

《嵌入式系统原理与实践》作业

10213903403 岳锦鹏

10225001410 朱宇笑

2024 年 10 月 26 日

目录

第一次作业

第一次作业
STM32CubeMX
MDK-ARM
实验结果

选择的 MCU 型号为 STM32G473RCT6:

New Project from a MCU/MPU

MCU/MPU Selector | Board Selector | Example Selector | Cross Selector

MCU/MPU Filters

Commercial Part Number: **STM32G473RCT6**

PRODUCT INFO

- Segment >
- Series >
- Line >
- Marketing Status >
- Price >
- Package >
- Core >
- Coprocessor >

MEMORY

- Flash = 256 (kBytes)
- 256
- EEPROM = 0 (Bytes)
- 0
- RAM Total = 160 (kBytes)
- 160

Features | Block Diagram | Docs & Resources | CAD Resources | Datasheet | Buy | **Start Project**

STM32G4 Series

STM32G473RCT6

Mainstream Arm Cortex-M4 MCU 170 MHz with 256 Kbytes of Flash memory, Math Accelerator, High Analog level integration

ACTIVE
Product is in mass production

Unit Price for 10kU (US\$) : **3.2482**

LQFP 64 10x10x1.4 mm

The STM32G473xB/xC/xE devices are based on the high-performance Arm[®] Cortex[®]-M4 32-bit RISC core. They operate at a frequency of up to 170 MHz. The Cortex-M4 core features a single-precision floating-point unit (FPU), which supports all the Arm single-precision data-processing instructions and all the data types. It also implements a full set of DSP (digital signal processing) instructions and a memory protection unit (MPU) which enhances the application's security. These devices embed high-speed memories (up to 512 Kbytes of flash memory, and 128 Kbytes of SRAM), a flexible external memory controller (FSMC) for static memories (for devices with packages of 100 pins and more), a Quad-SPI flash memory interface, and an extensive range of enhanced I/Os and peripherals connected to two APB buses, two AHB buses and a 32-bit multi-AHB bus matrix. The devices also embed several protection mechanisms for embedded flash memory and SRAM: readout protection, write protection, securable memory area and proprietary code readout protection. The devices embed peripherals allowing mathematical/arithmetic function acceleration (CORDIC for trigonometric functions and FMAC unit

MCUs/MPUs List: 2 items

Export

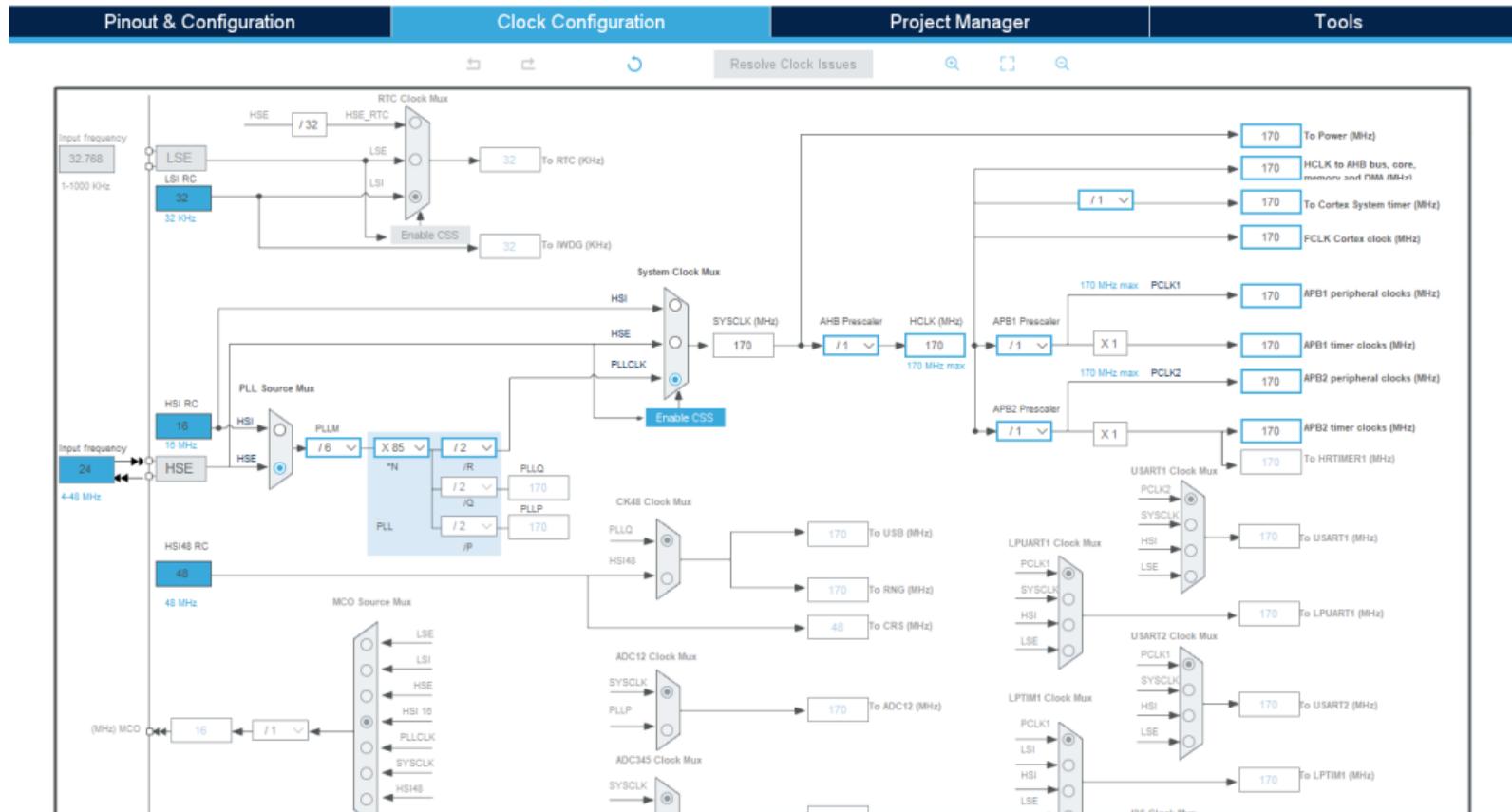
* Commercial Part No	Part No	Reference	Marketing ...	Unit Price for 10k...	Board	Package	Flash	RAM	I/O	Frequ...
☆ STM32G473RCT6	STM32G...	STM32G473R...	Active	3.2482		LQFP 64 10x10x1.4 mm	256 kBy...	128 kByt...	52	170 MHz
☆ STM32G473RCT6TR	STM32G...	STM32G473R...	Active	3.2482		LQFP 64 10x10x1.4 mm	256 kBy...	128 kByt...	52	170 MHz

先设置时钟为外部：

The screenshot displays the STM32CubeMX interface with the 'Clock Configuration' tab selected. The left sidebar shows the 'System Core' tree with 'RCC' highlighted. The main panel shows the 'RCC Mode and Configuration' settings. The 'High Speed Clock (HSE)' is set to 'Crystal/Ceramic Resonator', which is circled in red. A red circle with the number '1' is around the 'RCC' item in the sidebar, and a red circle with the number '2' is around the 'Crystal/Ceramic Resonator' dropdown menu.

Category	Mode
High Speed Clock (HSE)	Crystal/Ceramic Resonator
Low Speed Clock (LSE)	Disable
Master Clock Output	<input type="checkbox"/>
LSCO Clock Output	<input type="checkbox"/>
Audio Clock Input (I2S_CKIN)	<input type="checkbox"/>
CRS SYNC	Disable

再设置时钟频率：



开启 debug 模式:

The screenshot displays the STM32CubeMX interface. On the left, the 'Pinout & Configuration' tab is active, showing a tree view of system components. The 'SYS' component is highlighted, and a red arrow labeled '1' points to it. The main area shows the 'SYS Mode and Configuration' window. The 'Debug' dropdown is set to 'Serial Wire'. The 'System Wake-Up 2' checkbox is checked and highlighted in pink, with a red arrow labeled '2' pointing to it. Other options include 'System Wake-Up 1', 'System Wake-Up 4', 'Power Voltage Detector In', 'VREFBUF Mode', and 'Timebase Source'. A warning message at the bottom states: 'Warning: This peripheral has no parameters to be configured.'

开始调整端口：

Pinout & Configuration | Clock Configuration | Project Manager | Tools

Software Packs | Pinout

GPIO Mode and Configuration

Configuration

Group By Peripherals

GPIO | RCC | SYS

Search Signals

Search (Ctrl+F) Show only Modified Pins

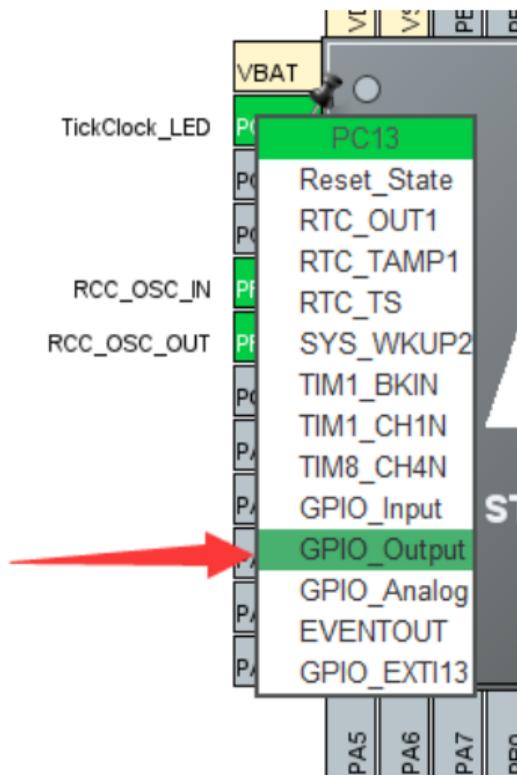
	Sig	GPI	GPI	GPI	Ma	Fas	Use	Mo
PC13	n/a	High	Out...	Pull...	Low	n/a	Tick...	<input checked="" type="checkbox"/>

Select Pins from table to configure them. Multiple selection

Pinout view | System view

STM32G473CBTx LQFP48

VBAT TickClock_LED PC13 PC14... PC15... RCC_OSC_IN PF9-O PF1-O PG10- PA0 PA1 PA2 PA3 PA4 PA5 PA6 PA7 PA8 PA9 PA10 PA11 PA12 PA13 PA14 PA15 PA16 VDD VSS



选择 GPIO_Output:



调整端口配置：

项目设置名称 exp1:

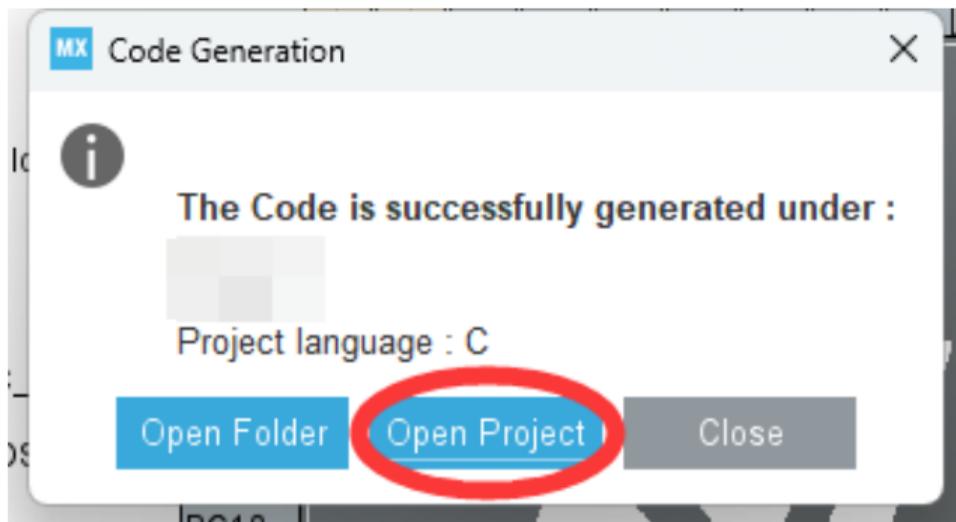
Pinout & Configuration	Clock Configuration	Project Manager	Tools
Project	Project Settings		
	Project Name	<input type="text" value="exp1"/>	
	Project Location	<input type="text"/> <input type="button" value="Browse"/>	
	Application Structure	<input type="text" value="Advanced"/> <input type="checkbox"/> Do not generate the main()	
Code Generator	Toolchain Folder Location	<input type="text" value="...\\exp1\\"/>	
	Toolchain / IDE	<input type="text" value="MDK-ARM"/>	Min Version <input type="text" value="V5.32"/> <input type="checkbox"/> Generate Under Root

继续项目设置：

Pinout & Configuration	Clock Configuration	Project Manager	Tools
Project	<p>STM32Cube MCU packages and embedded software packs</p> <ul style="list-style-type: none"><input type="radio"/> Copy all used libraries into the project folder<input checked="" type="radio"/> Copy only the necessary library files<input type="radio"/> Add necessary library files as reference in the toolchain project configuration file		
Code Generator	<p>Generated files</p> <ul style="list-style-type: none"><input checked="" type="checkbox"/> Generate peripheral initialization as a pair of '.c/.h' files per peripheral<input type="checkbox"/> Backup previously generated files when re-generating<input checked="" type="checkbox"/> Keep User Code when re-generating<input type="checkbox"/> Delete previously generated files when not re-generated		

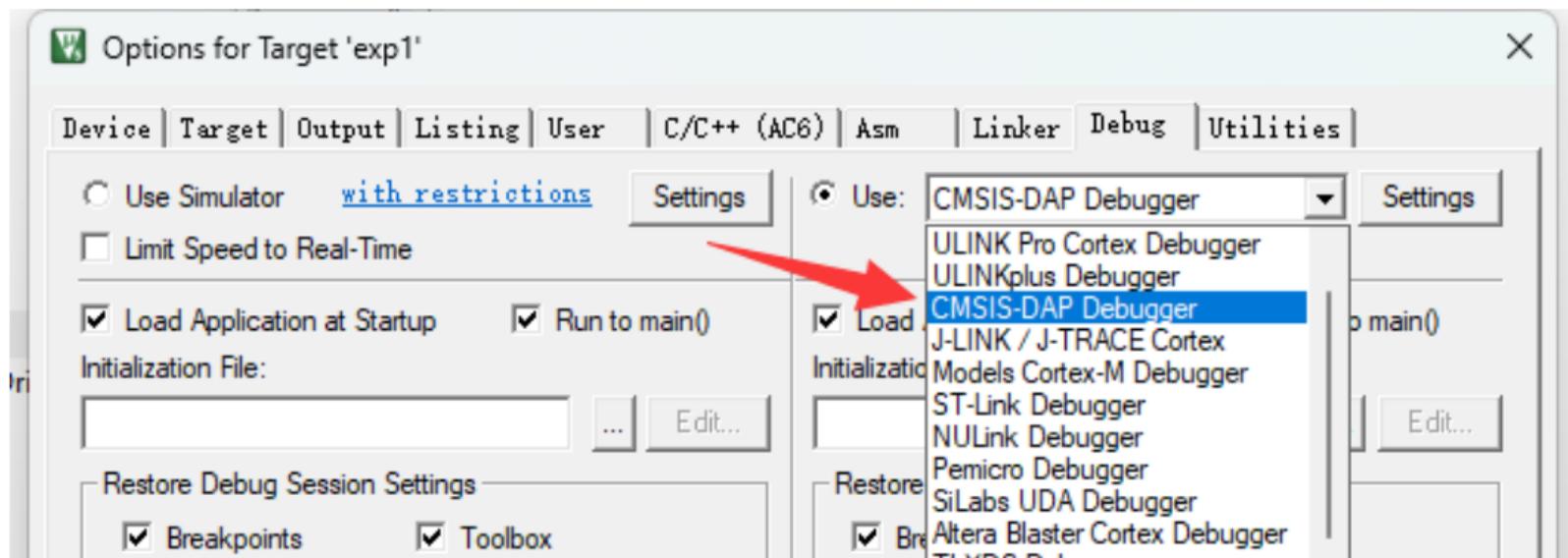
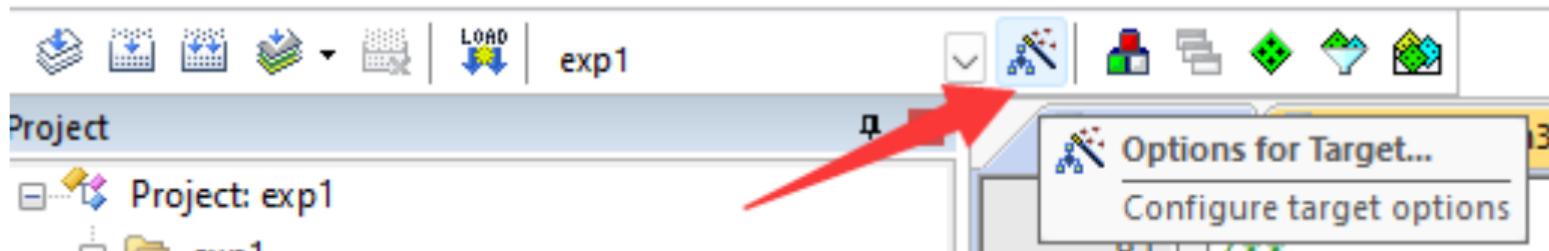
GENERATE CODE

生成代码：



打开项目：

修改调试器:



修改调试设置，把 reset and run 打勾，就不需要手动按重置按钮了。

The image shows two overlapping dialog boxes from the STM32CubeMX software. The top dialog is 'Options for Target 'exp1'' with the 'Debug' tab selected. It shows 'Use: CMSIS-DAP Debugger' selected, with a red arrow labeled '1' pointing to its 'Settings' button. The bottom dialog is 'CMSIS-DAP Cortex-M Target Driver Setup' with the 'Flash Download' tab selected. It shows the 'Download Function' section with 'Reset and Run' unchecked, and a red arrow labeled '3' pointing to this checkbox. Another red arrow labeled '2' points to the 'Settings' button in the top dialog. The 'RAM for Algorithm' section shows 'Start: 0x20000000' and 'Size: 0x00008000'. The 'Programming Algorithm' table is also visible.

Description	Device Size	Device Type	Address Range
STM32G47x-8x 128 KB Flash	128k	On-chip Flash	08000000H - 0801FFFFH

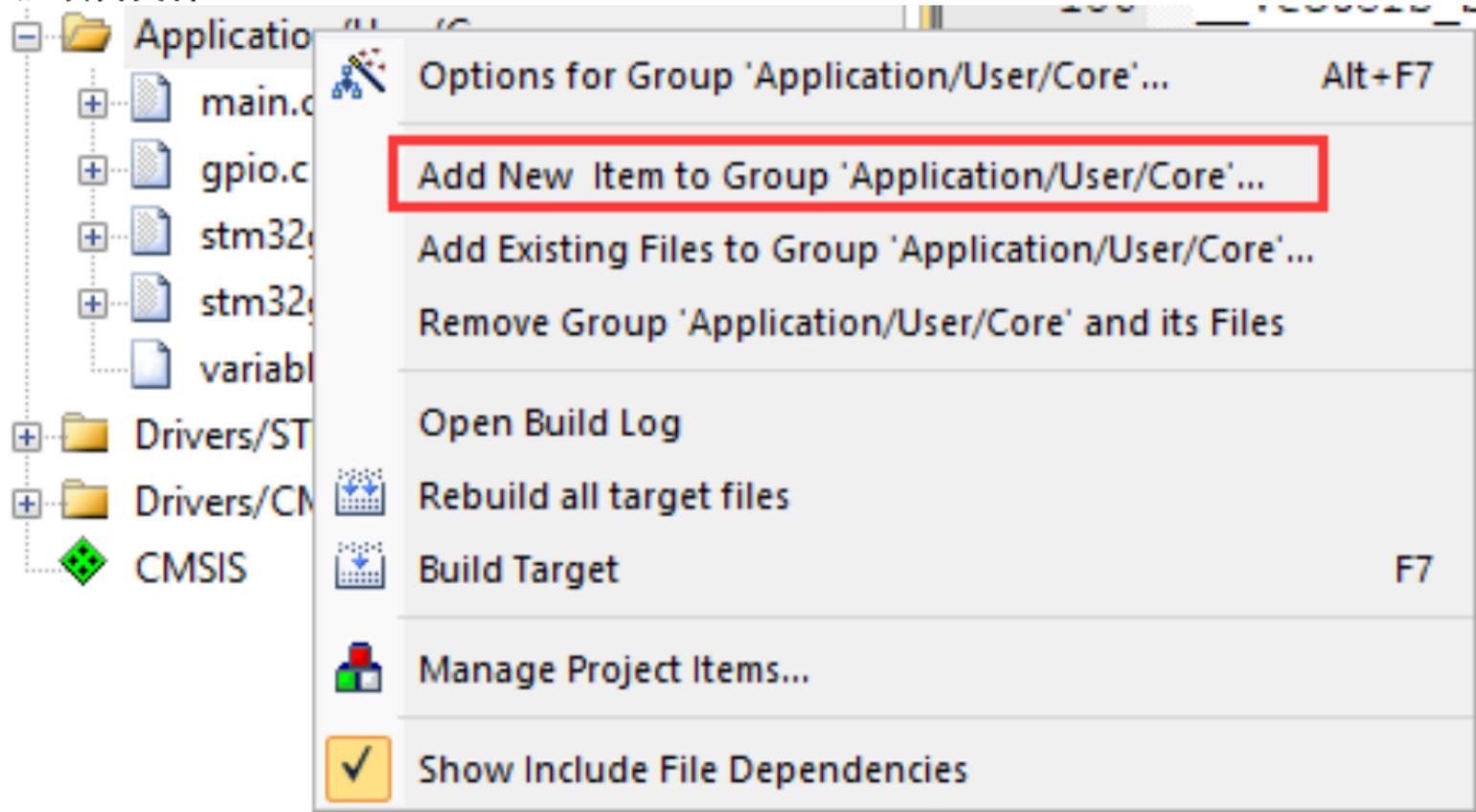
第一次作业

STM32CubeMX

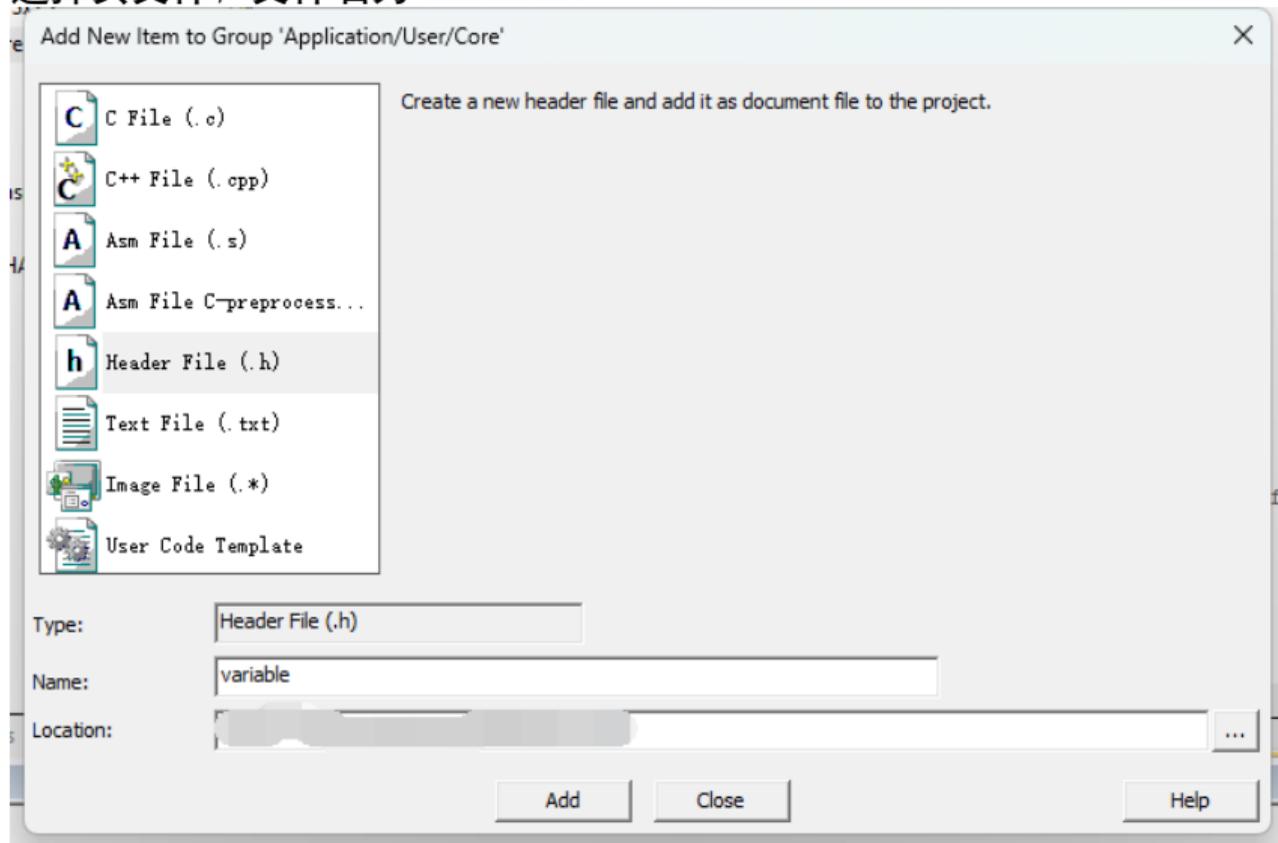
MDK-ARM

实验结果

添加项目文件：



选择头文件，文件名为 variable.h:



variable.h:

```
1  #include <stdint.h>
2  #ifndef __VARIABLE_H
3  #define __VARIABLE_H
4
5  #ifdef __cplusplus
6  extern "C" {
7  #endif
8
9  typedef struct {
10     uint8_t mMilSecCount;    // 毫秒计数
11     uint8_t bTenMilSecOk;   // 10 毫秒标志位
12     uint8_t mTimeCount;     // 秒计数
13     uint8_t bTimeOk;       // 秒标志位
14 } stSysTickTimer;
15
16 #ifdef __cplusplus
17 }
18 #endif
19
20 #endif /* __VARIABLE_H */
```

stm32g4xx_it.c:

```
24  /* USER CODE BEGIN Includes */
25  #include "variable.h"
26  /* USER CODE END Includes */

60  /* USER CODE BEGIN EV */
61  extern stSysTickTimer sSysTickTimer;
62  extern uint16_t mSecCount;
63  extern uint16_t bSecondIsOk;
64  /* USER CODE END EV */

183 /**
184  * @brief This function handles System tick timer.
185  */
186 void SysTick_Handler(void)
187 {
188     /* USER CODE BEGIN SysTick_IRQn 0 */
189
190     /* USER CODE END SysTick_IRQn 0 */
191     HAL_IncTick();
192     /* USER CODE BEGIN SysTick_IRQn 1 */
193     if (++mSecCount >= 100) {
194         mSecCount = 0;
195         bSecondIsOk = 1;
196     }
197
198     if (++sSysTickTimer.mMilSecCount >= 10) {
199         sSysTickTimer.mMilSecCount = 0;
200         sSysTickTimer.bTenMilSecOk = 1;
201         if (++sSysTickTimer.mTimeCount >= 100) {
202             sSysTickTimer.mTimeCount = 0;
203             sSysTickTimer.bTimeOk = 1;
204         }
205     }
206     /* USER CODE END SysTick_IRQn 1 */
207 }
```

main.h:

```
48  /* USER CODE BEGIN EM */
49  #define SYSTICKCLK 170 // Systick Frequency 170MHz
50  /* USER CODE END EM */
51
52  /* Exported functions prototypes
   ↪  -----*/
53  void Error_Handler(void);
54
55  /* USER CODE BEGIN EFP */
56  void delay_us(uint32_t nus);
57  /* USER CODE END EFP */
```

main.c:

```

24  /* USER CODE BEGIN Includes */
25  #include "variable.h"
26  /* USER CODE END Includes */

45  /* USER CODE BEGIN PV */
46  stSysTickTimer sSysTickTimer = {
47    0, 0, 0, 0
48  };
49  uint16_t mSecCount = 0;
50  uint16_t bSecondIsOk = 0;
51  /* USER CODE END PV */

60  /* USER CODE BEGIN 0 */
61  void delay_us(uint32_t nus) {
62    uint32_t ticks;
63    uint32_t told, tnow, tcnt=0;
64    uint32_t reload = SysTick->LOAD; // LOAD 的值

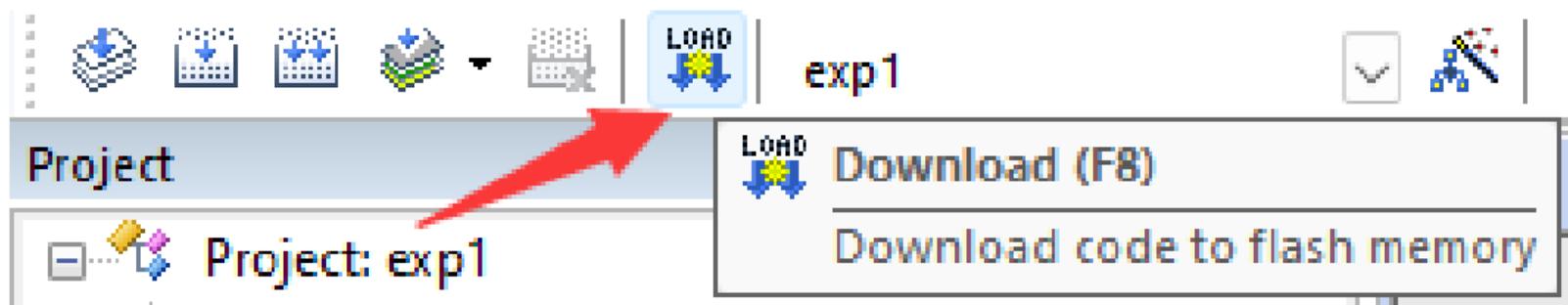
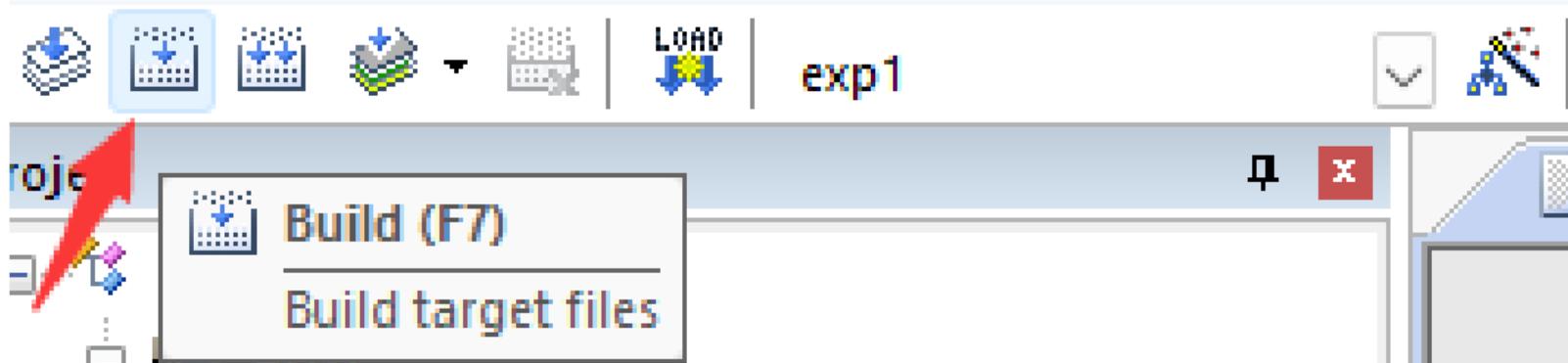
65    ticks = nus * SYSTICKCLK; // 需要的节拍数
66    told = SysTick->VAL; // 刚进入时的计
    ↪ 数器值
67    while (1) {
68      tnow = SysTick->VAL;
69      if (tnow != told) {
70        if (tnow < told)
71          tcnt += told - tnow; // SYSTICK 是一
    ↪ 个递减的计数器就可以了
72      else
73        tcnt += reload - tnow + told;
74      told = tnow;
75      if (tcnt >= ticks) break; // 事件超过/等于
    ↪ 要延迟的时间, 则退出
76    }
77  }
78  }
79  /* USER CODE END 0 */

```

main.c:

```
81  /**                                104  /* USER CODE BEGIN SysInit */
82   * @brief The application entry point. 105
83   * @retval int                       106  /* USER CODE END SysInit */
84   */                                  107
85  int main(void)                       108  /* Initialize all configured peripherals */
86  {                                     109  MX_GPIO_Init();
87                                       110  /* USER CODE BEGIN 2 */
88   /* USER CODE BEGIN 1 */            111
89                                       112  /* USER CODE END 2 */
90   /* USER CODE END 1 */              113
91                                       114  /* Infinite loop */
92   /* MCU Configuration-----*/       115  /* USER CODE BEGIN WHILE */
93                                       116  while (1)
94   /* Reset of all peripherals, Initializes the Flash 117
   ↳ interface and the Systick. */      {
95   HAL_Init();                          118   /* USER CODE END WHILE */
96                                       119
97   /* USER CODE BEGIN Init */          120   if (sSysTickTimer.bTimeOk) {
98                                       121     sSysTickTimer.bTimeOk = 0;
99   /* USER CODE END Init */            122     HAL_GPIO_TogglePin(TickClock_LED_GPIO_Port,
100                                       ↳ TickClock_LED_Pin);
101   /* Configure the system clock */     123   }
102   SystemClock_Config();                124   }
103                                       125  /* USER CODE END 3 */
                                       126  }
```

编译和运行：



第一次作业

STM32CubeMX

MDK-ARM

实验结果

实验结果：亮一秒，暗一秒。



完整视频可以查看：

https://gitea.librastalker.top/423A35C7/STM32CubeMX-Keil_uVision5