西南林业大学 本科毕业(设计)论文 (二〇一八届)

题	目:	RongOS — 一个简单操作系统的实
		现
分院系	:部:	计算机与信息科学学院
专	业:	计算机科学与技术专业
姓	名:	蒲启元
导师姓		
导师职		进师
子则以	! /h/\	[] [* 1] []

二〇一八 年 六 月

RongOS — 一个简单操作系统的实现

蒲启元

(西南林业大学计算机与信息科学学院,云南昆明650224)

摘 要:操作系统管理着计算机的硬件和软件资源,它是向上层应用软件提供服务 (接口)的核心系统软件,这些服务包括进程管理,内存管理,文件系统,网络通信,安全机制等。操作系统的设计与实现则是软件工业的基础与内核。为此,在国务院提出的《中国制造 2025》中专门强调了操作系统的开发。但长期以来,操作系统核心开发技术都掌握在外国人手中,技术受制,对于我们的软件工业来说很不利。本文拟从零开始设计开发一个简单的操作系统,包括 boot loader,中断,内存管理,图形接口,多任务,以及在这个系统上的几个小应用等。尽管这个系统很简单,但它为自主开发操作系统做了一个小小的尝试。

关键词:操作系统,开发,自主

The implement of a simple OS — RongOS

Qiyuan Pu

School of Computer and Information Science Southwest Forestry University Kunming 650224, Yunnan, China

Abstract: Operating system manages the sources of hardware and software, it lie in the core of the system software and provide service(interface) to upper application. These service including process management, memory management, file system, network communication, security mechanism etc. The design and implement of operating system is the foundation and core of software industry. Therefore, «Made in China 2025» emphasize the development of operating system that put forward by The State Council. For a long time, however, the kernel development technology grasped in the hand of foreigner, it's bad for our software industry cause of limited technology. So this article will design and develop a simple operating system, including boot loader, interrupt, memory management, graphic interface, multitasking, and some little application depend on this system. In spite of the simple of this system, it's a small trying for autonomous development operating system.

Key words: operating system, development, autonomous

目 录

1	Intr	duction	1
	1.1	Background	1
	1.2	Preliminary Works	1
		1.2.1 Development Environment	1
		1.2.2 Tools	1
		1.2.3 Install	1
2	Desi	n	3
	2.1	Top Level Design	3
	2.2	Detailed Design	3
		2.2.1 Boot Loader	3
3	Imp	ementation	4
	3.1	Boot Loader	4
		3.1.1 Chose Disk	4
		3.1.2 The Structure of Floppy Disk	4
		3.1.3 Flowchart of Boot Loader	5
		3.1.4 Codes and Comments of Boot Loader	6
	3.2	32-bit Mode and Import C Codes	13
	3.3	Screen Display and Text	13
	3.4	Control Mouse	13
	3.5	Memory Management	13
	3.6	Making Window	13
	3.7	Timer	13
	3.8	Multitasking	13
	3.9	Command Line Window	13

目 录

3	.10 API	13
3	.11 OS Protection	13
3	.12 Graphics Processing	13
3	.13 Window Operation	13
3	.14 Application Protection	13
3	.15 File Operation	13
3.	.16 Some Applications	13
3	.17 Prospects and Shortages	13
参考	文献	14
指导教师简介		
致	谢	16

插图目录

3-1	Floppy Disk Structure	4
3-2	Flowchart of Boot Loader	5

表格目录

1 Introduction

1.1 Background

1.2 Preliminary Works

1.2.1 Development Environment

Operating System: Debian 4.11.0-1-amd64

Debug System: QEMU emulator version 2.8.1(Debian 1:2.8+dfsg-7)

Emacs version: GNU Emacs 25.2.2

1.2.2 Tools

Some tools used to develop RongOS, see tools.¹.

1.2.3 Install

Debian System: there is a small tutorial.²

QEMU, for my x86_64 architecture:

\$ sudo apt-get install qemu-system-x86_64

Note that the tools is exe formate, so on Debian system, you need to install wine:

\$ sudo apt-get update

\$ sudo apt-get install wine

Maybe you also need to add i386 architecture cause of AMD64 on your machine to use these tools:

\$ sudo dpkg —add—architecture i386

¹https://github.com/Puqiyuan/RongOS/tree/master/Tools

²http://cs2.swfc.edu.cn/~wx672/lecture_notes/linux/install.html

\$ sudo apt-get update

2 Design

- 2.1 Top Level Design
- 2.2 Detailed Design
- 2.2.1 Boot Loader

3 Implementation

3.1 Boot Loader

3.1.1 Chose Disk

There are many ways to boot a operating system, from hard disk, USB, floppy disk etc. I chose floppy disk, although it is out of date. For my purpose is that develop a simple operating system, pay my attention on how to development. The structure of floppy disk is simple and for my simple operating system it's enough.

3.1.2 The Structure of Floppy Disk

This picture show the inside of floppy disk:



图 3-1 Floppy Disk Structure

The floppy store information in two sides. There are 80 cylinders from the outermost to the core in each side, numbering 0, 1, ..., 79. The head can assign be 0 or 1, representing two sides of floppy. When specify head number and cylinder number, forming a ring, named track in jargon. The track is large so we divide it to 18 small parts, named sector. A sector can store 512 byte. So the capacity of a floppy is:

$$18 * 80 * 2 * 512 = 1474560Byte = 1440KB.$$

The IPL(Initial Program Loader) in C0-H0-S1(cylinder 0, head 0, sector 2), and the next sector is C0-H0-S2.

3.1.3 Flowchart of Boot Loader

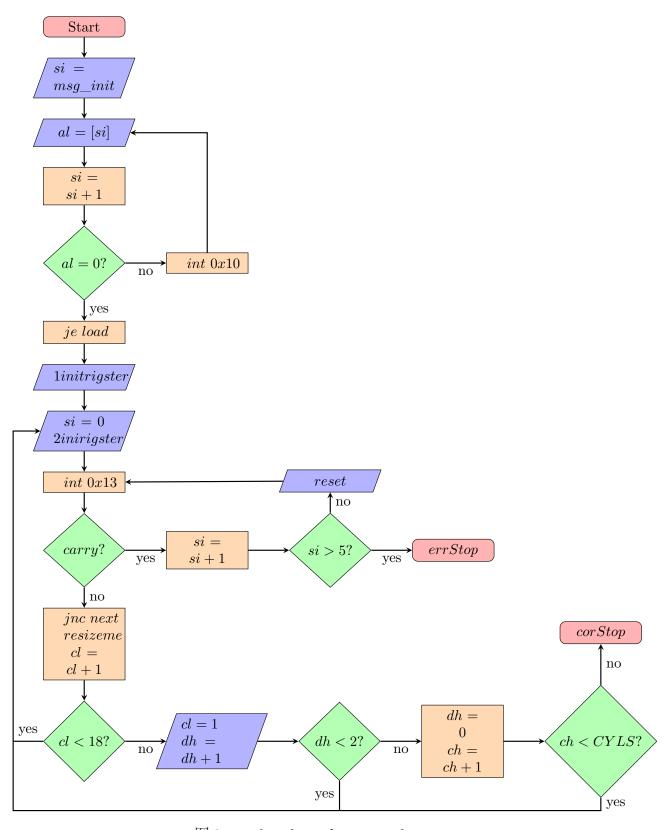


图 3-2 Flowchart of Boot Loader

3.1.4 Codes and Comments of Boot Loader

```
; read ten cylinders to memory begin with 0x8200.
; read order:
        ; CO-HO-S1 --- CO-HO-S18
        ; CO-H1-S1 --- CO-HO-S18
        ; C1-H0-S1 --- C1-H0-S18
        ; C1-H1-S1 --- C1-H1-S18
        ; C9-H1-S1 --- C9-H1-S18
        ; C is cylinder, H is head, S is sector.
        ; total 10 * 2 * 18 * 512 = 184320Byte = 180KB.
        ; begin with 0x8200, end with 0x34fff in memory.
        CYLS equ 10 ; read 10 cylinders,
org 0x7c00; load the program to address 0x7c00.
        jmp entry
        ; The next codes specify the format of standard FAT12 floppy disk.
db 0x90 ;db is the abbreation of "define byte", it literally places that byte
        ; right there in the executable.
db "RONGBOOT" ; The name of boot sector, must be 8 byte.
dw 512; the size of every sector, must be 512 byte.
db 1; the size of cluster, must be 1.
dw 1 ; the start point of FAT, 1 general case.
db 2; the number of FAT, must be 2.
dw 224; the size of root directory, 224 in general.
dw 2880; the size of this floppy disk, must be 2880.
db 0xf0; the kind of disk.
dw 9; the length of FAT.
dw 18; how many sectors in one track, must be 18.
```

```
dw 2; the number of head, must be 2.
   dd 0; no partion, must be 0.
   dd 2880; the size if re-writer one time.
   db 0,0,0x29; just fixed, no meaning.
   dd Oxfffffff
   db "RONGBOOTOS " ; the name of disk.
   db "FAT12"; the name of disk formate.
   resb 18; reserved 18 byte.
           ; end FAT12 formate.
40
41
   entry:
           mov ax, 0; init the registers.
42
           mov ss, ax; can not directly write ss segment register.
           mov sp, 0x7c00; the instructions of this program
44
            ; loaded to 0x7c00 in memory, so sp=0x7c00, from here
            ; to execute.
47
           mov ds, ax
48
49
           mov si, msg_init; show some init message.
           jmp init
   init:
           mov al, [si]
           add si, 1; increment by 1.
           cmp al, 0
            je load ; if al == 0, jmp to load, the msg_init info displayed.
    ; the lastest character is null character, coding in O.
60
           mov ah, 0x0e; write a character in TTY mode.
61
```

```
mov bx, 15 ; specify the color of the character.
62
            int 0x10; call BIOS function, video card is number 10.
            jmp init
64
    ; show some init messages.
66
   msg_init:
67
   db 0x0a ; new line
68
   db 0x0d
69
   db "Copyright: GPL"
   db 0x0a
   db 0x0d
   db "Author: Qiyuan Pu"
   db 0x0a
74
   db 0x0d
   db "https://github.com/Puqiyuan/RongOS"
   db 0x0a
   db 0x0d
   db "IPL is loading, please waiting..."
79
   db 0x0a
80
   db 0x0d
    db "...."
83
84
    load:
86
            mov ax, 0
87
88
            mov ax, 0x0820; load CO-HO-S2 to memory begin with 0x0820.
89
90
            mov es, ax
            mov ch, 0 ; cylinder 0.
91
            mov dh, 0 ; head 0.
92
```

```
mov cl, 2; sector 2.
    readloop:
            mov si, 0 ; si register is a counter, try read a sector
            ; five times.
    retry:
            mov ah, 0x02; parameter 0x02 to ah, read disk.
            mov al, 1; parameter 1 to al, read disk.
            mov bx, 0
            mov dl, 0x00; the number of driver number.
            int 0x13; after prepared parameters, call 0x13 interrupted.
            jnc next; if no carry read next sector.
            add si, 1; tring again read sector, counter add 1.
            cmp si, 5 ; until five times
            jae error ; if tring times large than five, failed.
            ; reset the status of floppy and read again.
            mov ah, 0x00
            mov dl, 0x00
            int 0x13
114
            jmp retry
    next:
            mov ax, es
            ; we can not directly add to es register.
            add ax, 0x0020; add 0x0020 to ax
            mov es, ax; the memory increase 0x0020 * 16 = 512 byte.
            ; size of a sector.
            add cl, 1; sector number add 1.
```

```
cmp cl, 18; one track have 18 sector.
            jbe readloop; jump if below or equal 18, read the next sector.
            mov cl, 1; cl number reset to 1, ready to read the other side.
            add dh, 1; the other side of floppy.
            cmp dh, 2; only two sides of floppy.
            jb readloop; if dh < 2, read 18 sectors of the other sides
            ; of floppy.
            mov dh, 0; after finished read the other side, reset head to 0.
            add ch, 1; two sides of a cylinder readed, add 1 to ch.
            cmp ch, CYLS; read 10 cylinders.
            jb readloop
            jmp correct; if 10 cylinders readed, show correct message.
    fin:
            hlt; halt the cpu.
139
            jmp fin
142
    error:
            mov si, msg
146
    correct:
            mov si, msg_corr
    putloop:
            mov al, [si]
            add si, 1
            cmp al, 0
154
```

```
mov [0x0ff0], ch
155
             je 0xc200
156
             mov ah, 0x0e
             mov bx, 15
             int 0x10
             jmp putloop
162
    msg_corr:
163
    db 0x0a
164
    db 0x0d
    db 0x0a
166
    db 0x0d
    db "OK: IPL loaded"
    db 0x0a
169
    db 0x0d
    db 0
174
    msg:
    db 0x0a
    db "IPL load error"
176
    db 0x0a
    db 0
178
    resb 0x7dfe-$
180
181
182
    \mbox{\bf db} Ox55, Oxaa ; the sector end with Ox55 Oxaa, the sector is
             ;boot sector.
183
```

3.2	32-bit Mode and Import C Codes
3.3	Screen Display and Text
3.4	Control Mouse
3.5	Memory Management
3.6	Making Window
3.7	Timer
3.8	Multitasking
3.9	Command Line Window
3.10	API
3.11	OS Protection
3.12	Graphics Processing
3.13	Window Operation
3.14	Application Protection
3.15	File Operation
3.16	Some Applications

参考文献

- [1] 国务院。中国制造 2025, 2015-05。。
- [2] WiKipedia. Operating System, 2017-08..
- [3] 川合秀实. 30 天自制操作系统. 人民邮电出版社, 2012-08.

指导教师简介

王晓林,男,49岁,硕士,讲师,毕业于英国格林尼治大学,分布式系统专业,现任西南林业大学计信学院教师,执教 Linux、操作系统、网络技术等方面的课程,有丰富的 Linux 教学和系统管理经验。

致 谢

首先我想感谢我的老师,王晓林。大学期间,他给了我很多指导,包括专业方面和上大学的意义等。很多时候,他对学生的要求看起来都是不近情理的,但正是通过这个"痛苦"的过程,我锻炼了坚强的意志,和战胜困难的信心。谢谢你,王老师。我最想感谢的是我的女友,她容忍我在完成这个设计时的很多个夜晚不陪她,给我支持,鼓励我,不抱怨。所以我愿意把这个简单操作系统命名为 RongOS,蓉便是她名字的最后一个字。谢谢你,我最亲爱的。