M031 APROM程序绑定UID

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

应用简述	本范例代码介绍如何通过绑定 MCU 的 UID 码，实现程序与 MCU 的绑定
BSP 版本	M031_Series_BSP_CMSIS_V3.04.000
开发平台	NuMaker-M032SE V1.3

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1 概述

新唐的M031系列MCU，每一颗都有一个96位的唯一ID（UID）码，本文介绍如何将程序绑定UID码，以避免他人将MCU中的Bin文件拷贝出来，烧录到新的MCU，复制出一样的产品。

1.1 原理

由于M031系列MCU，每一颗都有一个96位的UID码，所以可在程序中加入对UID码的判断，来决定程序的执行流程，这样尽管将运行正常的MCU固件读出来烧录到另外一颗同型号的MCU中，也得不到正常的运行结果，其大致原理如图1-1所示。

注：使用该方法必须保证产品出厂之前，MCU已经上电运行过一次，以保证存储在APROM中的初始密钥被擦除。

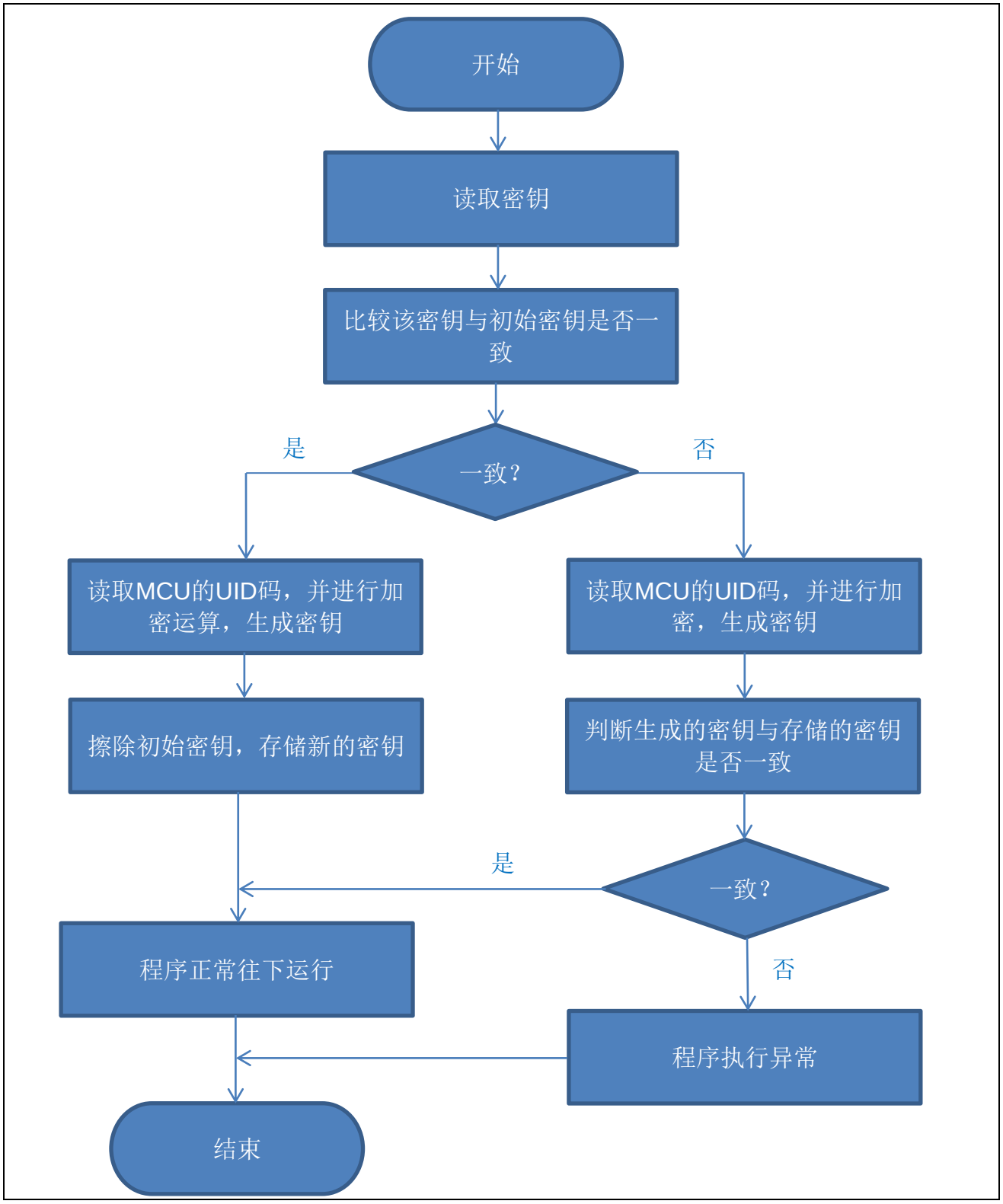
开始
读取密钥
比较该密钥与初始密钥是否一致
一致？
是
否
读取MCU的UID码，并进行加密运算，生成密钥
擦除初始密钥，存储新的密钥
读取MCU的UID码，并进行加密，生成密钥
判断生成的密钥与存储的密钥是否一致
一致？
是
否
程序正常往下运行
程序执行异常
结束

图 1-1 密钥判断流程图

1.2 执行结果

将程序烧录到“NuMaker-M032SE V1.3”板子，运行时的打印信息如图1-2所示：

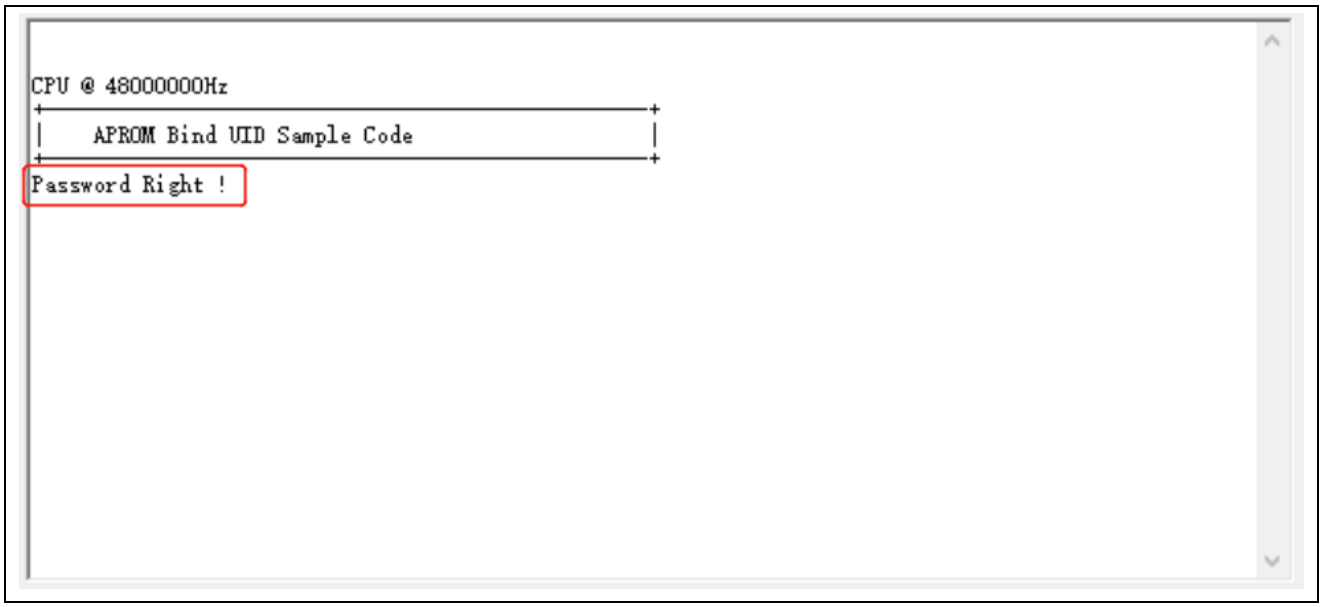

图 1-2 运行正常打印信息

通过“NuMicro ICP Programming Tool”从“NuMaker-M032SE V1.3”板子读出MCU APROM的程序，然后烧录到另外一块“NuMaker-M032SE V1.3”板子，运行时，打印信息如图1-3所示：

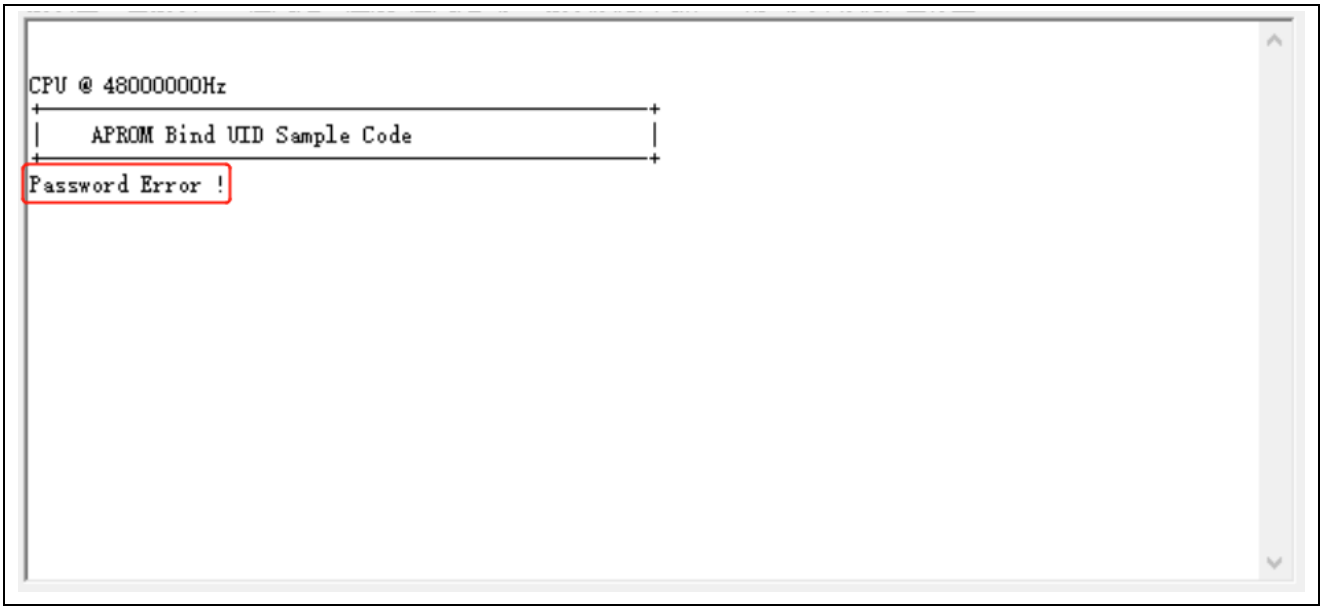

图 1-3 运行异常打印信息

2 代码介绍

初始密钥设置（用户可自行更改）：

```
#define INIT_PASSWORD_0       0x12121212 /* Define by user */
#define INIT_PASSWORD_1       0x34343434 /* Define by user */
#define INIT_PASSWORD_2       0x56565656 /* Define by user */
```

将 UID 进行加密（用户可以根据自己的加密算法进行更改）：

```
void UID_Encrypt(uint32_t au32Uid[3])
{
    uint8_t i;

    /* Encrypt the UID, users can change it according to their encryption algorithm */
    for(i = 0; i < 3; i++)
    {
        au32Uid[i] = (~au32Uid[i]) * 5 / i;
    }
}
```

判断密钥与初始密钥是否一致，若一致，则擦除初始密钥，写入由 UID 加密后的新密钥；若不一致，判断 UID 加密后的密钥与存储的密钥是否一致：

```
uint8_t UID_PasswordCheck(void)
{
    uint8_t i;
    uint32_t au32Uid[3];
    uint32_t *pu32Password = (uint32_t *)g_au32Password;

    if((pu32Password[0] == INIT_PASSWORD_0) && (pu32Password[1] == INIT_PASSWORD_1)
    && (pu32Password[2] == INIT_PASSWORD_2))
    {
        UID_Read(au32Uid);
        UID_Encrypt(au32Uid);
        UID_PasswordWrite(au32Uid);
    }
    else
    {
        UID_Read(au32Uid);
        UID_Encrypt(au32Uid);

        for(i = 0; i < 3; i++)
        {
            if(au32Uid[i] != pu32Password[i])
            {
                return 0;
            }
        }
    }

    return 1;
}
```

3 软件与硬件需求

- 软件需求
  - BSP 版本
    - M031_Series_BSP_CMSIS_V3.04.000
  - IDE 版本
    - Keil uVersion 4.74
- 硬件需求
  - 电路组件
    - NuMaker-M032SE V1.3

4 目录信息

EC_M031_APROM_Bind_UID_V1.00	
Library	Sample code header and source files
CMSIS	Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
Device	CMSIS compliant device header file
StdDriver	All peripheral driver header and source files
SampleCode	
ExampleCode	Source file of example code

图 4-1 目录信息

5 范例程序执行

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 APROM_Bind_UID.uvproj。
2. 进入编译模式界面
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开仿真模式
3. 进入仿真模式界面
   a. 执行代码

6 修订纪录

Date	Revision	Description
2022.03.08	1.00	1. 初始发布.

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