GigaDevice Semiconductor Inc.

Arm[®] Cortex[®]- M3/M4/M23/M33 32-bit MCU

应用笔记 AN023



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1. 简介

Letter shell 是一个 C 语言编写的,可以嵌入在程序中的嵌入式 shell, 主要面向嵌入式设备, 以 C 语言函数为运行单位,可以通过命令行调用,运行程序中的函数。

1.1. 主要特性

- 命令自动补全
- 快捷键功能定义
- 命令权限管理
- 用户管理
- 变量支持
- 代理函数和参数代理解析



2. 获取 Letter shell 源码

Letter shell 的 github 仓库地址为: <u>https://github.com/NevermindZZT/letter-shell</u>。具体如<u>图</u> 2-1. Letter shell 的 github 仓库</u>所示。

图 2-1. Letter shell 的 github 仓库

Search or jump to 🛛 Pull re	equests Issues Marketplace Explo	pre			
🖟 NevermindZZT / letter-shell					
<> Code ⊙ Issues 57 1 Pull requests 2	Discussions 🕞 Actions	🛄 Projects 🛄 Wiki 🕕 Security	🗠 Insights		
29 ma	aster 🗸 🧚 4 branches 🔊 1 tag		Go to file Add file -	⊻ Code -	About
S N	levermindZZT Merge pull request #92 f	rom NevermindZZT/shell3.1	6d6803e 24 days ago 🕄	3130 commits	letter shell
💼 de	emo	新增 双击tab快速帮助		last month	শ্রু MIT License
in de	oc/img	新增 文件系统支持组件		11 months ago	
ex	xtensions	修复 passthrough模式退出时缓冲区未清空的	问题	2 months ago	Releases 1
in sr	rc	优化 最大历史记录设置为0s时移除相关代码		24 days ago	♥ v3.0.6 (Latest)
to	pols	update shellTools.py		4 months ago	on 3 Apr
g	gitattributes	Initial commit		3 years ago	
g	jitignore	修复 编译问题		2 months ago	Packages
	ICENSE	Create LICENSE		2 years ago	No packages published
	EADME.md	优化最大历史记录设置为0s时移除相关代码		24 days ago	Contributors 3

本 AN 使用的 Letter shell 版本为 3.0.6。



3. GD32F450 Letter shell 移植

3.1. 工程文件结构

本 AN 是以 GD32F4xx_Firmware_Library 默认的 Template 工程为基础搭建的,新建 Letter_shell 文件夹,导入 Letter_shell 核心文件,将 extensions、src 和 tools 文件夹直接拷 贝到 Letter_shell 文件夹里,新建 port 文件夹,用于存放移植接口文件 shell_cfg.h、shell_port.h 和 shell_port.c 文件。具体如<u>**Ø 3-1**. 工程文件结构</u>所示。





3.2. 搭建 Keil 工程框架

以Keil这个IDE为例(其他IDE工程搭建情况类似,这里不做赘述),在工程里添加Letter_shell, 并将 src 文件夹和 port 文件夹下的 c 文件添加进来,具体如<u>**Ø 3-2.** Keil 工程结构</u>所示。

图 3-2. Keil 工程结构



在 Setup Compiler Include Paths 中将 src 和 port 文件夹里的头文件包含进来,具体如<u>图 3-3.</u> *Keil Folder Setup 设置*所示。



图 3-3. Keil Folder Setup 设置

Folder Setup	? ×
Setup Compiler Include Paths:	∞ × → ↓
\Yimmware\CMSIS\GD\GD32F4xx\Include \\Utilities \Yimmware\CMSIS \ \Etter_shell\src \Letter_shell\src \Letter_shell\port	
OK Cancel	

在 Keil 工程的 Linker 选项卡里, 添加--keep shellCommand*, 以防被编译优化, 具体如<u>图 3-4.</u> Keil Linker 设置</u>所示。

图 3-4. Keil Linker 设置

Device Target Output Listing Vser C/C	++ Asm Linker Debug Utilities
✓ Use Memory Layout from Target Dialog	X/O Base:
Make RW Sections Position Independent Make RO Sections Resition Independent	R/O Base: 0x08000000
Don't Search Standard Libraries	R/W Base 0x20000000
Report 'might fail' Conditions as Errors	disable Warnings:
Scatter	Edit
nie ,	<u> </u>
Misc -keep shellCommand*	×.
controls	*
Linker -cpu Cortex-M4.fp *.o controllibrary_type=microlibstrictscatter "v	output\Project.sct"
string	· · ·

3.3. 编写移植接口文件

移植接口文件编写主要是 shell_port.c,具体如表 3-1. Shell 结构体 所示。

表 3-1. Shell 结构体

typedef struct shell_	_def		
{			
struct			
{			



```
const struct shell_command *user;
        int activeTime;
        char *path;
    #if SHELL_USING_COMPANION == 1
        struct shell_companion_object *companions;
    #endif
    } info;
    struct
    {
        unsigned short length;
        unsigned short cursor;
        char *buffer;
        char *param[SHELL_PARAMETER_MAX_NUMBER];
        unsigned short bufferSize;
        unsigned short paramCount;
        int keyValue;
    } parser;
    struct
    {
        char *item[SHELL_HISTORY_MAX_NUMBER];
        unsigned short number;
        unsigned short record;
        signed short offset;
    } history;
    struct
    {
        void *base:
        unsigned short count;
    } commandList;
    struct
    {
        unsigned char isChecked : 1;
        unsigned char isActive : 1;
        unsigned char tabFlag : 1;
    } status;
    signed char (*read)(char *);
    void (*write)(const char);
} Shell;
```

从对 Shell 结构的定义来看,需要实现 shell read 和 write 函数,具体如<u>表 3-2. userShellRead</u> 函数实现和表 3-3. userShellWrite 函数实现

表 3-2. userShellRead 函数实现

signed char userShellRead(char *data)



{

```
*data = 0;
if (usart_flag_get(EVAL_COM0, USART_FLAG_RBNE) != RESET) {
    *data = usart_data_receive(EVAL_COM0);
}
if (*data == 0) {
    return -1;
}
return 0;
```

表 3-3. userShellWrite 函数实现

```
void userShellWrite(char data)
{
    while (RESET == usart_flag_get(EVAL_COM0,USART_FLAG_TC));
    usart_data_transmit(EVAL_COM0, (uint8_t) data);
}
```

完成 userShellRead 和 userShellWrite 函数实现以后,将其注册到 shell 结构体中,具体如<u>表</u> 3-4. 注册 userShellRead 和 userShellWrite 函数所示。

表 3-4. 注册 userShellRead 和 userShellWrite 函数

```
shell.write = userShellWrite;
shell.read = userShellRead;
shellInit(&shell, shellBuffer, sizeof(shellBuffer)/sizeof(shellBuffer[0]));
.....
```

3.4. Letter shell 函数调用

Letter shell 的接口不是很多,主要有以下两点需要注意:

- 1、 在主程序里调用 userShellInit 完成 Letter shell 初始化;
- 2、 周期性调用 shellTask 任务。

具体如<u>表 3-5. Letter shell 的函数调用</u>所示。



表 3-5. Letter shell 的函数调用

userShellInit();		
while (1){		
shellTask(&shell);		
delay_1ms(50);		
}		



4. Lettle shell 简单应用

4.1. 串口终端软件

对于基于串口移植, letter shell 建议使用 secureCRT 软件, letter shell 中的相关按键映射都是 按照 secureCRT 进行设计的,使用其他串口软件时,可能需要修改键值。

打开 secureCRT,进行正确配置之后,将程序烧录到 GD32F450i-EVAL 开发板上,执行结果 如 **图 4-1. Letter shell 移植成功打印结果**所示。

图 4-1. Letter shell 移植成功打印结果

🗸 Serial-CO	M8 ×	4
		-
Build: Version: Copyright	Jul 20 2021 15:17:41 3.0.6 :: (c) 2020 Letter	
letter:/\$;	

4.2. 添加自定义功能

Letter shell 支持添加自定义的功能,这里自定义了 3 个功能,具体如<u>表 4-1. reboot 功能</u>、<u>表</u> 4-2. led 控制功能和表 4-3. random data 获取功能</u>所示。



表 4-1. reboot 功能

```
int reboot(int argc, char *agrv[])
{
    printf(" %dparameter(s)\r\n", argc);
    for (char i = 1; i < argc; i++)
    {
        printf("%s\r\n", agrv[i]);
    }
    NVIC_SystemReset();
    return 0;
}
SHELL_EXPORT_CMD(SHELL_CMD_PERMISSION(0)|SHELL_CMD_TYPE(SHELL_TYPE_CMD_MAIN), reboot, reboot);</pre>
```

表 4-2. led 控制功能

```
int led(int argc, char *agrv[])
{
    uint32_t temp, rtn, i;
    if(argc == 2){
        rtn = sscanf(agrv[1],"%d", &temp);
        if(rtn == 1){
             if(temp == 0){
                 gd_eval_led_off(LED2);
                 printf("LED2 is off!\r\n");
             }else if(temp == 1){
                 gd_eval_led_on(LED2);
                 printf("LED2 is on!\r\n");
             else if(temp == 2)
                 gd_eval_led_toggle(LED2);
                 printf("LED2 is toggled!\r\n");
             else if(temp == 3)
                 for(i = 0; i < 6; i++){
                      gd_eval_led_toggle(LED2);
                      delay_1ms(400); // cannot be used in interrupt.
                 }
                 printf("LED is blinked!\r\n");
             }
        }
    }
    return 0;
}
SHELL_EXPORT_CMD(SHELL_CMD_PERMISSION(0)|SHELL_CMD_TYPE(SHELL_TYPE_CMD_
MAIN)|SHELL_CMD_DISABLE_RETURN, led, led, led);
```



表 4-3. random data 获取功能

```
int rand_data(int argc, char *agrv[])
{
    uint32_t temp;
    if(SUCCESS == trng_ready_check()){
        temp = trng_get_true_random_data();
        printf("Randon Data = 0x%08x\r\n", temp);
    }
    return 0;
}
SHELL_EXPORT_CMD(SHELL_CMD_PERMISSION(0)|SHELL_CMD_TYPE(SHELL_TYPE_CMD_MAIN)|SHELL_CMD_DISABLE_RETURN, rand_data, rand_data, rand_data);
```

用户可以键入 help 查看支持哪些命令,具体如<u>图 4-2. 键入 help 的打印结果</u>所示。

图 4-2. 键入 help 的打印结果



4.3. reboot 功能执行结果

在 secureCRT 软件键入 reboot,可以实现打印和软复位芯片的效果,具体如<u>图 4-3. 键入</u> reboot 的打印结果</u>所示。



图 4-3. 键入 reboot 的打印结果



4.4. led 控制功能执行结果

在 secureCRT 软件键入 led+数字(0~3),可以实现对 LED 的控制效果,具体如<u>**图**4-4. 键入</u> led <u>的打印结果</u>所示。

图 4-4. 键入 led 的打印结果

```
letter:/$ led 0
LED2 is off!
letter:/$ led 1
LED2 is on!
letter:/$ led 2
LED2 is toggled!
letter:/$ led 3
LED is blinked!
letter:/$
```

4.5. random data 获取功能执行结果

在 secureCRT 软件键入 rand_data,可以实现获取随机数的效果,具体如<u>图 4-5. 键入</u> rand data 的打印结果</u>所示。

图 4-5. 键入 rand_data 的打印结果

```
letter:/$ rand_data
Randon Data = 0x83a5a48d
letter:/$ rand_data
Randon Data = 0x8e525d5c
letter:/$ rand_data
Randon Data = 0x4c85d0ee
letter:/$ rand_data
Randon Data = 0x24d0c816
letter:/$ rand_data
Randon Data = 0xaalc9c20
letter:/$
```

注意:所有命令均可以按 Tab 实现命令自动补全。



5. 版本历史

表 5-1. 版本历史

版本号.	说明	日期
1.0	首次发布	2021 年 11 月 30 日



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