure template is shown below.

```
static struct gpio_keys_button gpio_buttons[] = {
        {
                .code                   = KEY_F1,
                .gpio                   = 26,
                .desc                   = "menu",
                .active_low             = true,
        },
        {
                .code                   = KEY_ESC,
                .gpio                   = 29,
                .desc                   = "back",
                .active_low             = true,
        },
};

static struct gpio_keys_platform_data gpio_key_info = {
        .buttons        = gpio_buttons,
        .nbuttons       = ARRAY_SIZE(gpio_buttons),
};

static struct platform_device keys_gpio = {
        .name   = "gpio-keys",
        .id     = -1,
```

```
        .dev    = {
                .platform_data  = &gpio_key_info,
        },
};
```

2) GPIO pinmux Configuration

Setup the GPIO 26, 29 as M4 (GPIO mode), IEM (Input enable).

u-boot-03.00.02.07/board/dm3730_evk.h

```
/*
 * IEN  - Input Enable
 * IDIS - Input Disable
 * PTD  - Pull type Down
 * PTU  - Pull type Up
 * DIS  - Pull type selection is inactive
 * EN   - Pull type selection is active
 * M0   - Mode 0
 * The commented string gives the final mux configuration for that pin
*/
MUX_VAL(CP(ETK_D12_ES2),        (IEN  | PTU | DIS | M4)) /*GPIO_26*/\
MUX_VAL(CP(ETK_D15_ES2),        (IEN  | PTU | DIS | M4)) /*GPIO_29*/\
```

3) Driver Design

linux-2.6.32-dm3730_evk/drivers/input/keyboard/gpio_keys.c

a) Structure for platform_driver_register to register gpio_keys driver.

```
static struct platform_driver gpio_keys_device_driver = {
        .probe          = gpio_keys_probe,
        .remove         = __devexit_p(gpio_keys_remove),
        .driver         = {
                .name   = "gpio-keys",
                .owner  = THIS_MODULE,
#ifdef CONFIG_PM
                .pm     = &gpio_keys_pm_ops,
#endif
```

```
        }
};

static int __init gpio_keys_init(void)
{
        return platform_driver_register(&gpio_keys_device_driver);
}

static void __exit gpio_keys_exit(void)
{
        platform_driver_unregister(&gpio_keys_device_driver);
}

module_init(gpio_keys_init);
module_exit(gpio_keys_exit);

MODULE_LICENSE("GPL");
MODULE_AUTHOR("Phil Blundell <pb@handhelds.org>");
MODULE_DESCRIPTION("Keyboard driver for CPU GPIOs");
MODULE_ALIAS("platform:gpio-keys");
```

b) Structure for input_register_device to register input driver.

```
static int __devinit gpio_keys_probe(struct platform_device *pdev)
{
…
        input = input_allocate_device();
…
        for (i = 0; i < pdata->nbuttons; i++) {
                struct gpio_keys_button *button = &pdata->buttons[i];
                struct gpio_button_data *bdata = &ddata->data[i];
                unsigned int type = button->type ?: EV_KEY;
```

```
                bdata->input = input;
                bdata->button = button;

                error = gpio_keys_setup_key(dev, bdata, button);
                if (error)
                        goto fail2;

                if (button->wakeup)
                        wakeup = 1;

                input_set_capability(input, type, button->code);
        }

        error = input_register_device(input);
…
```

c) Apply GPIO and setup the GPIO as the input, registration gpio interrupt.

```
static int __devinit gpio_keys_setup_key(struct device *dev,
                                         struct gpio_button_data *bdata,
                                         struct gpio_keys_button *button)
{
        char *desc = button->desc ? button->desc : "gpio_keys";
        int irq, error;

        setup_timer(&bdata->timer, gpio_keys_timer, (unsigned long)bdata);
        INIT_WORK(&bdata->work, gpio_keys_work_func);

        error = gpio_request(button->gpio, desc);
        if (error < 0) {
                dev_err(dev, "failed to request GPIO %d, error %d\n",
                        button->gpio, error);
                goto fail2;
```

```
		}

		error = gpio_direction_input(button->gpio);
		if (error < 0) {
			dev_err(dev, "failed to configure"
				" direction for GPIO %d, error %d\n",
				button->gpio, error);
			goto fail3;
		}

		irq = gpio_to_irq(button->gpio);
		if (irq < 0) {
			error = irq;
			dev_err(dev, "Unable to get irq number for GPIO %d, error %d\n",
				button->gpio, error);
			goto fail3;
		}

		error = request_irq(irq, gpio_keys_isr,
				    IRQF_SHARED |
					IRQF_TRIGGER_RISING | IRQF_TRIGGER_FALLING,
					desc, bdata);
		if (error) {
			dev_err(dev, "Unable to claim irq %d; error %d\n",
				irq, error);
			goto fail3;
		}

		return 0;

fail3:
```

```
        gpio_free(button->gpio);
fail2:
        return error;
}
```

d) Interrupt handling,

Button is pressed, an interrupt is generated, reporting key

```
static irqreturn_t gpio_keys_isr(int irq, void *dev_id)
{
…
schedule_work(&bdata->work);
…
}

static void gpio_keys_work_func(struct work_struct *work)
{
…
gpio_keys_report_event(bdata);
…
}

static void gpio_keys_report_event(struct gpio_button_data *bdata)
{
        struct gpio_keys_button *button = bdata->button;
        struct input_dev *input = bdata->input;
        unsigned int type = button->type ?: EV_KEY;
        int state = (gpio_get_value(button->gpio) ? 1 : 0) ^ button->active_low;

        input_event(input, type, button->code, !!state);
        input_sync(input);
}
```

3.6.2 Driver for the gpio_leds

1) Device Definition

linux-2.6.32-dm3730_evk/arch/arm/mach-omap2/board-dm3730_evk.c

The driver main() will introduce how to create the driver on the kernel and enable the LED2, LED3, LED4, LED5, the kernel configuration respectively are: user_ledb (GPIO186), sys_led (twl4030 LEDB), user_led1 (twl4030 GPIO2), user_led2 (twl4030 GPIO15), low level is enable:

```
static struct gpio_led gpio_leds[] = {
        {
                .name                   = "sys_led",
                .default_trigger        = "heartbeat",
                .gpio                   = 186,
                .active_low              = true,
        },
        {
                .name                   = "user_ledb",
                .gpio                   = -EINVAL,
                .active_low              = true,
        },
        {
                .name                   = "user_led1",
                .gpio                   = -EINVAL,
                .active_low              = true,
        },
        {
                .name                   = "user_led2",
                .gpio                   = -EINVAL,
                .active_low              = true,
        },

};
```

```
static struct gpio_led_platform_data gpio_led_info = {
        .leds                   = gpio_leds,
        .num_leds            = ARRAY_SIZE(gpio_leds),
};

static struct platform_device leds_gpio = {
        .name     = "leds-gpio",
        .id         = -1,
        .dev       = {
                .platform_data    = &gpio_led_info,
        },
};

static int dm3730_evk_twl_gpio_setup(struct device *dev,
                        unsigned gpio, unsigned ngpio)
{
…
        /* TWL4030_GPIO_MAX + 1 == ledB, PMU_STAT (out, active low LED) */
        gpio_leds[1].gpio = gpio + TWL4030_GPIO_MAX + 1;
        gpio_leds[2].gpio = gpio + 2;
        gpio_leds[3].gpio = gpio + 15;
…
}
```

2) GPIO pinmux Setup:

u-boot-03.00.02.07/board/dm3730_evk.h

Configure GPIO 186 as M4(MODE 4 = GPIO), IDIS(Input not allowed)

```
/*
 * IEN  - Input Enable
 * IDIS - Input Disable
 * PTD  - Pull type Down
 * PTU  - Pull type Up
```

```
 * DIS    - Pull type selection is inactive
 * EN     - Pull type selection is active
 * M0     - Mode 0
 * The commented string gives the final mux configuration for that pin
 */
MUX_VAL(CP(SYS_CLKOUT2),            (IDIS | PTU | EN    | M4)) /*GPIO_186*/\
```

3) Driver design:

linux-2.6.32-dm3730_evk/drivers/leds/leds-gpio.c

a) Structure for platform_driver_register to register gpio_leds.

```
static struct platform_driver gpio_led_driver = {
        .probe          = gpio_led_probe,
        .remove         = __devexit_p(gpio_led_remove),
        .driver         = {
                .name   = "leds-gpio",
                .owner  = THIS_MODULE,
        },
};

static int __init gpio_led_init(void)
{
        int ret;

#ifdef CONFIG_LEDS_GPIO_PLATFORM
        ret = platform_driver_register(&gpio_led_driver);
        if (ret)
                return ret;
#endif
#ifdef CONFIG_LEDS_GPIO_OF
        ret = of_register_platform_driver(&of_gpio_leds_driver);
#endif
#ifdef CONFIG_LEDS_GPIO_PLATFORM
```

```
	if (ret)
		platform_driver_unregister(&gpio_led_driver);
#endif

	return ret;
}

static void __exit gpio_led_exit(void)
{
#ifdef CONFIG_LEDS_GPIO_PLATFORM
	platform_driver_unregister(&gpio_led_driver);
#endif
#ifdef CONFIG_LEDS_GPIO_OF
	of_unregister_platform_driver(&of_gpio_leds_driver);
#endif
}

module_init(gpio_led_init);
module_exit(gpio_led_exit);

MODULE_AUTHOR("Raphael Assenat <raph@8d.com>, Trent Piepho
<tpiepho@freescale.com>");
MODULE_DESCRIPTION("GPIO LED driver");
MODULE_LICENSE("GPL");
```

b) Called platform_driver_register to register gpio_leds. Apply GPIO and called led_classdev_regisiter to register led_classdev.

```
static int __devinit gpio_led_probe(struct platform_device *pdev)
{
…
	leds_data = kzalloc(sizeof(struct gpio_led_data) * pdata->num_leds,
					GFP_KERNEL);
```

```
…
        for (i = 0; i < pdata->num_leds; i++) {
                ret = create_gpio_led(&pdata->leds[i], &leds_data[i],
                                        &pdev->dev, pdata->gpio_blink_set);
                if (ret < 0)
                        goto err;
        }
…
}

static int __devinit create_gpio_led(const struct gpio_led *template,
        struct gpio_led_data *led_dat, struct device *parent,
        int (*blink_set)(unsigned, unsigned long *, unsigned long *))
{
…
        ret = gpio_request(template->gpio, template->name);
…
        ret = gpio_direction_output(led_dat->gpio, led_dat->active_low ^ state);
…
        ret = led_classdev_register(parent, &led_dat->cdev);
…
}
```

c) User can access brightness file on the directory of /sys/class/leds/xxx/, called function gpio_led_set to configure led states.

```
static void gpio_led_set(struct led_classdev *led_cdev,
        enum led_brightness value)
{
…
                gpio_set_value(led_dat->gpio, level);
}
```

3.7 Updated of system

3.7.1 Update of TF card system image

1) **The formatting of MMC/SD card**

HP USB Disk Storage Format Tool 2.0.6 is recommended:

The software is downloading from

http://www.embedinfo.com/english/download/SP27213.exe .

a) Insert TF card into the card reader in PC.

b) Open the HP USB Disk Storage Format Tool, the following steps will show in detail:

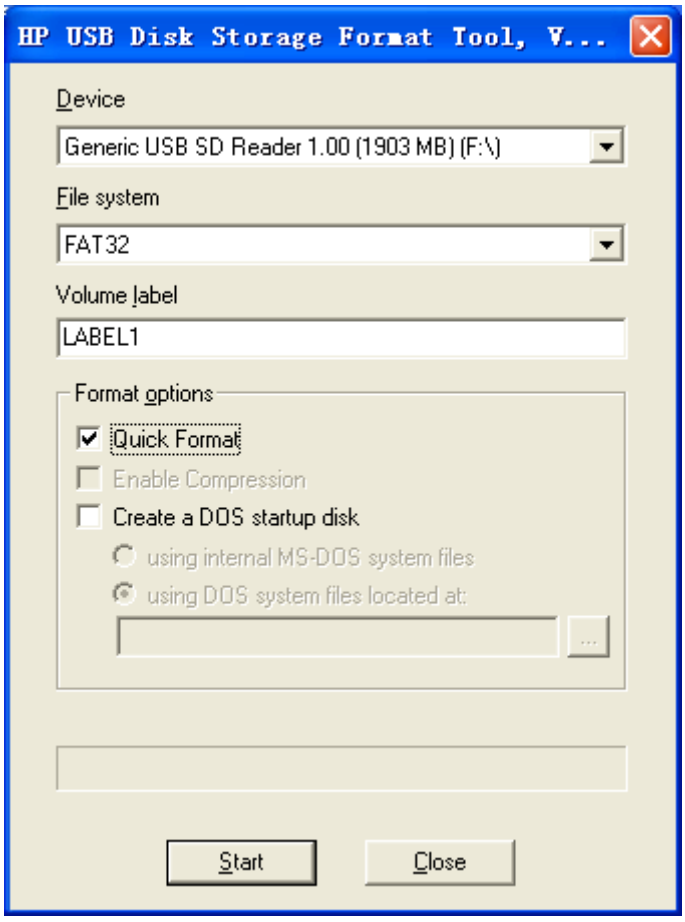


Figure 3-7-1

c) Select “FAT32”.

d) Click “Start”.

e) When formatting is completed, click “OK”.

HP USB Disk Storage Format Tool will clear partitions of the TF card. Please use the formatting software provided in the computer system

2) **Update of images**

Copy all files under the directory linux/image to the TF card, and **rename uImage_xx as uImage** according to the used display device LCD (4.3", 7") or VGA. Connect the TF card, power on and boot it, the serial port information will be displayed as follows:

```
60


Texas Instruments X-Loader 1.47 (Sep 27 2011 - 15:53:45)
DM3730_EVK xM Rev A
Starting X-loader on MMC
Reading boot sector

1153680 Bytes Read from MMC
Starting OS Bootloader from MMC...
Starting OS Bootloader...



U-Boot 2010.06-rc1-svn (Sep 27 2011 - 14:54:40)

OMAP34xx/35xx-GP ES2.1, CPU-OPP2 L3-165MHz
DM3730_EVK board + LPDDR/NAND
I2C:    ready
DRAM:   512 MiB
NAND:   512 MiB
*** Warning - bad CRC or NAND, using default environment

In:     serial
Out:    serial
Err:    serial
DM3730_EVK xM Rev A
```

```
Die ID #065400029e3800000168263d0600900a
Net:   dm9000
Hit any key to stop autoboot:  0
mmc1 is available
reading boot.scr

** Unable to read "boot.scr" from mmc 0:1 **
reading uImage

2551588 bytes read
reading ramdisk.gz

7686374 bytes read
Booting from mmc ...
## Booting kernel from Legacy Image at 80300000 ...
   Image Name:   Linux-2.6.32
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    2551524 Bytes = 2.4 MiB
   Load Address: 80008000
   Entry Point:  80008000
   Verifying Checksum ... OK
   Loading Kernel Image ... OK
OK

Starting kernel ...
Uncompressing
Linux.....
..... done, booting the kernel.
Linux version 2.6.32 (luofc@TIOP) (gcc version 4.4.0 (GCC) ) #1 Mon Mar 14 10:08:34 CST
2011
……
```

```
……
Remounting root file system...
mount: mounting /dev/root on / failed: Invalid argument
mount: mounting /dev/root on / failed: Invalid argument
root: mount: mounting rootfs on / failed: No such file or directory
root: mount: mounting usbfs on /proc/bus/usb failed: No such file or directory
Setting up IP spoofing protection: rp_filter.
Configuring network interfaces... udhcpc (v1.11.3) started
Sending discover...
udhcpc: sendto: Network is down
Sending discover...
udhcpc: sendto: Network is down
INIT: Entering runlevel: 5
Starting syslogd/klogd: done
.-------.
|           |                          .-.
|     |     |-----.-----.-----.| |     .----..-----.-----.
|           |       | __    |    ---'| '--.|    .-'|       |       |
|     |     |   |   |       |---    ||    --'|    |   |    '    | | | |
'---'---'--'--'--.    |-----"----"--'    '-----'-'-'-'
                        -'    |
                        '---'
The Angstrom Distribution DM3730_EVK ttyS2
Angstrom 2008.1-test-20090127 DM3730_EVK ttyS2
DM3730_EVK login:
```

HyperTerminal displays above information to indicate that it is successful to boot Linux system from TF card.

3.7.2 Update of NAND Flash

Update of NAND boot image is finished in aid with u-boot. No matter whether NAND Flash has data or not, u-boot of the TF card can be used to update NAND Flash images.

1) Preparation

a) Format the TF card to FAT or FAT32 file system through HP USB Disk Storage Format Tool 2.0.6

b) Copy x-load.bin.ift_for_NAND, flash-uboot.bin, uImage_xx and ubi.img image files in the disc to the TF card, and rename uImage_xx as uImage according to the display device LCD (4.3", 7") or VGA you used.

2) **Update**

a) Insert the TF card with the system images into the development board, power on and boot it, and press any key on the PC keyboard to enter the u-boot according to the following clock prompts:

```
Texas Instruments X-Loader 1.47 (Sep 27 2011 - 15:53:45)
DM3730_EVK xM Rev A
Starting X-loader on MMC
Reading boot sector

1153680 Bytes Read from MMC
Starting OS Bootloader from MMC...
Starting OS Bootloader...



U-Boot 2010.06-rc1-svn (Sep 27 2011 - 14:54:40)

OMAP34xx/35xx-GP ES2.1, CPU-OPP2 L3-165MHz
DM3730_EVK board + LPDDR/NAND
I2C:   ready
DRAM:  512 MiB
NAND:  512 MiB
```

```
*** Warning - bad CRC or NAND, using default environment
In:       serial
Out:      serial
Err:      serial
DM3730_EVK xM Rev A
Die ID #22e800211e3000000158ed8408008020
Net:      dm9000
Hit any key to stop autoboot:  0  （Here press any key to enter u-boot）
```

b) After entering the u-boot command line, input “run updatesys” from the PC keyboard, to start to update the system automatically:

```
DM3730_EVK # run updatesys

NAND erase: device 0 whole chip
Skipping bad block at  0x1c9c0000
Erasing at 0x1ffe0000 -- 100% complete.
OK
mmc1 is available
reading x-load.bin.ift_for_NAND

11000 bytes read
HW ECC selected

NAND write: device 0 offset 0x0, size 0x2af8
 12288 bytes written: OK
reading flash-uboot.bin

230764 bytes read
SW ECC selected

NAND write: device 0 offset 0x80000, size 0x3856c
 231424 bytes written: OK
```

```
reading uImage


2561868 bytes read
SW ECC selected


NAND write: device 0 offset 0x280000, size 0x27174c
 2562048 bytes written: OK
reading ubi.img


7602176 bytes read
SW ECC selected


NAND write: device 0 offset 0x680000, size 0x740000
 7602176 bytes written: OK
DM3730_EVK #
```

c) At this time, flickering of LED lamp on the board indicates that update has been finished; you just need to reboot it.

3.8 Instructions

3.8.1 Various Tests scenario

3.8.1.1 LED Testing

SYS_LED, USER_LEDB, USER_LED1 and USER_LED2 in the board is user' led lamp.

The following operation carried out in HyperTerminal:

1) Control sys_led:

```
root@DM3730_EVK:# echo 1 > /sys/class/leds/sys_led/brightness
root@DM3730_EVK:# echo 0 > /sys/class/leds/sys_led/brightness
```

2) Control user_ledb:

```
root@DM3730_EVK:# echo 1 > /sys/class/leds/user_ledb/brightness
root@DM3730_EVK:# echo 0 > /sys/class/leds/user_ledb/brightness
```

3) Control user_led1:

```
root@DM3730_EVK:# echo 1 > /sys/class/leds/user_led1/brightness
root@DM3730_EVK:# echo 0 > /sys/class/leds/user_led1/brightness
```

4) Control user_led2:

```
root@DM3730_EVK:# echo 1 > /sys/class/leds/user_led2/brightness
root@DM3730_EVK:# echo 0 > /sys/class/leds/user_led2/brightness
```

The user pushes a LED with operation are to kill bright.

3.8.1.2 KEYPAD Testing

Board has two users keyboard USER1 USER2, users can and perform the following command testing:

```
root@DM3730_EVK:~# evtest /dev/input/event0
Input driver version is 1.0.0evdev.c(EVIOCGBIT): Suspicious buffer size 511, limiting output to 64 bytes. See http://userweb.kernel.org/~dtor/eviocgbit-bug.html

Input device ID: bus 0x19 vendor 0x1 product 0x1 version 0x100
Input device name: "gpio-keys"
Supported events:
  Event type 0 (Sync)
  Event type 1 (Key)
  Event code 1 (Esc)
  Event code 59 (F1)
Testing ... (interrupt to exit)
Event: time 44.232697, type 1 (Key), code 59 (F1), value 1
Event: time 44.232697, ---------- Report Sync ------------
Event: time 44.396515, type 1 (Key), code 59 (F1), value 0
Event: time 44.396515, ---------- Report Sync ------------
Event: time 45.219238, type 1 (Key), code 1 (Esc), value 1
Event: time 45.219268, ---------- Report Sync ------------
Event: time 45.358306, type 1 (Key), code 1 (Esc), value 0
Event: time 45.358306, ---------- Report Sync ------------
```

Press CONTROL+C to quit the test. The back of the test is the same.

3.8.1.3 Touch Screen Testing

This testing requires Linux boot from NAND FLASH

1) Run the command to test the touch screen.

```
root@DM3730_EVK: # 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@DM3730_EVK: # ts_test
```

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

3.8.1.4 RTC Testing

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 Fri Aug 8 20:00:00 2011

```
root@DM3730_EVK: # date 011820002011
Fri Aug  8 20:00:00 UTC 2011
```

2) Write the system clock into RTC

```
root@DM3730_EVK: # hwclock -w
```

3) Read the RTC

```
root@DM3730_EVK: # hwclock
Fri Aug  8 20:00:00 UTC 2011
```

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@DM3730_EVK: # hwclock -s
root@DM3730_EVK: # date
Fri Aug  8 20:00:00 UTC 2011
```

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

The DM3730-EVK Development board RTC battery can use model CR1220, user needs to prepare themselves.

3.8.1.5 TF Card Testing

1) After connecting TF card, the system will mount the file system of the TF card under the directory /media automatically:

```
root@DM3730_EVK:~# cd /media/
root@DM3730_EVK:/media# ls
card        hdd         mmcblk0p1   ram         union
cf          mmc1        net         realroot
```

2) Enter the following command , you can see the contents inside the TF card:

```
root@DM3730_EVK:/media# ls mmcblk0p1/
flash-uboot.bin          u-boot.bin          x-load.bin.ift_for_NAND
mlo                      uImage
ramdisk.gz               ubi.img
```

3.8.1.6 USB Devices Testing

In the USB DEVICE testing, a connection line is used to connect the mini USB interface of the development board and the USB interface at the computer end; for the computer end, the development board is recognized as a network device to realize ping communication of two ends.

1) After booting the system, a USB mini B to USB A transfer line is used to connect the development board and the computer end, wherein USB mini B interface is connected with the development board, and the USB A interface is connected with the computer end. At this time, the computer needs to be installed with Linux USB Ethernet driver. Please refer to Appendix III for detailed installation method.

2) The following commands are input at the HyperTerminal, for example:

```
root@DM3730_EVK:~# ifconfig usb0 192.168.1.115
root@DM3730_EVK:~# 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)
```

3) After the development board is configured, please click My Computer-Network Neighborhood-Check Network Connection, a virtual network adapter will be added at the PC end.

4) Right-click virtual network adapter at the computer end, left-click “Attribute”, double-left-click to enter the “Internet Protocol (TCP/IP)” to configure the IP address of the virtual network adapter:

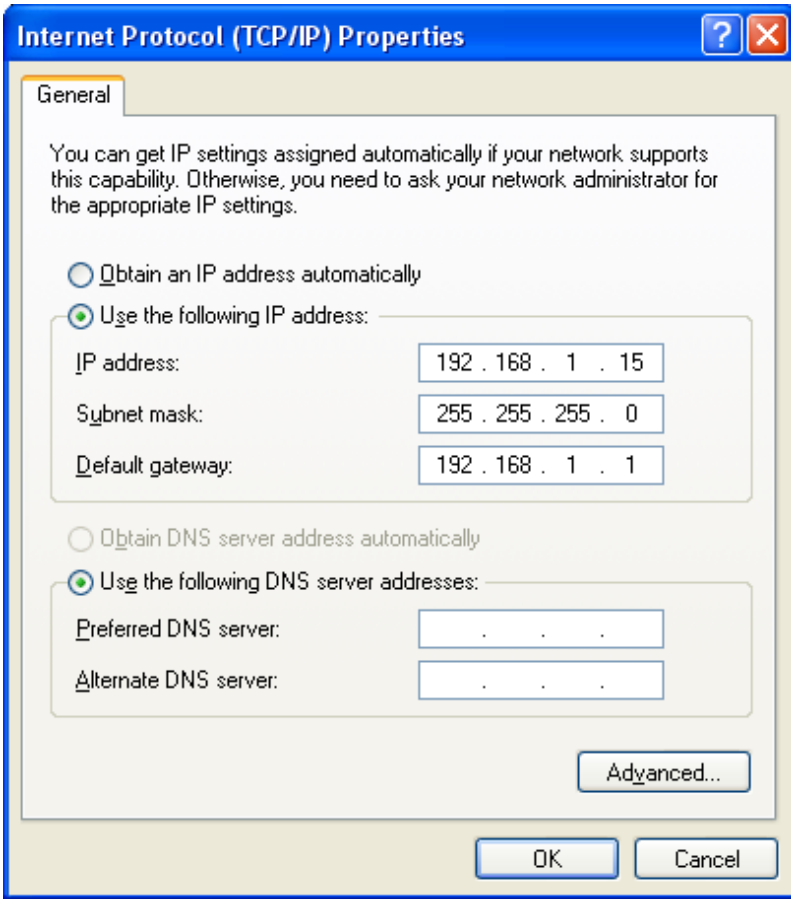


Figure 3-8-1-6

5) Use ping command in the HyperTerminal to test whether the settings of the development board are successful:

```
root@DM3730_EVK:~#  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
```

6) Occurrence of above serial port information indicates that the testing is successful.

IP address of the network adapter configured in OTG cannot be the same as that of Ethernet interface.

3.8.1.7 USB HOST Testing

1) After connecting USB flash disk, the system will mount the file system of the USB flash disk under the directory /media automatically:

```
root@DM3730_EVK:~#  cd /media/
root@DM3730_EVK:/media# ls
card          hdd           mmcblk0p1   ram           sda1
cf            mmc1          net         realroot      union
```

2) Contents in the USB flash disk will be seen after the following instruction is input:

```
root@DM3730_EVK:/media#  ls sda1/
flash-uboot.bin          u-boot.bin                x-load.bin.ift_for_NAND
mlo                      uImage
ramdisk.gz               ubi.img
```

3.8.1.8 Audio Testing

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

1) Recording Test：

Plug in a microphone, you can test recording.

```
root@DM3730_EVK:~# arecord -t wav -c 1 -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
```

2) Playback Testing：

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

```
root@DM3730_EVK:~# 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
```

3.8.1.9 Network Testing

1) The board has a 10/100M self-adapting network card DM9000; users can connect the board to the LAN and enter the following commands for a test:

```
root@DM3730_EVK:~# ifconfig eth0 192.192.192.200
eth0: link down
eth0: link up, 100Mbps, full-duplex, lpa 0x41E1

root@DM3730_EVK:~# 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
[root@DM3730_EVK /]# ping 192.192.192.170
PING 192.192.192.170 (192.192.192.170): 56 data bytes
64 bytes from 192.192.192.170: seq=0 ttl=128 time=4.486 ms
64 bytes from 192.192.192.170: seq=1 ttl=128 time=0.336 ms
```

2) Occurrence of above serial port information indicates that the testing is successful.

3.8.1.10 Camera Testing

1) If you have bought the specific camera module of DM3730-EVK, after connecting CAMERA module and CCD camera, connect LCD screen; carry out the testing by executing the following commands:

```
root@DM3730_EVK:~# 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...
```

2) At this time, LCD display screen will display images collected by the CCD camera.

3.8.1.11 GPRS8000-S module

If the camera modules are from Embest then you can download the module material from below link:

http://www.timll.com/chinese/uploadFile/GPRS8000.rar

3.8.1.12 GPS8000-S module

If the camera modules are from Embest then you can download the module material from below link:

http://www.timll.com/chinese/uploadFile/GPS8000.rar

3.8.1.13 CDMA8000-U module

If the camera modules are from Embest then you can download the module material from below link:

http://www.timll.com/chinese/uploadFile/cdma8000.rar

3.8.1.14 WCDMA8000-U module

If the camera modules are from Embest then you can download the module material from below link:

http://www.timll.com/chinese/uploadFile/WCDMA8000-110113.zip

3.8.2 Demo

3.8.2.1 Android system demonstration

DM3730-EVK provides Android system demonstration, please follow below steps:

1) Copy all files under the directory CD\linux\demo\Android\image to the TF card, select according to the size of LCD you have bought, and rename uImage_xx as uImage;

2) Put the TF card in the development card, and directly power it on; the debugging tool will display the following information:

```
60



Texas Instruments X-Loader 1.47 (Sep 20 2011 - 16:18:31)
```

```
DM3730-EVK xM Rev A
Starting X-loader on MMC
Reading boot sector

1153712 Bytes Read from MMC
Starting OS Bootloader from MMC...
Starting OS Bootloader...



U-Boot 2010.06-rc1-svn (Sep 27 2011 - 14:57:19)

OMAP34xx/35xx-GP ES2.1, CPU-OPP2 L3-165MHz
DM3730_EVK board + LPDDR/NAND
I2C:      ready
DRAM:    512 MiB
NAND:    512 MiB
*** Warning - bad CRC or NAND, using default environment

In:       serial
Out:      serial
Err:      serial
DM3730_EVK xM Rev A
Die ID #3a7e00229e3800000168263d0402302f

NAND erase: device 0 whole chip
Erasing at 0x1ffe0000 -- 100% complete.
OK
mmc1 is available
reading x-load.bin.ift_for_NAND

10892 bytes read
```

```
HW ECC selected

NAND write: device 0 offset 0x0, size 0x2a8c
  12288 bytes written: OK
reading flash-uboot.bin

1152260 bytes read
SW ECC selected

NAND write: device 0 offset 0x80000, size 0x119504
  1153024 bytes written: OK
reading uImage

2572792 bytes read
SW ECC selected

NAND write: device 0 offset 0x280000, size 0x2741f8
  2574336 bytes written: OK
reading ubi.img

79036416 bytes read
SW ECC selected

NAND write: device 0 offset 0x680000, size 0x4b60000
  79036416 bytes written: OK
```

3) LED lamp sys on the board will flicker to prompt after programming is finished, at this time, please pull the TF card out.

4) Power it on again and boot to enter the android operating system.

3.8.2.2 DVSDK System Demonstration

DVSDK (Digital Video Software Development Kit) is software developed by TI Company, the function of which is to establish a connection between ARM and DSP.

The application program runs at the ARM end, and ARM processes IO interface and the application program. ARM uses VISA APIs interface provided by Codec Engine to process video, image and voice signals. Codec Engine then uses DSP/BIOS Link and xDIAS as well as xDM protocol to communicate with the Codec Engine server. DSP processes these signals and puts results of processing in the memory space shared by ARM, such that the ARM end can obtain these results.

- The computer end has to be installed with Linux operating system in advance; and the instruction in Step 1 is finished in PC.
- uImage_4.3 mentioned in the following context means 4.3-inch screen; please use uImage_7 if the user uses 7-inch screen.

1) Divide the TF card into two partitions (please refer to Appendix IV for specific operation), connect the TF card to PC, and then execute the following commands:

```
cp /media/cdrom/linux/demo/dvsdk/image/MLO /media/LABEL1
cp /media/cdrom/linux/demo/dvsdk/image/u-boot.bin /media/LABEL1
cp /media/cdrom/linux/demo/dvsdk/image/uImage_4.3 /media/LABEL1/uImage
rm -rf /media/LABEL2/*
sudo tar jxvf linux/demo/dvsdk/image/ dvsdk-dm37x-evm-rootfs.tar.bz2 -C /media/LABEL2
sync
umount /media/LABEL1
umount /media/LABEL2
```

2) Prepare TF card, insert it in the development board, and turn the power switch on; it is necessary to configure parameters of u-boot; the boot-up serial port information is as follows: (boldface letters are character contents to be input)

```
60


Texas Instruments X-Loader 1.47 (Sep 27 2011 - 15:53:45)
```

DM3730_EVK xM Rev A

Starting X-loader on MMC

Reading boot sector

1153680 Bytes Read from MMC

Starting OS Bootloader from MMC...

Starting OS Bootloader...

U-Boot 2010.06-rc1-svn (Sep 27 2011 - 14:54:40)

OMAP34xx/35xx-GP ES2.1, CPU-OPP2 L3-165MHz

DM3730_EVK board + LPDDR/NAND

I2C: ready

DRAM: 512 MiB

NAND: 512 MiB

In: serial

Out: serial

Err: serial

DM3730_EVK xM Rev A

Die ID #3a7e00229e3800000168263d0402302fNet: dm9000

Hit any key to stop autoboot: 0 **(herein input any key)**

DM3730_EVK # **setenv bootargs console=ttyS2,115200n8 root=/dev/mmcblk0p2 rootfstype=ext3 rw rootwait mpurate=1000 mem=99M@0x80000000 mem=128M@0x88000000 omapdss.def_disp=lcd omap_vout.vid1_static_vrfb_alloc=y omapfb.vram=0:3M**

DM3730_EVK # **setenv bootcmd 'mmc init;fatload mmc 0 80300000 uImage;bootm 80300000'**

DM3730_EVK # **saveenv**

DM3730_EVK # **boot**

mmc1 is available

```
reading uImage


2547428 bytes read
## Booting kernel from Legacy Image at 80300000 ...
   Image Name:   Linux-2.6.32
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    2547364 Bytes = 2.4 MiB
   Load Address: 80008000
   Entry Point:  80008000
   Verifying Checksum ... OK
   Loading Kernel Image ... OK
OK


Starting kernel...
……
Arago Project http://arago-project.org dm37x-evm ttyS2


Arago 2010.07 dm37x-evm ttyS2


dm37x-evm login: root
```

3) DVSDK file system has some preinstalled application programs, which can be executed by the user; running This pipeline decodes H.264 of GStreamer pipelines will be taken as shown example below:

```
root@dm37x-evm:cd /usr/share/ti/gst/omap3530
root@dm37x-evm:/usr/share/ti/gst/omap3530#  ./loadmodules.sh
cmemk unregistered
CMEMK module: built on Oct 14 2010 at 13:14:41
   Reference Linux version 2.6.32
   File
/sdk/build/DVSDK_4_00/4_00_00_22/arago-install/arago-tmp/work/dm37x-evm-none-linux-gnueabi/ti-linuxutils-1_2_25_05_11-r89d/linuxutils_2_25_05_11/packages/ti/sdo/linuxutils/cmem/src/mo
```

dule/cmemk.c

allocated heap buffer 0xc9000000 of size 0x53d000

cmemk initialized

DSPLINK Module (1.65.00.02) created on Date: Oct 14 2010 Time: 13:21:09

SDMAK module: built on Oct 14 2010 at 13:14:44

Reference Linux version 2.6.32

File /sdk/build/DVSDK_4_00/4_00_00_22/arago-install/arago-tmp/work/dm37x-evm-none-linux-gnueabi/ti-linuxutils-1_2_25_05_11-r89d/linuxutils_2_25_05_11/packages/ti/sdo/linuxutils/sdma/src/module/sdmak.c

root@dm37x-evm:/usr/share/ti/gst/omap3530# **gst-launch filesrc location=/usr/share/ti/data/videos/davincieffect_480p30.264 \! typefind ! TIViddec2 ! TIDmaiVideoSink rotation=270 -v**

Setting pipeline to PAUSED ...

/GstPipeline:pipeline0/GstTypeFindElement:typefindelement0.GstPad:src: caps = video/x-h264

Pipeline is PREROLLING ...

/GstPipeline:pipeline0/GstTIViddec2:tividdec20.GstPad:sink: caps = video/x-h264

/GstPipeline:pipeline0/GstTIViddec2:tividdec20.GstPad:src: caps = video/x-raw-yuv, format=(fourcc)UYVY, framerate=(fraction)30000/1001, width=(int)720, height=(int)576

/GstPipeline:pipeline0/GstTIViddec2:tividdec20.GstPad:src: caps = video/x-raw-yuv, format=(fourcc)UYVY, framerate=(fraction)30000/1001, width=(int)720, height=(int)480

/GstPipeline:pipeline0/GstTIDmaiVideoSink:tidmaivideosink0.GstPad:sink: caps = video/x-raw-yuv, format=(fourcc)UYVY, framerate=(fraction)30000/1001, width=(int)720, height=(int)480

Pipeline is PREROLLED ...

Setting pipeline to PLAYING ...

New clock: GstSystemClock

4) At this time, the screen will play a video clip.

For detailed information please reference DVSDK TI main page, or TMS320DM3730_Software_Developers_Guide.PDF document.

3.9 The Development Of Application

This section mainly introduces to development of application programs, and illustrates the general process of development of application programs with cases.

Development example of LED application program

1) To Edit code

led_acc.c source code: control three LED lamps on the development board to flicker in a way of accumulator.

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

#define LED1 "/sys/class/leds/user_ledb/brightness"
#define LED2 "/sys/class/leds/user_led1/brightness"
#define LED3 "/sys/class/leds/user_led2/brightness"

int main(int argc, char *argv[])
{
        int f_led1, f_led2, f_led3;
        unsigned char i = 0;
        unsigned char dat1, dat2, dat3;
        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;
        }
        if((f_led3 = open(LED3, O_RDWR)) < 0){
            printf("error in open %s",LED3);
            return -1;
        }
        for(;;){
            i++;
            dat1 = i&0x1 ? '1':'0';
            dat2 = (i&0x2)>>1 ? '1':'0';
            dat3 = (i&0x4)>>2 ? '1':'0';
            write(f_led1, &dat1, sizeof(dat1));
            write(f_led2, &dat2, sizeof(dat2));
            write(f_led3, &dat3, sizeof(dat3));
            usleep(300000);
        }
    }
```

2) **To Cross-compile**

```
arm-eabi-gcc led_acc.c -o led_acc
```

3) Download and run

Upload to the development board system through TF card, USB flash disk or network, enter the directory with the led_acc file, input the following commands and press Enter, to run led_acc in the background.

```
./led_acc &
```

Chapter 4 WinCE Operating System

4.1 Introduction

This section mainly introduces DM3730-EVK system and application development under Windows Embedded CE 6.0 R3, as well as situation of software resources in disc, software features, establishment of development environment, and how to compile and port BSP (board support package) and so on.

4.2 Software Resources

BSP (Board Support Package)

CD\wince_6\BSP\DM3730_EVK.rar

CD\wince_6\BSP\OMAP35XX_TPS659XX_TI_V1.rar

CD\ wince_6\PowerVR\wince_gfx_sgx_01_01_00_patch_01_setup.exe

Windows Embedded CE 6.0 R3 sample project

CD\wince_60\prj\DM3730_EVK.rar

Sample application

CD\wince_60\app\GPIOAppDemo.rar

Pre-compile image

CD\wince_60\Image\

MLO	First bootloader for SD card boot
XLDRNAND.nb0	First bootloader for NAND boot
EBOOTSD.nb0	Second bootloader for SD card boot
EBOOTNAND.nb0	Second bootloader for NAND boot
NK.bin	WinCE runtime image

4.3 Features

Resources of BSP:

Catalog	**Item**	**Source code / binary**
X-Loader (First boot loader)	NAND	Source
	ONENAND	source
	SD	Source
EBOOT (Second boot loader)	NAND	Source
	ONENAND	Source
	SD	source
OAL	KILT(USB RNDIS)	Source
	REBOOT	Source
	Watchdog	Source
	RTC	Source
	System timer	Source
	Interrupt control	Source
	Low power suspend	Source
Driver	NLED driver	Source
	GPIO/I2C/SPI/MCBSP driver	Source
	Series port driver	Source
	6X6 keyboard driver	Source
	Audio driver	Source
	NAND driver	Source
	Display driver (LCD/DVI. S -Video/Composite Video)/ TOUCH driver	Source
	SD/MMC/SDIO driver	Source
	DM9000 network card driver	Source
	USB OTG driver	Source
	USB EHCI driver	Source

	VRFB driver	Source
	DSPLINKK/CMEMK driver	Binary
	AAC/MPEG2/MPEG4/H264 DSP Hardware decode fitler	Binary
	GPIO keyboard driver	Source
	PWM(TPS65930)driver	Source
	ADC(TPS65930)driver	Source
	ONENAND driver	Source
	Camera driver	Source
	DMA driver	Source
	RTC driver	Source
	Backlight driver	Source
	Battery driver	Source
	Sleep / wakeup button driver	Source
	DVFS/Smart Reflex	Source
SDK	powerVR DDK & SDK	Binary & Source

Table 4-3

4.4 System Development

4.4.1 Installation of compilation tools

Please install compilation tools to windows XP/Vista according to the following steps:

1) Visual Studio 2005
2) Visual Studio 2005 SP1
3) Visual Studio 2005 SP1 Update for Vista (vista system require)
4) Windows Embedded CE 6.0 Platform Builder
5) Windows Embedded CE 6.0 SP1
6) Windows Embedded CE 6.0 R2
7) Windows Embedded CE 6.0 Product Update Rollup 12/31/2008
8) Windows Embedded CE 6.0 R3
9) Windows Embedded CE 6.0 Product Update Rollup 12/31/2009

10) ActiveSync 4.5

11) Windows Mobile 6 Professional SDK

4.4.2 Establishment of development environment

The following preparations should be made:

1) Extract [\wince_6\bsp\DM3730_EVK.rar] to [C:\WINCE600\PLATFORM] directory.

2) Extract [\wince_6\bsp\OMAP35XX_TPS659XX_TI_V1.rar] to [C:\WINCE600\PLATFORM\COMMON\SRC\SOC].

3) Double click [CD\wince_6\PowerVR\wince_gfx_sgx_01_01_00_patch_01_setup.exe] to install PowerVR DDK and SDK, default install path is C:\TI\wince_gfx_sgx_01_01_00_patch_01, copy C:\TI\wince_gfx_sgx_01_01_00_patch_01\poweVR directory to C:\wince600\public.

4) Copy CD directory [CDROM\wince_6\prj\DM3730_EVK] to [C:\WINCE600\OSDesigns] directory.

5) Please modify the LCD or DVI config beford build solution.

For the 4.3” LCD

Modify platform/DM3730_EVK/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/DM3730_EVK/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 DVI output

Modify DM3730_EVK.bat

```
set BSP_DVI_1280W_720H=1
set BSP_NOTOUCH=1
```

The default installation path of the Windows Embedded CE 6.0 compilation tool in this context is [C:\WINCE600].

4.4.3 Sysgen & BSP compile

Below are the steps given for Sysgen and BSP compile

1) Open the existing project file DM3730_EVK.sln[C:\WINCE600\OSDesigns\DM3730_EVK]

2) Select [Build-> Build Solution] in vs2005 to sysgen and build BSP.

3) Images including MLO, EBOOTSD.nb0, NK.bin will be created after sysgen phase and build phase finished successfully, Copy the files MLO, EBOOTSD.nb0 and NK.bin under[C:\WINCE600\OSDesigns\DM3730_EVK\DM3730_EVK\RelDir\DM3730_EVK_ARMV4I_Release] to the SD card.

4) Insert the SD card into the device and boot the device for a test.

4.4.4 Introduction of driver

The following picture shows the BSP architecture of DM3730-EVK:

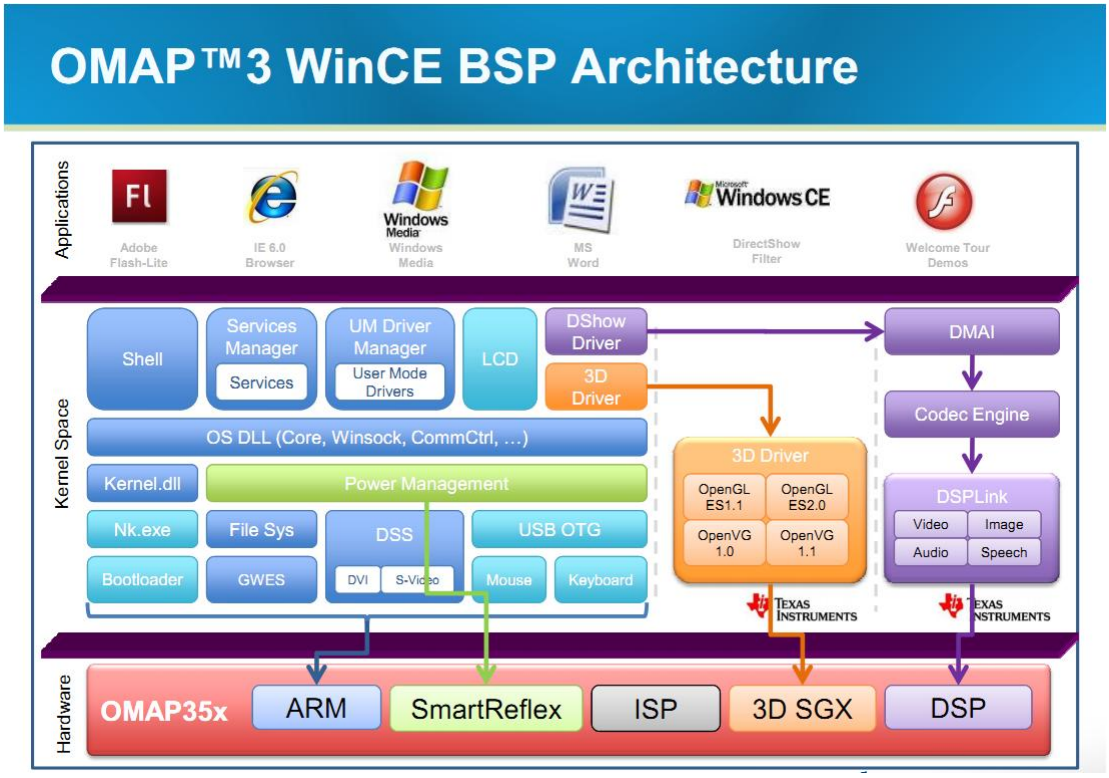


Figure 4-4-4

Source code path of all drivers of BSP:

NLED driver	bsp\DM3730_EVK\SRC\DRIVERS\NLED
GPIO	bsp\DM3730_EVK\SRC\DRIVERS\GPIO bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\GPIO
I2C	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\OAL\I2C

	bsp\DM3730_EVK\SRC\OAL\OALI2C bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\CEDDK\I2C
SPI	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\SPI
MCBSP driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\MCBSP
Series port driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap\COM_MDD2 bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\UART
6X6 keyboard driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap\GPIO_KEYPAD bsp\DM3730_EVK\SRC\DRIVERS\KEYPAD
Audio driver	bsp\DM3730_EVK\SRC\DRIVERS\CESYSGEN\WAVE bsp\OMAP35XX_TPS659XX_TI_V1\omap\TPS659XX\WAV E bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\WAVE
NAND driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\BLOCK bsp\DM3730_EVK\SRC\DRIVERS\BLOCK\NAND
Display driver(LCD/DVI. S -Video/Composite Video)	bsp\DM3730_EVK\SRC\DRIVERS\DISPLAY bsp\DM3730_EVK\SRC\DRIVERS\LCD bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\DISPLAY
TOUCH driver	bsp\DM3730_EVK\SRC\DRIVERS\TOUCH
SD/MMC/SDIO driver	bsp\DM3730_EVK\SRC\DRIVERS\SDBUS bsp\DM3730_EVK\SRC\DRIVERS\SDHC bsp\DM3730_EVK\SRC\DRIVERS\SDMEMORY bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\SDHC
DM9000 network card driver	bsp\DM3730_EVK\SRC\DRIVERS\DM9000
USB OTG driver	bsp\DM3730_EVK\SRC\DRIVERS\MUSB bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\musb
USB EHCI driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\USB\EHCIP DD
VRFB driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\VRFB
DSPLINKK/CMEMK	bsp\DM3730_EVK\FILES\ cmemk.dll bsp\DM3730_EVK\FILES\ dsplinkk.dll

AAC/MPEG2/MPEG4/H264 DSP Hardware decode fitler	bsp\DM3730_EVK\FILES\ MPEG2VideoDecoder.dll bsp\DM3730_EVK\FILES\ MPEG4VideoDecoder.dll bsp\DM3730_EVK\FILES\ H264VideoDecoder.dll bsp\DM3730_EVK\FILES\ AACAudioDecoder.dll
GPIO keyboard driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap\GPIO_KEYPAD bsp\DM3730_EVK\SRC\DRIVERS\KEYPAD
PWM(TPS65930)driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap\TLED
ADC(TPS65930)driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap\TPS659XX\MADC
ONENAND drive	bsp\DM3730_EVK\SRC\DRIVERS\BLOCK\ONENAND
Camera driver	bsp\DM3730_EVK\SRC\DRIVERS\CAMERA_MDC bsp\DM3730_EVK\SRC\DRIVERS\CAMERA_D
Backlight driver	bsp\DM3730_EVK\SRC\DRIVERS\BACKLIGHT
Battery driver	bsp\DM3730_EVK\SRC\DRIVERS\BATTERY
Sleep / wake-up button driver	bsp\DM3730_EVK\SRC\DRIVERS\PWRKEY
DVFS/Smart Reflex	bsp\OMAP35XX_TPS659XX_TI_V1\omap\PM bsp\DM3730_EVK\SRC\DRIVERS\PM
DMA driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap35xx\DMA
RTC driver	bsp\OMAP35XX_TPS659XX_TI_V1\omap\RTC

Table 4-4-4

If the user wants to refer to more WinCE driver development, please refer to the specific reference document of the Windows Embedded CE 6.0 compilation tool,

Start->

All programs->

MicroSoft Vistual Studio 2005->

MicroSoft Visual Studio Document->

Content(C)->

Windows Embedded CE 6.0->Develop a Device Driver.

4.5 Update of system

DM3730-EVK supports boot-up from TF card and NAND; this section will respectively introduce two different system update ways.

4.5.1 Update of TF card

1) Format TF card

Please refer to contents of 3.7.1 Update of TF card system image.

2) Load kernel image file

- Position to sub-catalogue lcd_800x480, lcd_480x272 and DVI_1280x720 under catalogue wince_6/image. You can select a specific sub-catalogue according to your display device, lcd_480x272 for LCD 4.3", lcd_800x480 for LCD 7", and DVI_1280x720 for VGA.
- Copy **MLO, EBOOTSD.nb0 and NK.bin** image files in the selected folder to the TF card.

3) Update image file

Insert TF card and reboot the system. At this time, the system boots from TF card. The HyperTerminal will output boot print information and display the following contents:

```
60
Texas Instruments Windows CE SD X-Loader for EVM 3730
Built Mar 23 2011 at 08:31:15
Version 6.15.00
open ebootsd.nb0 file
Init HW: controller RST
SDHC: 1 bit mode
SDCARD: reqested speed 1000000, actual speed 1000000
Using 4 bit mode
SDHC: 4 bit mode
SDCARD: reqested speed 25000000, actual speed 24000000
read ebootsd.nb0 file
jumping to ebootsd image
```

Microsoft Windows CE Bootloader Common Library Version 1.4 Built Mar 22 2011 18:45:08

Texas Instruments Windows CE EBOOT for Mistral OMAP EVM, Built Mar 23 2011 at 08:31:11

EBOOT Version 1.1, BSP 6.15.00

TI DM3730 Version 0x2b89102f (unknown)

TPS659XX Version 0x10 (ES1.1)

System ready!

Preparing for download...

INFO: Predownload....

WARN: Boot config wasn't found, using defaults

INFO: SW4 boot setting: 0x2f

>>> Forcing cold boot (non-persistent registry and other data will be wiped) <<<

Hit space to enter configuration menu 1...

Init HW: controller RST

SDHC: 1 bit mode

SDCARD: reqested speed 1000000, actual speed 1000000

Using 4 bit mode

SDHC: 4 bit mode

SDCARD: reqested speed 25000000, actual speed 24000000

BL_IMAGE_TYPE_BIN

Download file information:

---

[0]: Address=0x80101000 Length=0x022a14e4 Save=0x80001000

Download file type: 1 **(You may wait for a longer time here as the system boots from TF card)**

```
rom_offset=0x0.
ImageStart = 0x80101000, ImageLength = 0x22A14E4, LaunchAddr = 0x8010F82C

Completed file(s):
---------------------------------------------------------------------------
[0]: Address=0x80101000  Length=0x22A14E4  Name="" Target=RAM
ROMHDR at Address 80101044h
Launch Windows CE image by jumping to 0x8000f82c...

Windows CE Kernel for ARM (Thumb Enabled) Built on Oct 20 2009 at 18:39:19
OAL: CPU revision 0xffffffff
OAL: CPU L2 Aux register 0x400042
--- High Performance Frequecy is 32768 khz---
```

So far, the system has entered the calibration interface of WinCE, after finish of calibration, the system enters the desktop system of WinCE.

4.5.2 Update of NAND flash

1) Format TF card

Please refer to contents of 3.7.1 Update the image for TF card

2) Load kernel image file

- Position to sub-catalogue lcd_800x480, lcd_480x272 and DVI_1280x720 under catalogue wince_6/image. You can select a specific sub-catalogue according to your display device, lcd_480x272 for LCD 4.3", lcd_800x480 for LCD 7", and DVI_1280x720 for VGA.
- Copy **MLO, EBOOTNAND.nb0, NK.bin and XLDRNAND.nb0** image files in the selected folder to the TF card, and rename EBOOTNAND.nb0 as EBOOTSD.nb0.

3) Update image file

- Insert TF card and reboot the system. At this time, the system boots from TF card. The HyperTerminal will output boot print information, you can press [SPACE] to enter the EBOOT menu. There is an automatic update key [k] in the menu, which can update

XLDR, EBOOT, logo and NK images automatically, or you can update one by one according to the following steps:

- Press [5] to enter the Flash administration menu.
- Press [a], [b] and [c] to write XLDR, EBOOT and NK images respectively.
- Then press [0] to return to main menu, and respectively press [2], [4], [7] and [y] to change the boot devices.

Pull out TF card and then reboot the system. At this time, the system will boot from NAND Flash.

4.6 Instructions for use

4.6.1 How to use S-Video interface

In the WinCE operating system

1) Launch Start->Program->Command Prompt in windows ce
2) Type in the line below and enter in Command Prompt

```
do tvout on
```

4.6.2 How to use openGL ES demo

Copy C:\TI\wince_gfx_sgx_01_01_00_patch_01 \PowerVR-SDK\OGLES1.1\Binaries\Demos or C:\WINCE600\PUBLIC\PowerVR\oak\target\Rev125\ARMV4I\retail*.exe to DM3730-EVK wince system. And double click the demos to test.

Known problem: Some demos are unable to work normally when DVI is used as output. This problem will be solved in the next release version.

4.6.3 How to use CAM8000-A module

1) Modify the lines below in DM3730_EVK.bat

```
set BSP_NOCAMERA=
set BSP_NOCAMERA_MDC=
set BSP_NODIGITALCAMERA=1
```

2) Rebuild solution in vs 2005 to create nk.bin
3) Connect camera8000-A module to DM3730-EVK and boot with updated nk.bin.

4) Copy C:\wince600\platform\DM3730_EVK\files\CameraDshowApp_analog.exe to target system and then launch.

Knowing issue: CAM8000-A cannot work well on DVI display mode. This problem would be solved in next release edition, so it is recommend that use the 4.3/7 inch LCD when use cam8000-a module currently.

4.6.4 How to use CAM8000-D module

1) Modify the lines below in DM3730_EVK.bat

```
set BSP_NOCAMERA=
set BSP_NOCAMERA_MDC=1
set BSP_NODIGITALCAMERA=
```

2) Add the line below in the file locate in C:\wince600\platform\DM3730_EVK\src\driver\dirs

```
camera
```

3) Rebuild solution in vs 2005 to create nk.bin

4) Connect camera8000-D module to DM3730-EVK and boot with updated nk.bin.

5) Copy C:\wince600\platform\DM3730_EVK\files\CameraDshowApp_digital.exe to target system and then launch.

4.7 The development of application

This chapter introduces how to develop Windows Embedded CE 6.0 application program in DM3730-EVK.

Before development, it is necessary to install Windows Mobile 6 Professional SDK. Please refer to Appendix VI for download path.

It is necessary to establish Windows Embedded CE 6.0 development platform in order to develop Windows Embedded CE 6.0 operating system. The development case in this Manual is based on development of Windows Mobile 6 Professional SDK.

4.7.1 Application program interfaces and examples

API used for development of DM3730-EVK application programs employs Microsoft Windows Embedded CE 6.0 standard application program interface definition, DM3730-EVK only expands interface definition of GPIO based on standard API. Please refer to the CD\wince_6\app for the application program representatives that control the status of LED through GPIO pin.

Please check relative Help documents of MSDN Windows Embedded CE 6.0 API for Windows Embedded CE 6.0 standard application program interface definition.

There are some use routines of standard API in the chapter GPIO Application Program Development Case for reference of users. Some interfaces exported by drivers can only be used by drivers; the application programs have no permission to call them.

4.7.2 GPIO application program interfaces and examples

GPIO device name is L"GIO1:" corresponding device 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

Table 4-7-2-1

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;
```

3) 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);
```

4) 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

Table 4-7-2-2

5) The operation of GPIO Pin

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

6) Output high level:

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

7) Output low level:

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

8) 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

9) 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

10) Close GPIO device

```
CloseHandle(hFile);
```

(1) Definition of GPIO pin: 0~191 MPU Bank1~6 GPIO pin, 192~209 TPS65930 GPIO 0~17.

(2) GPIO pin 0~191 has to be configured as GPIO under xldr/platform.c and oalib/oem_pinmux.c two files.

(3) GPIO break mode can only be used by drivers; setting such mode in application programs is invalid.

Appendix

Appendix I Hardware Dimensions

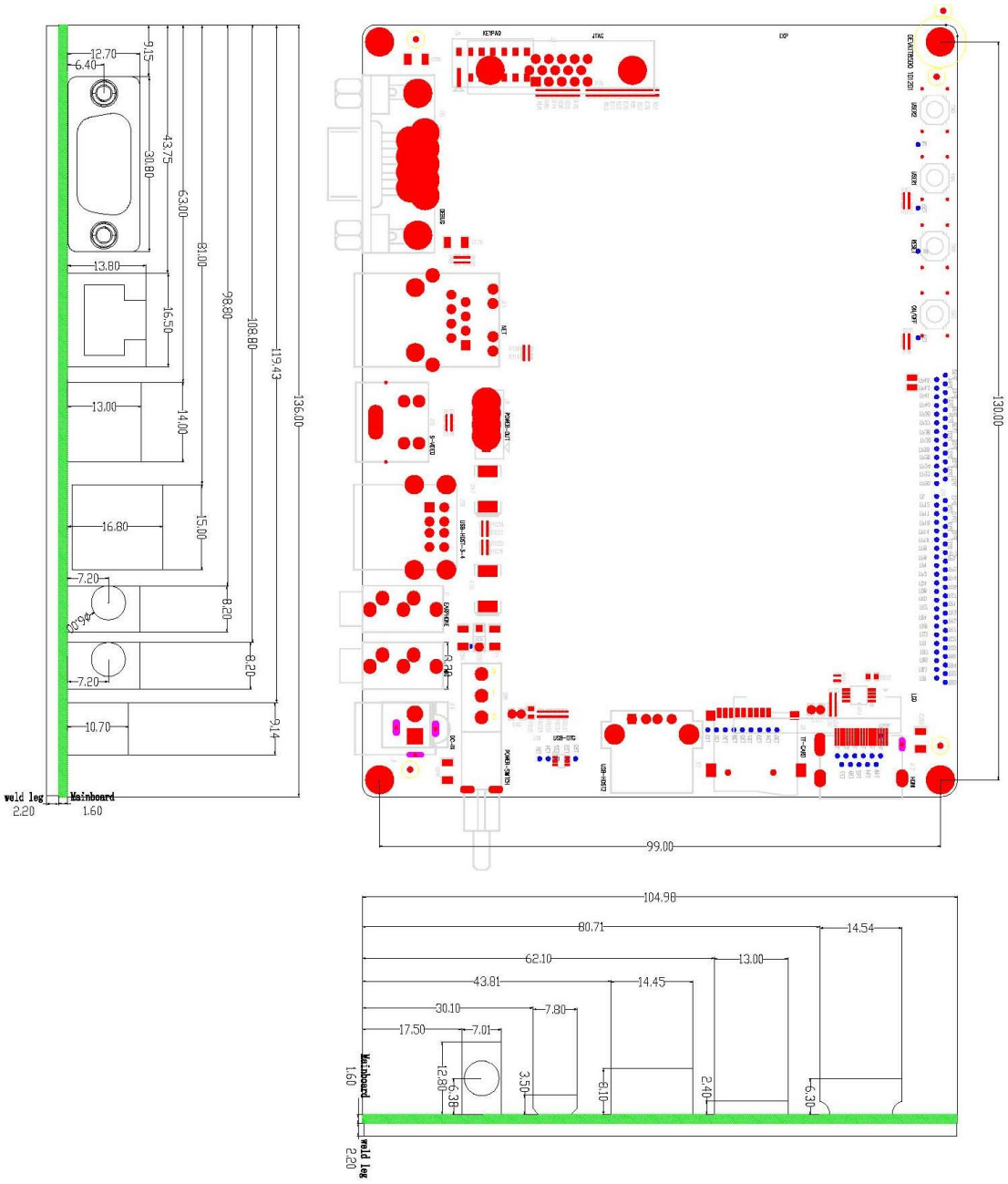


Figure Appendix 1 Hardware Dimensions Diagram

Appendix II The Installation Of Ubuntu

Installing Ubuntu in Windows using VirtualBox

The screenshots in this tutorial use Ubuntu 11.04, but the same principles apply also to Ubuntu 10.10, 11.04, and any future version of Ubuntu. Actually, you can install pretty much any Linux distribution this way.

VirtualBox allows you to run an entire operating system inside another operating system. Please be aware that you should have a minimum of 512 MB of RAM. 1 GB of RAM or more is recommended.

Installation Process

1. Download software

Before installing Ubuntu, you must get VirtualBox software and Ubuntu disk image (ISO file).

Available in the VirtualBox download page VirtualBox program VirtualBox-4.0.10-72479-Win.exe.

In the Ubuntu download page to get Ubuntu disk image ubuntu-11.04-desktop-i386.iso.

2. Create New Virtual machine

Figure Appendix 2.2.1

After you launch VirtualBox from the Windows Start menu, click on **New** to create a new virtual machine. When the New Virtual Machine Wizard appears, click **Next**.

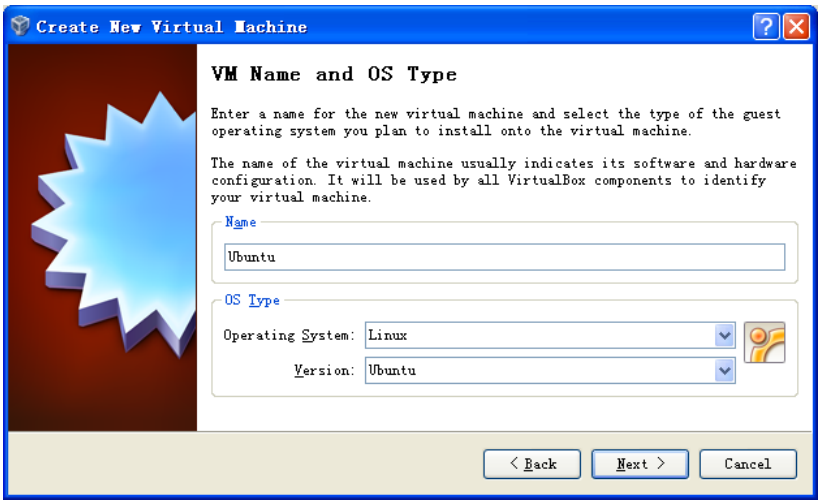


Figure Appendix 2.2.2

You can call the machine whenever you want. If you're installing Ubuntu, it makes sense to call it **Ubuntu**, I guess. You should also specify that the operating system is **Linux**.

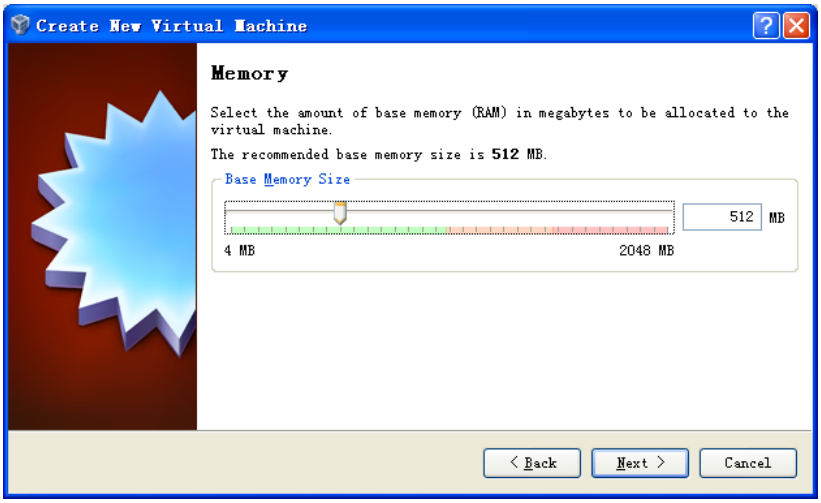


Figure Appendix 2.2.3

VirtualBox will try to guess how much of your memory (or RAM) to allocate for the virtual machine. If you have 1 GB or less of RAM, I would advise you stick with the recommendation. If, however, you have over 1 GB, about a quarter your RAM or less should be fine. For example, if you have 2 GB of RAM, 512 MB is fine to allocate. If you have 4 GB of RAM, 1 GB is fine to allocate. If you have no idea what RAM is or how much of it you have, just go with the default.

Click **Next**.

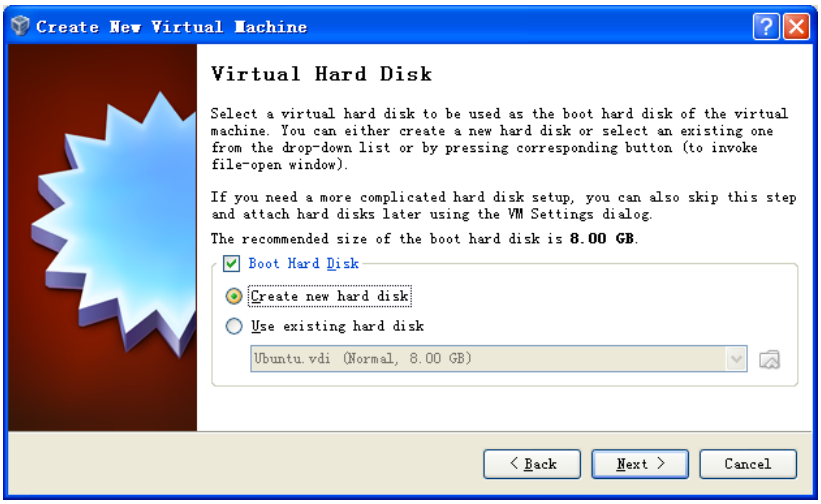


Figure Appendix 2.2.4

If this is your first time using VirtualBox (which it probably is if you need a tutorial on how to use it), then you do want to create new hard disk and then click **Next**.

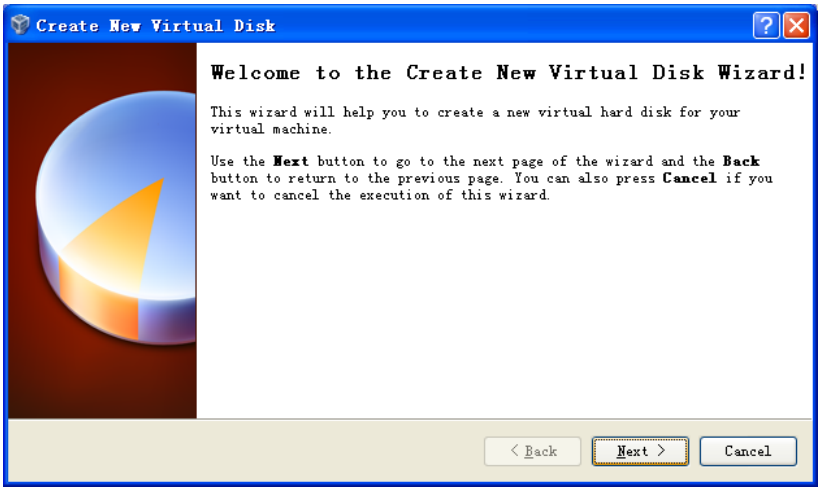


Figure Appendix 2.2.5

Click **Next** again.

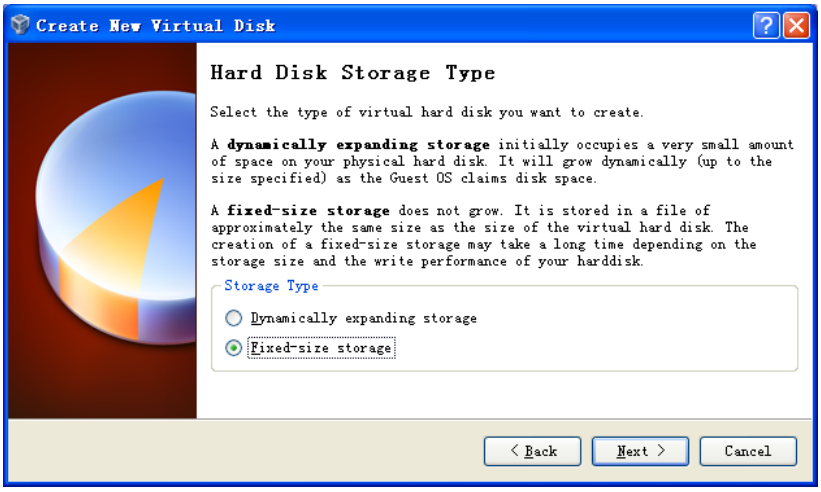


Figure Appendix 2.2.6

Theoretically, a dynamically expanding virtual hard drive is best, because it'll take up only what you actually use. I have come upon weird situations, though, when installing new software in a virtualized Ubuntu, in which the virtual hard drive just fills up instead of expanding. So I would actually recommend picking **Fixed-size storage**.

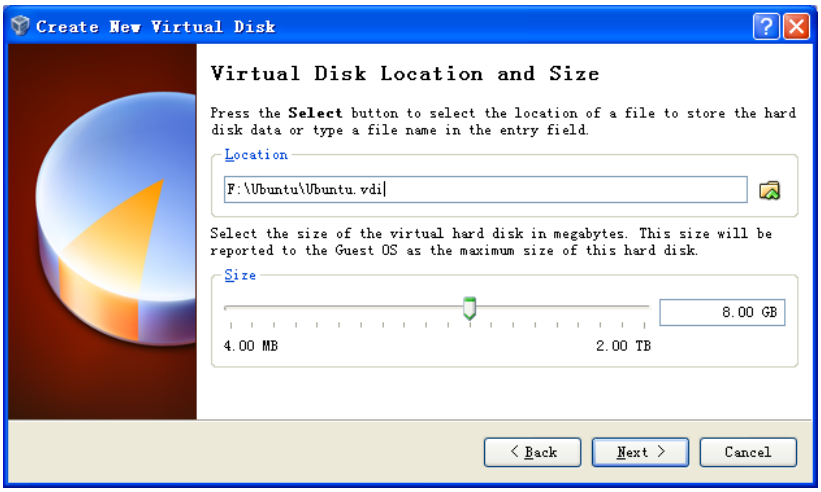


Figure Appdix 2.2.7

Ubuntu's default installation is less than 8 GB. If you plan on adding software or downloading large files in your virtualized Ubuntu, you should tack on some buffer.

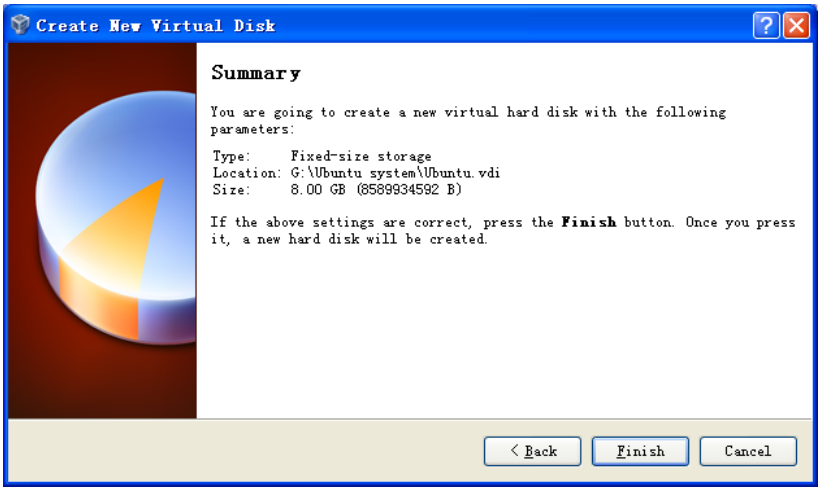


Figure Appendix 2.2.8

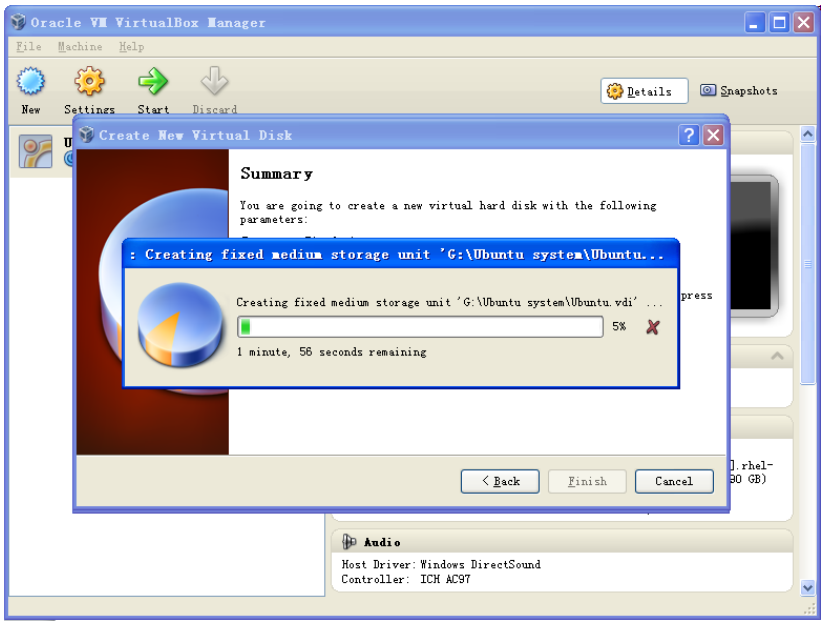


Figure Appendix 2.2.9

Click **Finish** and wait for the virtual hard drive to be created. This is actually just a very large file that lives inside of your Windows installation.

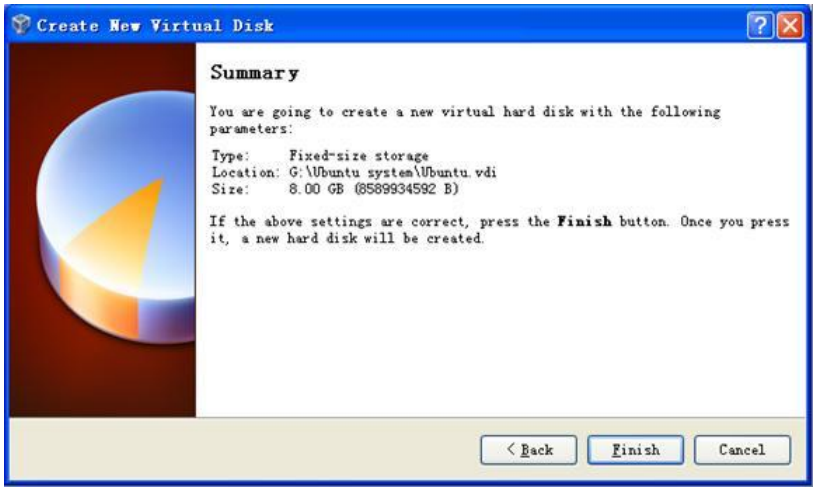


Figure Appendix 2.2.10

Click **Finish**, the virtual hard drive is successfully created.

3. Installing Ubuntu

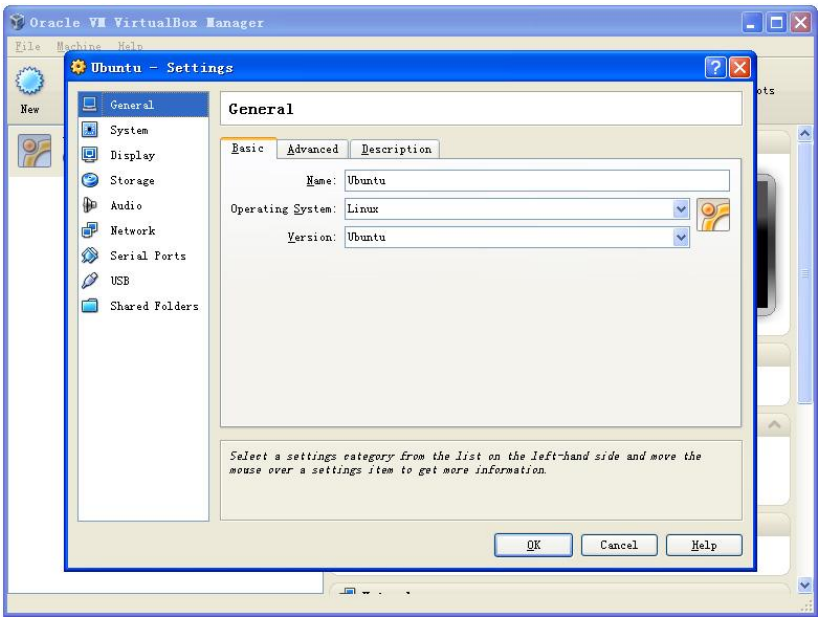


Figure Appendix 2.3.1

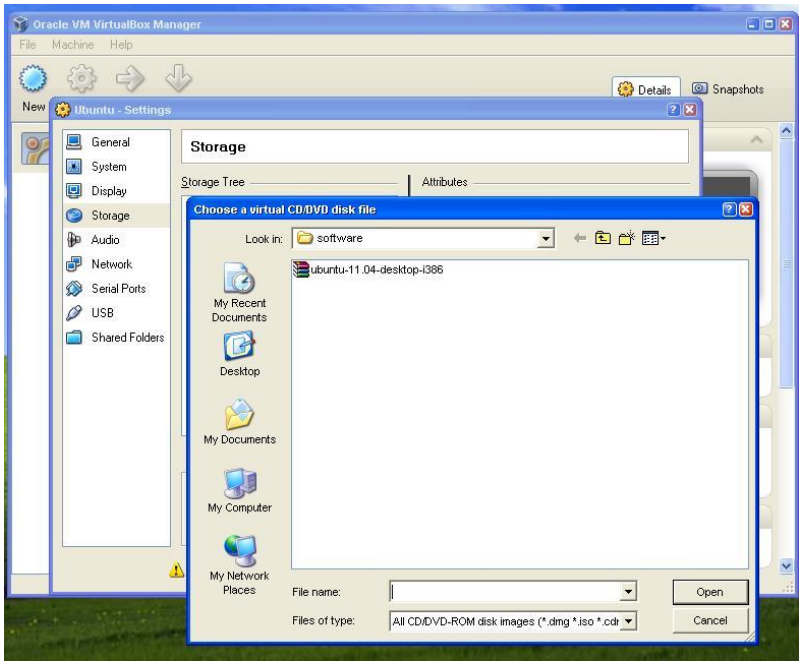


Figure Appendix 2.3.2

Before Installing Ubuntu in a virtual machine, the first thing to do to make the (currently blank) virtual hard drive useful is to add the downloaded Ubuntu disk image (the .iso) boot on your virtual machine. Click on **Settings** and **Storage**. Then, under CD/DVD Device, next to Empty, you'll see a little folder icon. Click that, and you can select the Ubuntu .iso you downloaded earlier.

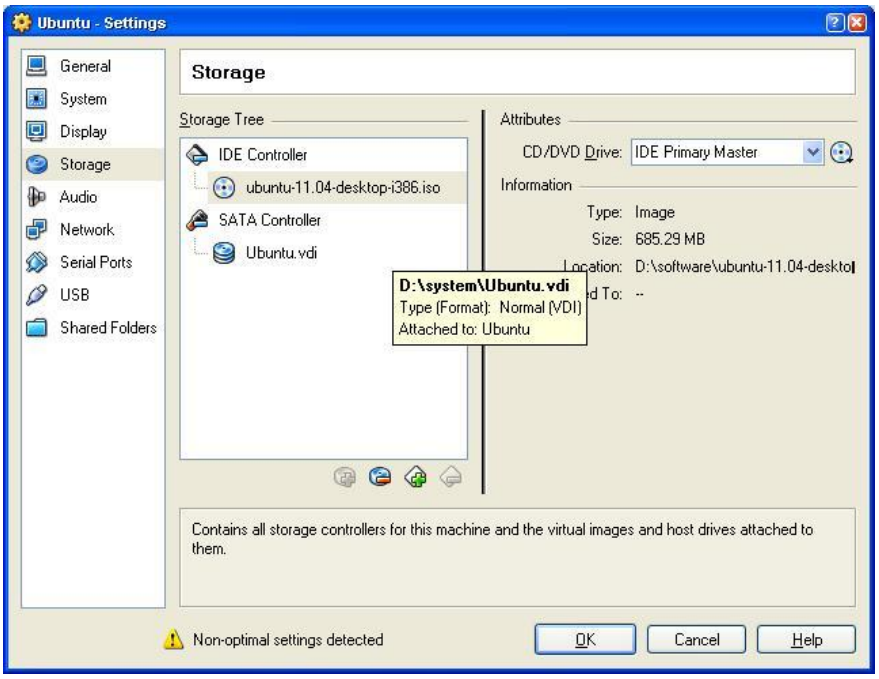


Figure Appendix 2.3.3

Once you've selected it, click **OK**.

Then double-click your virtual machine to start it up.

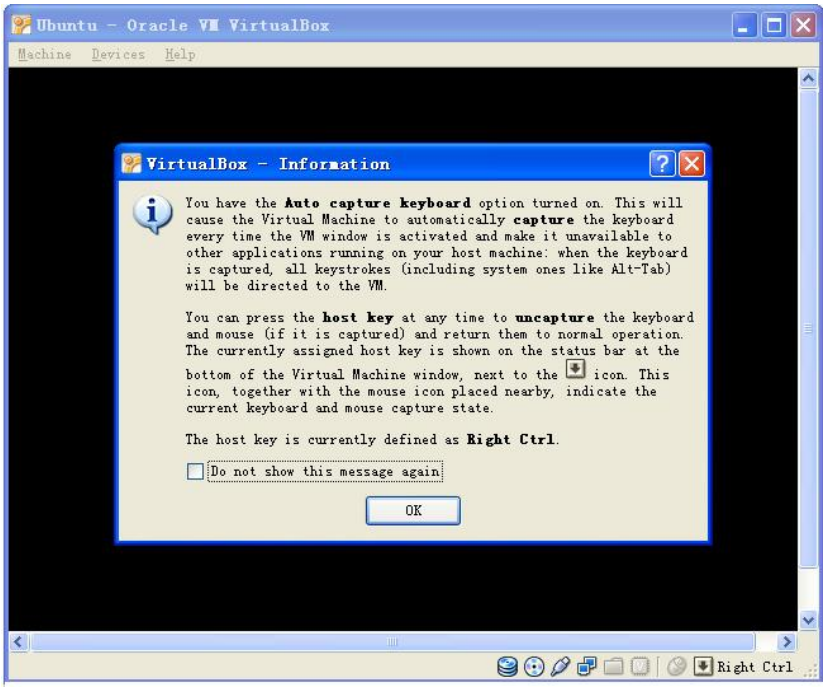


Figure Appendix 2.3.4

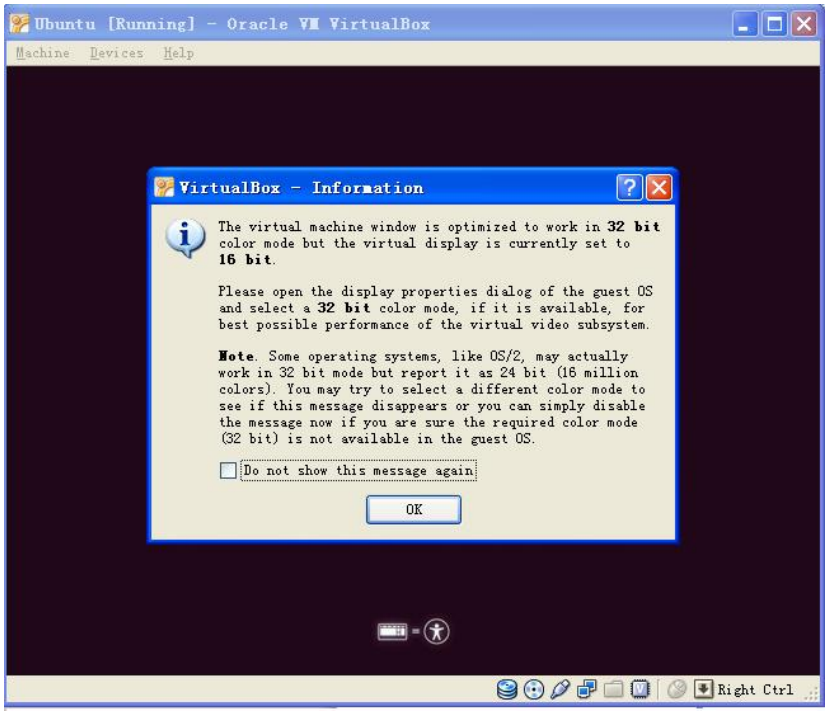


Figure Appendix 2.3.5

Click **OK**

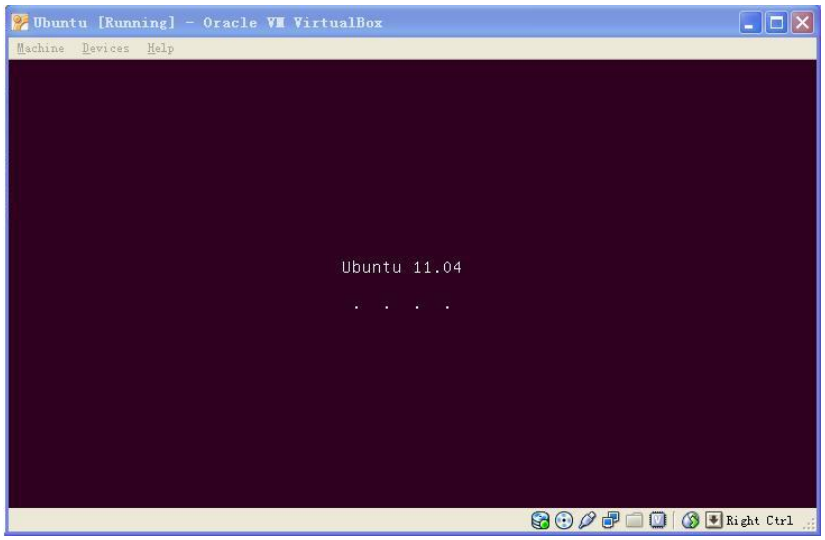


Figure Appendix 2.3.6

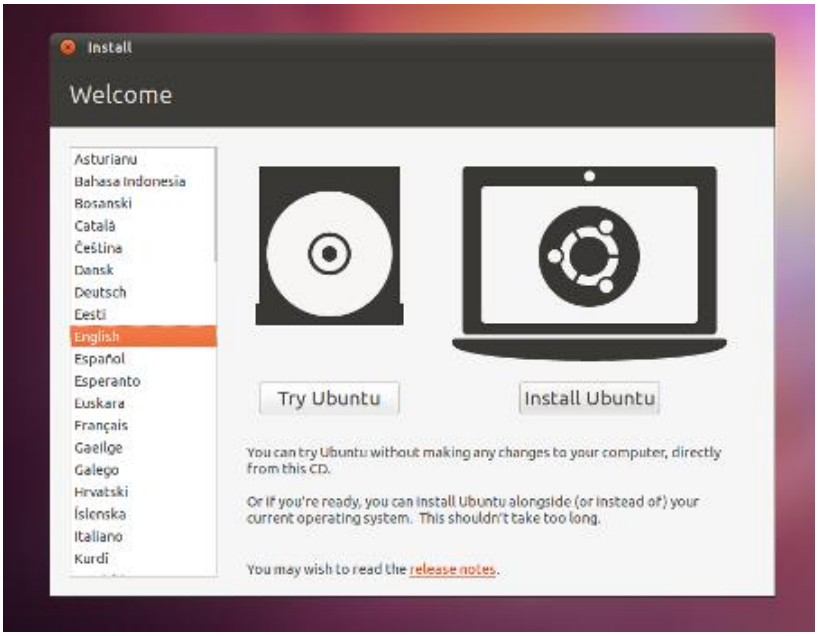


Figure Appendix 2.3.7

Select language and click **Install Ubuntu**.

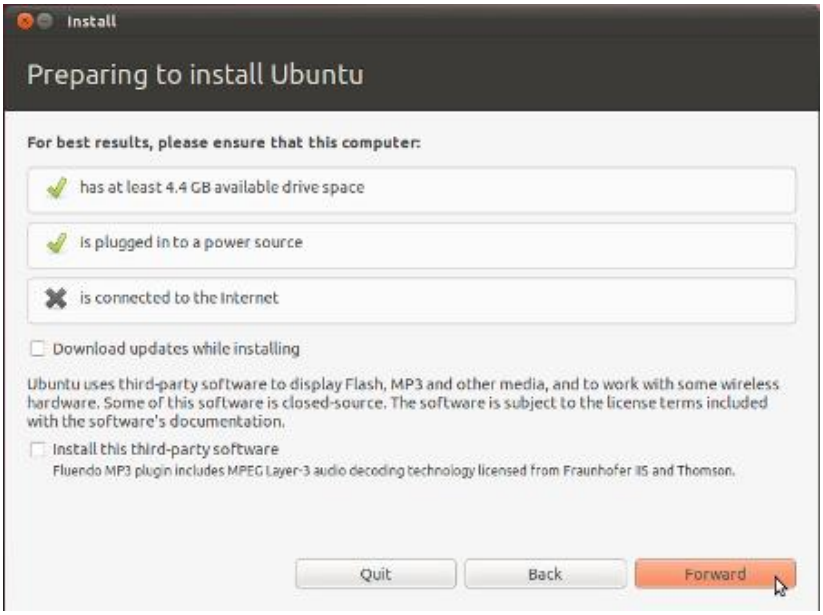


Figure Appendix 2.3.8

There is a new option in the Ubuntu 11.04 and 10.10 installers that asks if you want to install closed source third-party software for MP3 playback and Flash, for example. I would strongly suggest—unless you know who Richard Stallman is—that you check (or tick) this option.

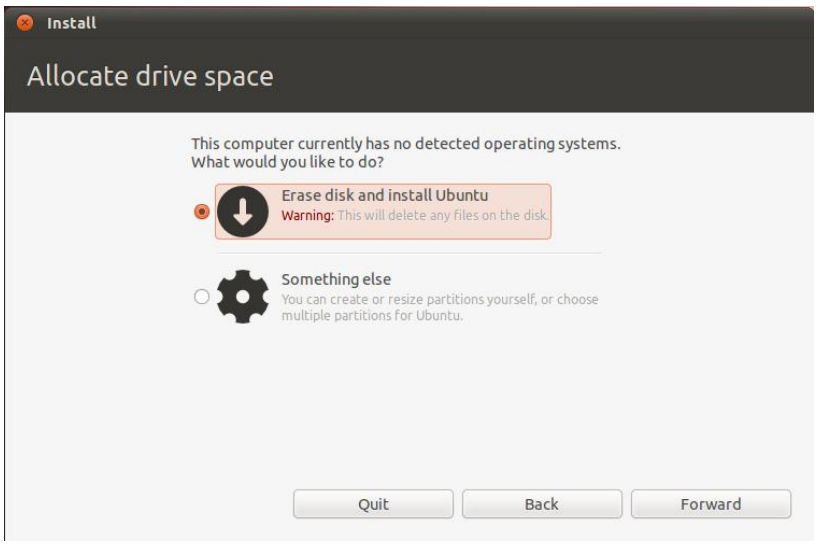


Figure Appendix 2.3.9

Click **Forward**.

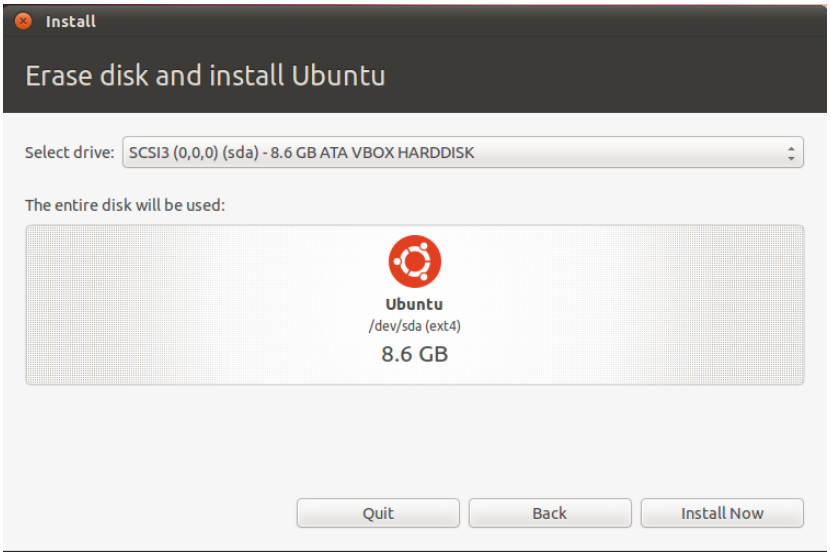


Figure Appendix 2.3.10

This is the no-turning-back point. If you decide to do this, your hard drive will be repartitioned and part or all of it will be formatted. Before you click this button “Install Now” to continue, make sure you have everything backed up.

Figure Appendix 2.3.11

While Ubuntu is preparing files to copy over for installation, it'll ask you some questions. They're self-explanatory.

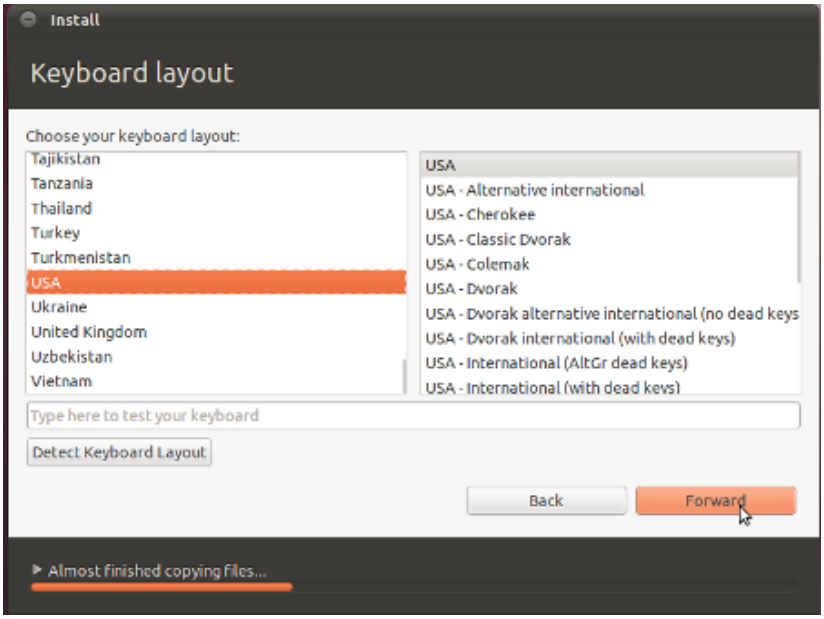


Figure Appendix 2.3.12

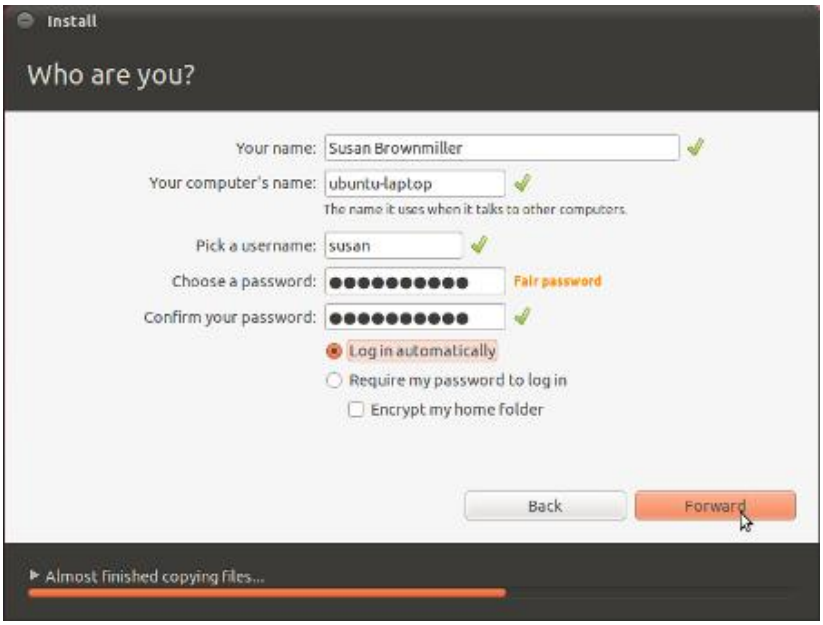


Figure Appendix 2.3.13

Figure Appendix 2.3.14

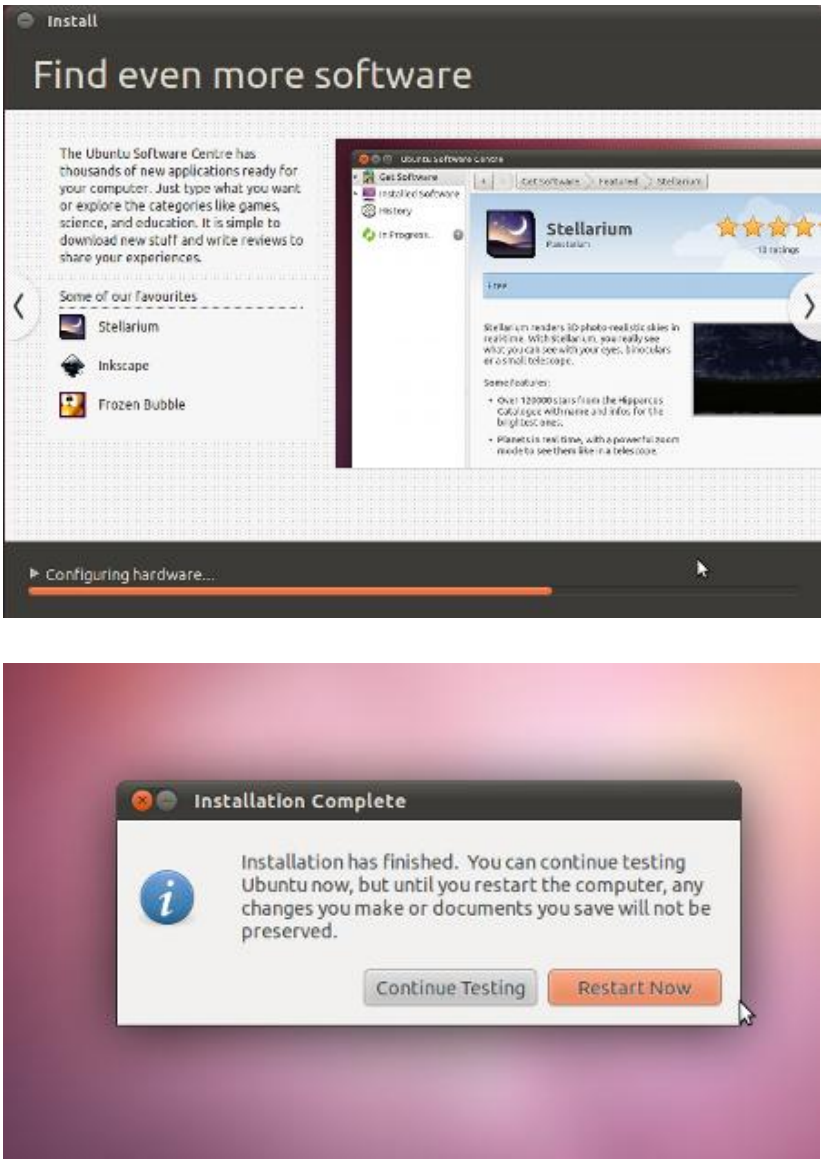


Figure Appendix 2.3.15

The installation will finish (the whole thing can take anywhere between 15 minutes and an hour, depending on the speed of your computer).

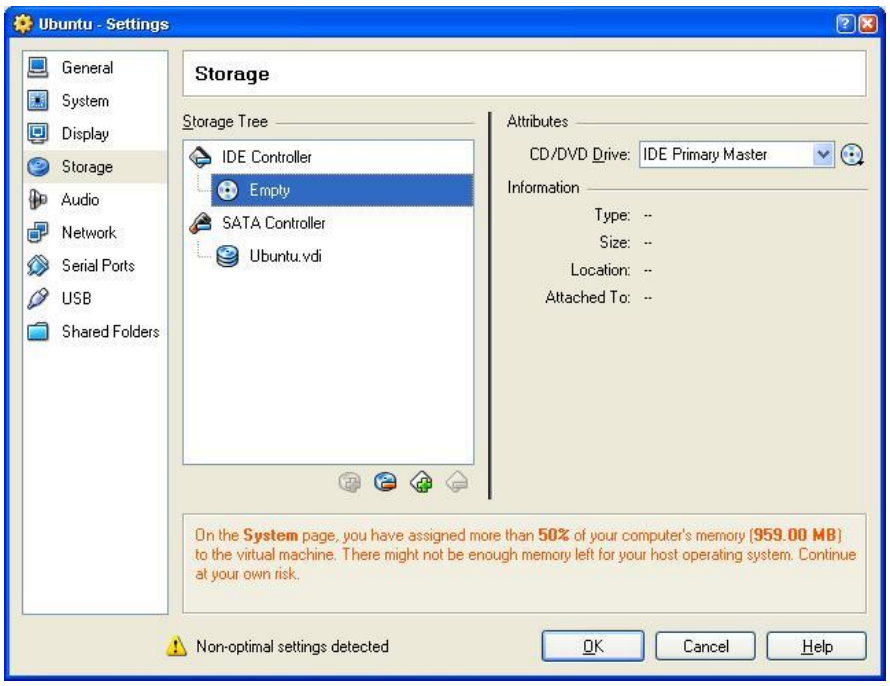


Figure Appendix 2.3.16

Afterwards, in order to use your virtualized installation (instead of continually booting the live CD), you have to change the CD/DVD Device entry to be **Empty** again.

Appendix III 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"

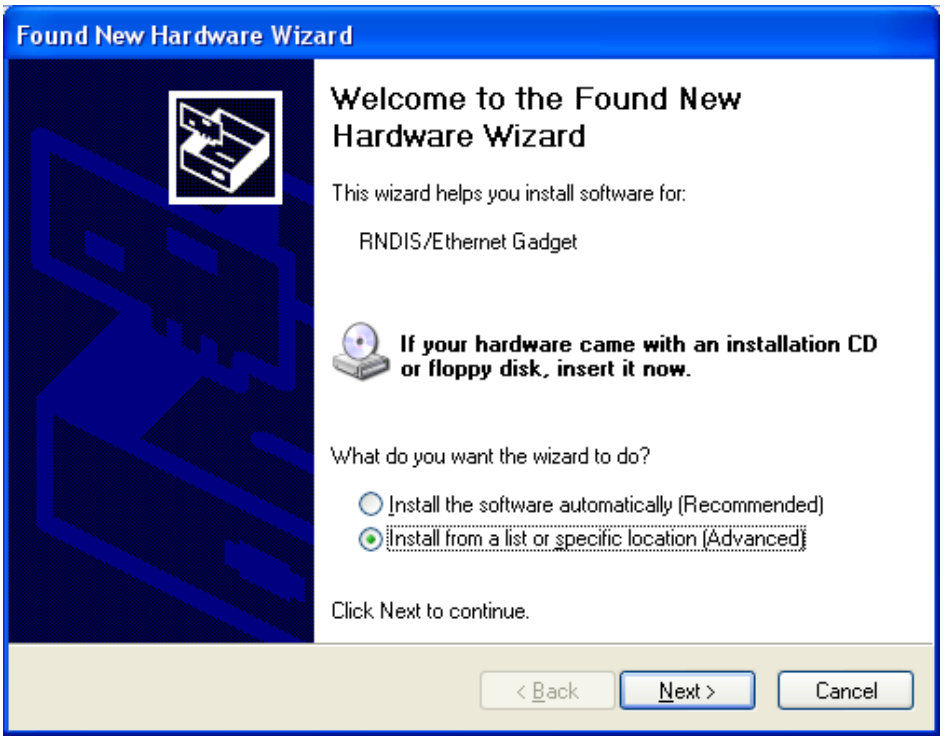


Figure Appendix 3.1

2. Designate a path for the usb driver, and the usb driver directory is [disk\linux\tools], then click "Next"

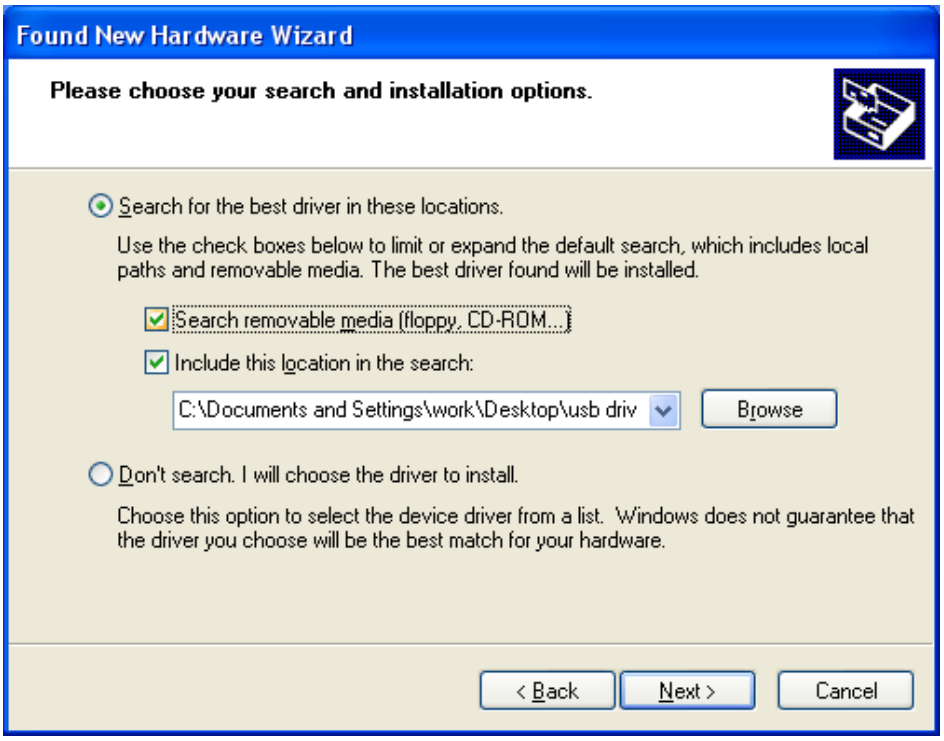


Figure Appendix 3.2

3. When the following appears, select “Continue”

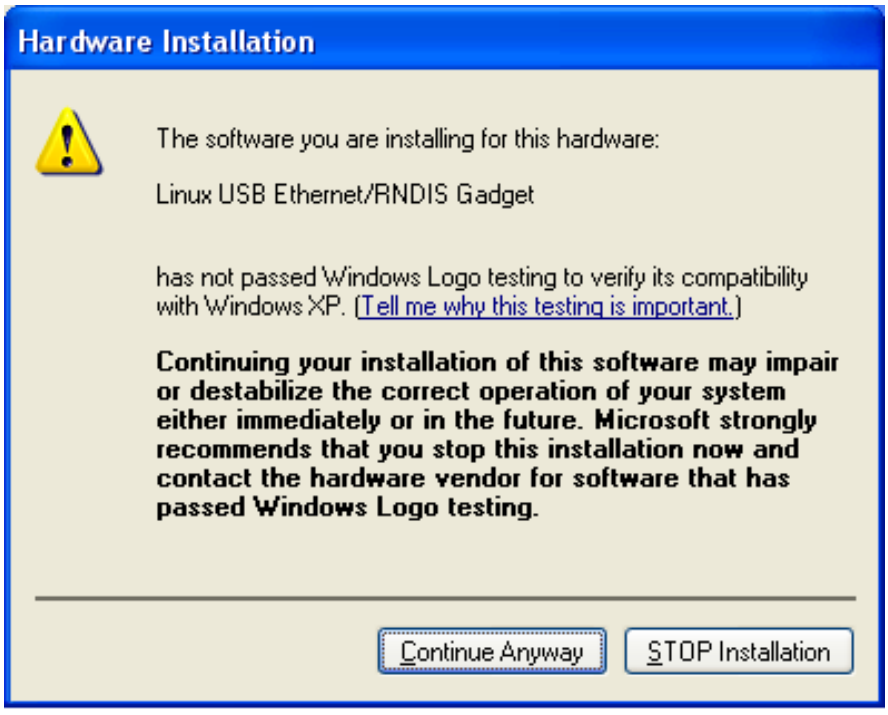


Figure Appendix 3.3

4. Please wait until the installation is completed

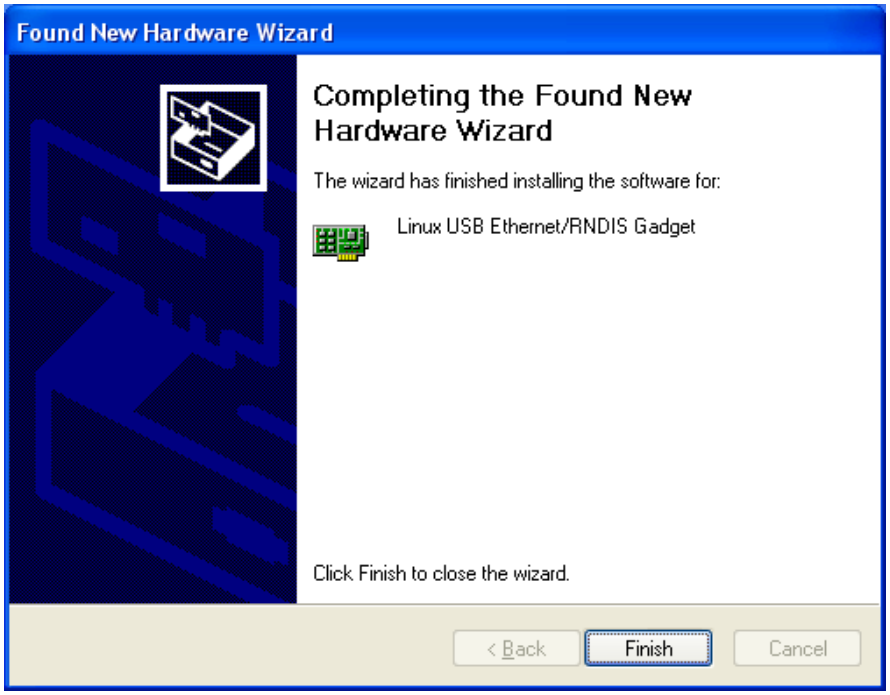


Figure Appendix 3.4

Appendix IV Linux Boot Disk Format

How to create a dual-partition card for DM3730-EVK to boot Linux from first partition and have root file system at second partition

Introduction

This guide is meant for those who are looking to create a dual-partition card, booting from a FAT partition that can be read by the DM3 ROM bootloader and Linux/Windows, then utilizing an ext3 partition for the Linux root file system.

Text marked with [] shows user input.

1. Determine which device the SD Card Reader is 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 V 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 VI WinCE Source

1. Visual Studio 2005 SP1 Update for Vista (if applicable)

http://download.microsoft.com/download/c/7/d/c7d9b927-f4e6-4ab2-8399-79a2d5cdfac9/VS80sp1-KB932232-X86-ENU.exe

2. 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

3. Windows Embedded CE 6.0 R2

http://www.microsoft.com/downloads/details.aspx?FamilyID=f41fc7c1-f0f4-4fd6-9366-b61e0ab59565&displaylang=en

4. Windows Embedded CE 6.0 R3

http://download.microsoft.com/download/F/5/2/F5296720-250A-4055-991C-0CEA5DE11436/CE6R3.iso

5. WinCEPB60-091231-Product-Update-Rollup-Armv4I.msi

http://download.microsoft.com/download/E/D/7/ED779010-1B2E-4ACA-BF9F-9F1D0EF8052B/WinCEPB60-091231-Product-Update-Rollup-Armv4I.msi

6. Viewers for Windows Embedded CE 6.0 R3

http://download.microsoft.com/download/3/3/8/3383B6CE-F70A-4A2C-873A-8C67D3CF55F6/WesttekFileViewers6.exe

7. Windows Mobile 6 Professional SDK Refresh.msi

http://download.microsoft.com/download/f/2/3/f232f773-7edc-4300-be07-d3b76a5b3a91/Windows%20Mobile%206%20Professional%20SDK%20Refresh.msi

8. Windows Embedded CE 6.0 USB Camera Driver.msi

http://download.microsoft.com/download/f/a/1/fa1aaef1-6ae3-4cf3-ab95-b01d3e428403/Windows%20Embedded%20CE%206.0%20USB%20Camera%20Driver.msi

Customer Service & Technical support

Customer Service

Please contact Premier Farnell local sales and customer services staffs for the help.

Website: http://www.farnell.com/

Technical Support

Please contact Premier Farnell local technical support team for any technical issues through the telephone, live chat & mail, or post your questions on the below micro site, we will reply to you as soon as possible.

Centralized technical support mail box: knode_tech@element14.com

Community: http://www.element14.com/community/community/knode/dev_platforms_kits

Please visit the below micro site to download the latest documents and resources code:

http://www.element14.com/community/community/new_technology/dm3730-evk

Notes

This board was designed by element14's design partner- Embest, you can contact them to get the technical support as well.

Marketing Department:

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