# USCD Embedded C Assignment 5

By
Norman McEntire

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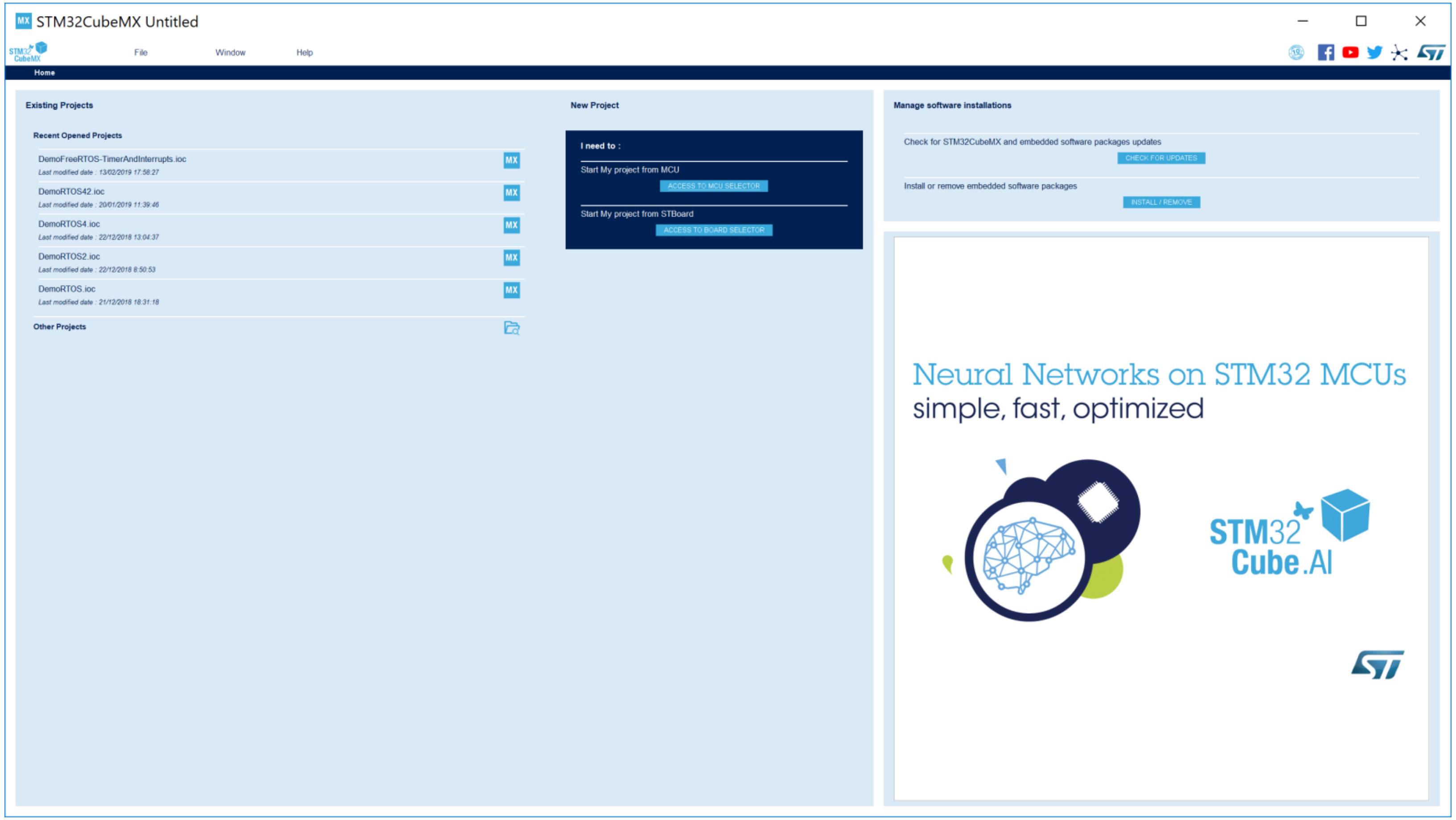
# Step 1. Startup STM32CubeMX



**Existing Projects**

**Recent Opened Projects**

DemoFreeRTOS-TimerAndInterrupts.ioc
*Last modified date : 13/02/2019 17:56:27*

DemoRTOS42.ioc
*Last modified date : 20/01/2019 11:39:46*

DemoRTOS4.ioc
*Last modified date : 22/12/2018 13:04:37*

DemoRTOS2.ioc
*Last modified date : 22/12/2018 8:50:53*

DemoRTOS.ioc
*Last modified date : 21/12/2018 18:31:18*

**Other Projects**

**New Project**

**I need to :**

Start My project from MCU

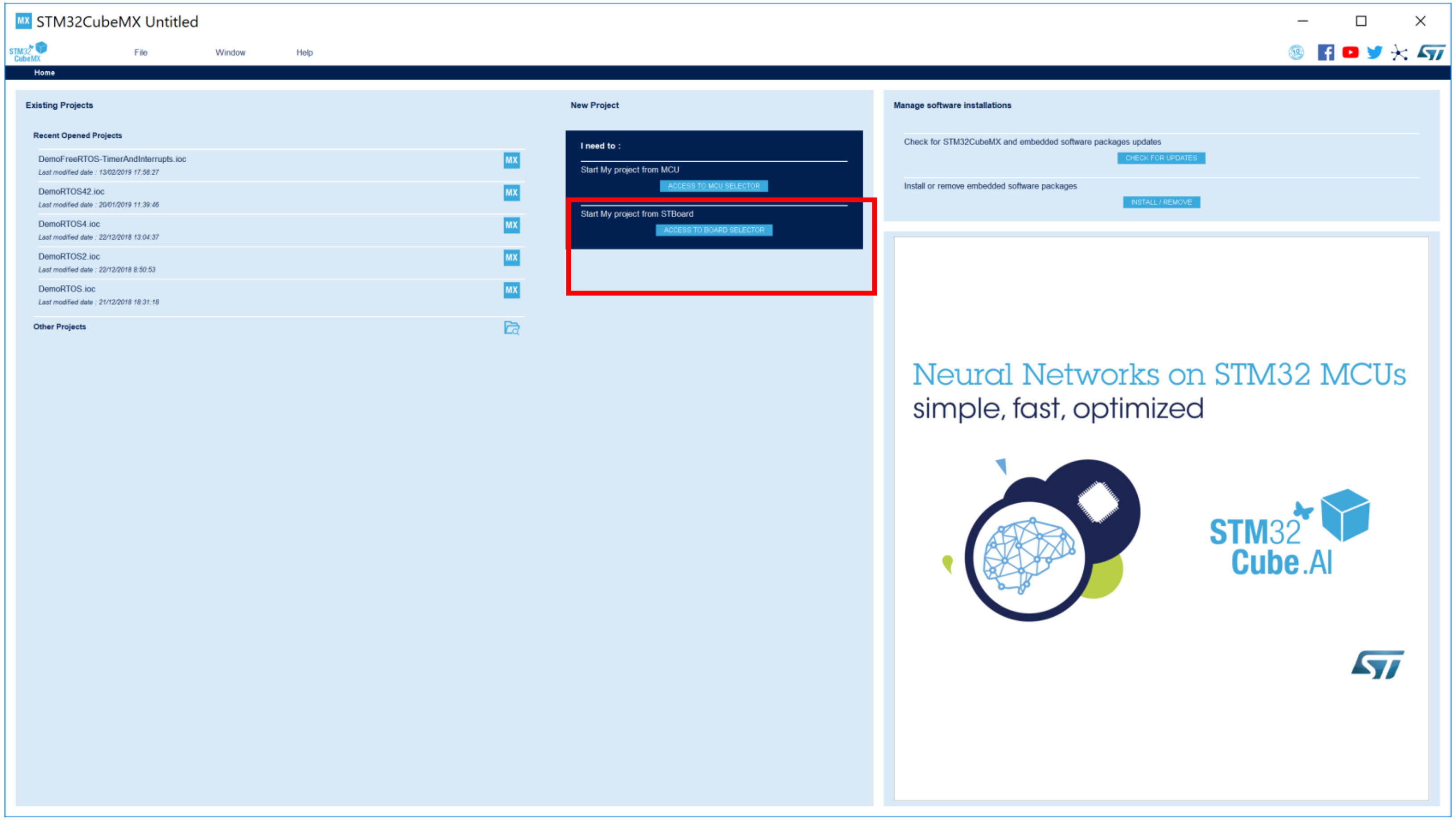
Start My project from STBoard

**Manage software installations**

Check for STM32CubeMX and embedded software packages updates

Install or remove embedded software packages

# Step 2. Access Board Selector



**Existing Projects**

**Recent Opened Projects**

DemoFreeRTOS-TimerAndInterrupts.ioc
*Last modified date : 13/02/2019 17:58:27*

DemoRTOS42.ioc
*Last modified date : 20/01/2019 11:39:46*

DemoRTOS4.ioc
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DemoRTOS2.ioc
*Last modified date : 22/12/2018 8:50:53*

DemoRTOS.ioc
*Last modified date : 21/12/2018 18:31:18*

**Other Projects**

**New Project**

**I need to :**

Start My project from MCU

Start My project from STBoard

**Manage software installations**

Check for STM32CubeMX and embedded software packages updates

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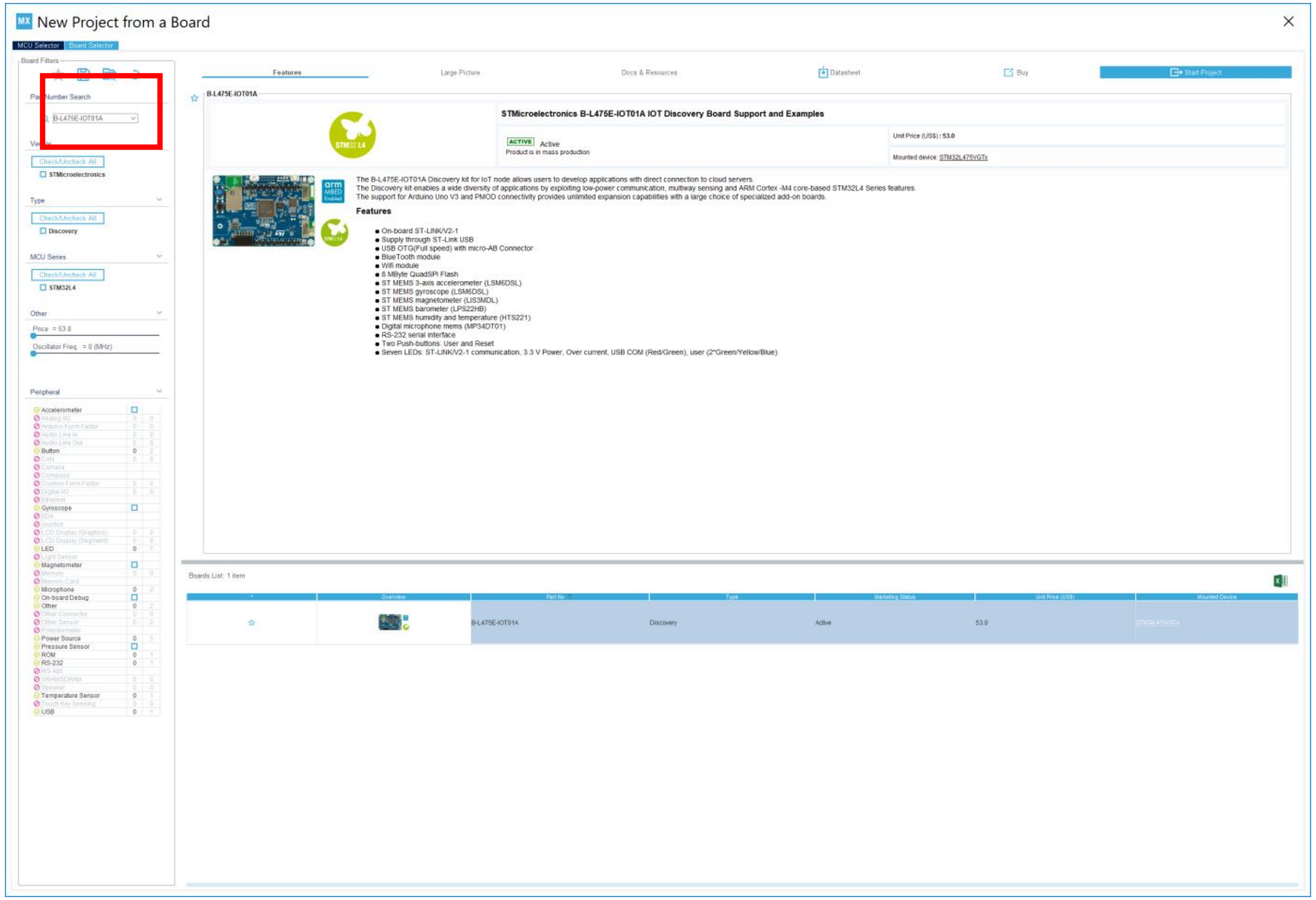
# Step 3. Enter “B-L475E-IOT01A” Board



Part Number Search: B-L475E-IOT01A

- □ STMicroelectronics
- □ Discovery
- □ STM32L4

Price = 53.0

Oscillator Freq. = 0 (MHz)

Accelerometer, Button, Gyroscope, LED, Magnetometer, Microphone, On-board Debug, Other, Power Source, Pressure Sensor, ROM, RS-232, Temperature Sensor, USB

B-L475E-IOT01A

**STMicroelectronics B-L475E-IOT01A IOT Discovery Board Support and Examples**

ACTIVE Active
Product is in mass production

Unit Price (US$) : 53.0

Mounted device: STM32L475VGTx

The B-L475E-IOT01A Discovery kit for IoT node allows users to develop applications with direct connection to cloud servers.
The Discovery kit enables a wide diversity of applications by exploiting low-power communication, multiway sensing and ARM Cortex -M4 core-based STM32L4 Series features.
The support for Arduino Uno V3 and PMOD connectivity provides unlimited expansion capabilities with a large choice of specialized add-on boards.

**Features**

- On-board ST-LINK/V2-1
- Supply through ST-Link USB
- USB OTG(Full speed) with micro-AB Connector
- BlueTooth module
- Wifi module
- 8 MByte QuadSPI Flash
- ST MEMS 3-axis accelerometer (LSM6DSL)
- ST MEMS gyroscope (LSM6DSL)
- ST MEMS magnetometer (LIS3MDL)
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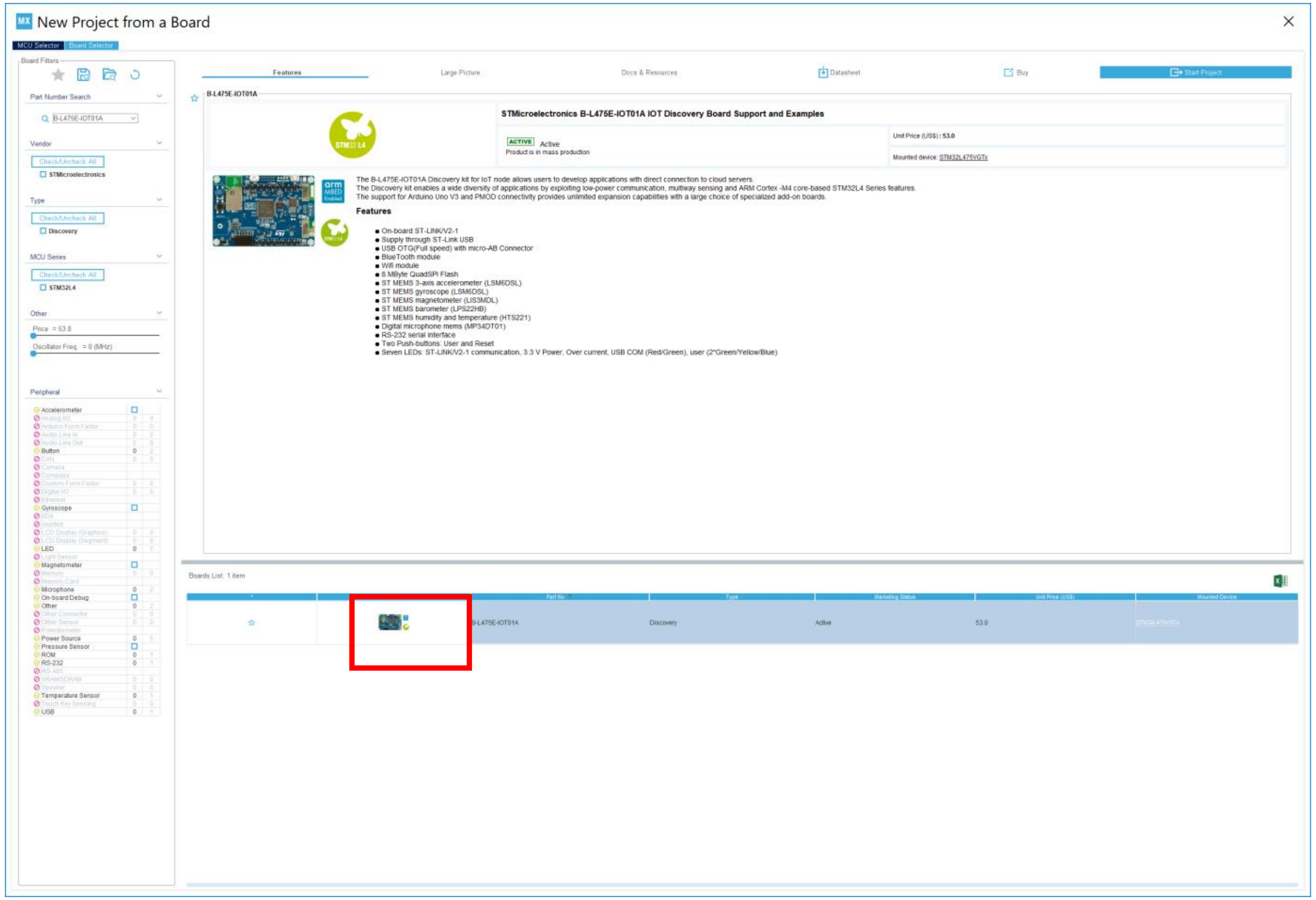
- ST MEMS humidity and temperature (HTS221)
- Digital microphone mems (MP34DT01)
- RS-232 serial interface
- Two Push-buttons: User and Reset
- Seven LEDs: ST-LINK/V2-1 communication, 3.3 V Power, Over current, USB COM (Red/Green), user (2*Green/Yellow/Blue)

Boards List: 1 item

| * | Overview | Part No | Type | Marketing Status | Unit Price (US$) | Mounted Device |
|---|---|---|---|---|---|---|
| ☆ | | B-L475E-IOT01A | Discovery | Active | 53.0 | STM32L475VGTx |

# Step 4. Select Board Photo



Part Number Search: B-L475E-IOT01A

Vendor
Check/Uncheck All
□ STMicroelectronics

Type
Check/Uncheck All
□ Discovery

MCU Series
Check/Uncheck All
□ STM32L4

Other
Price = 53.0
Oscillator Freq. = 0 (MHz)

Peripheral

| | | |
|---|---|---|
| Accelerometer | □ | |
| Analog I/O | 0 | 0 |
| Arduino Form Factor | 0 | 0 |
| Audio Line In | 0 | 0 |
| Audio Line Out | 0 | 0 |
| Button | 0 | 2 |
| CAN | 0 | 0 |
| Camera | | |
| Compass | | |
| Custom Form Factor | 0 | 0 |
| Digital I/O | 0 | 0 |
| Ethernet | | |
| Gyroscope | □ | |
| IrDA | | |
| Joystick | | |
| LCD Display (Graphics) | 0 | 0 |
| LCD Display (Segment) | 0 | 0 |
| LED | 0 | 7 |
| Light Sensor | | |
| Magnetometer | □ | |
| Memory | 0 | 0 |
| Memory Card | | |
| Microphone | 0 | 2 |
| On-board Debug | □ | |
| Other | 0 | 2 |
| Other Connector | 0 | 0 |
| Other Sensor | 0 | 0 |
| Potentiometer | | |
| Power Source | 0 | 5 |
| Pressure Sensor | □ | |
| ROM | 0 | 1 |
| RS-232 | 0 | 1 |
| RS-485 | | |
| SRAM/SDRAM | 0 | 0 |
| Speaker | 0 | 0 |
| Temperature Sensor | 0 | 1 |
| Touch Key Sensing | 0 | 0 |
| USB | 0 | 1 |

B-L475E-IOT01A

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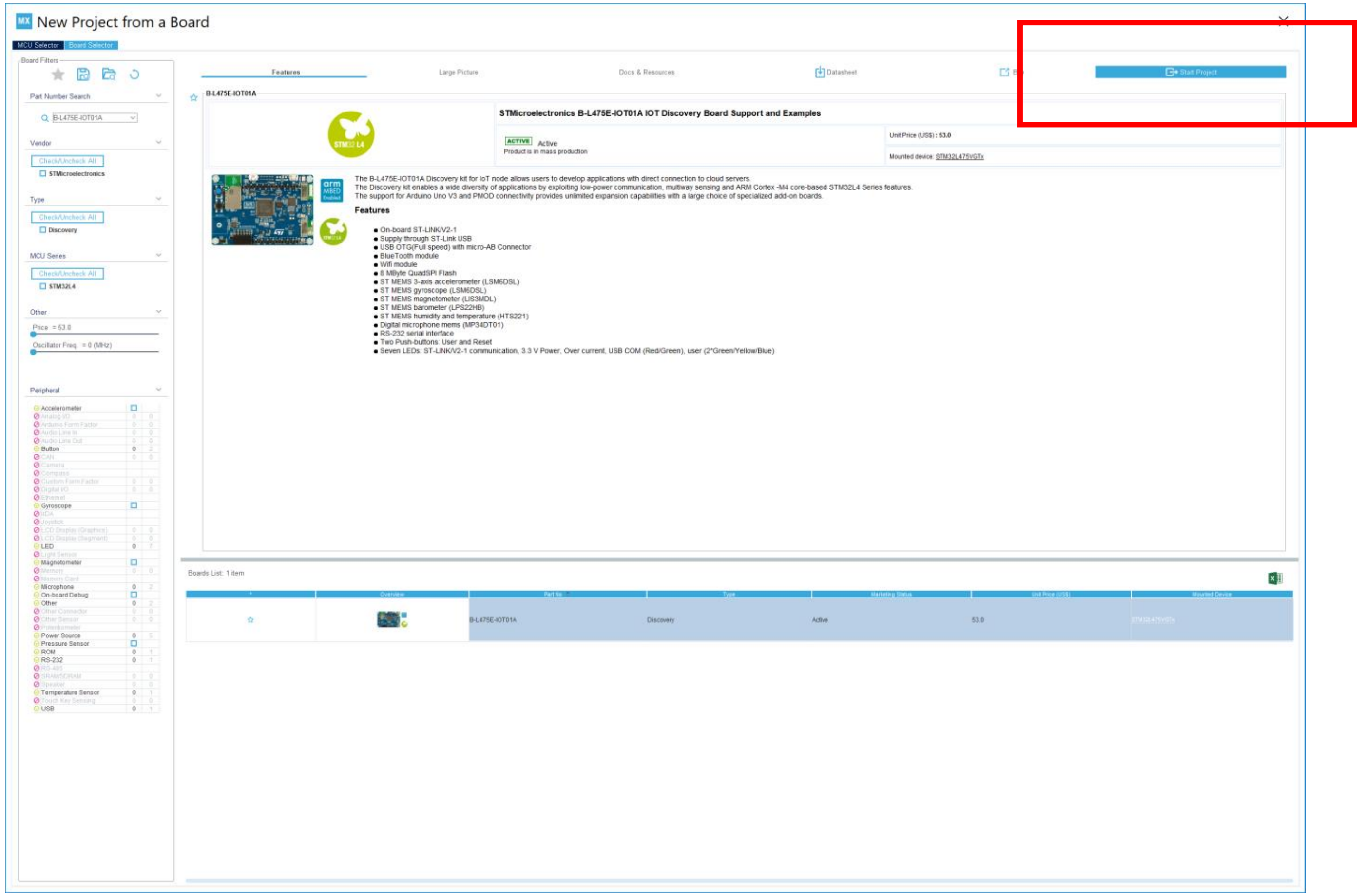
|---|---|---|---|---|---|---|
| ☆ | | B-L475E-IOT01A | Discovery | Active | 53.0 | STM32L475VGTx |

# Step 5. Select “Start Project”



Part Number Search: B-L475E-IOT01A

Vendor: □ STMicroelectronics

Type: □ Discovery

MCU Series: □ STM32L4

Other: Price = 53.0; Oscillator Freq. = 0 (MHz)

Peripheral

| | | |
|---|---|---|
| Accelerometer | □ | |
| Button | 0 | 2 |
| Gyroscope | □ | |
| LED | 0 | 7 |
| Magnetometer | □ | |
| Microphone | 0 | 2 |
| On-board Debug | □ | |
| Other | 0 | 2 |
| Power Source | 0 | 3 |
| Pressure Sensor | □ | |
| ROM | 0 | 1 |
| RS-232 | 0 | 1 |
| Temperature Sensor | 0 | 1 |
| USB | 0 | 1 |

B-L475E-IOT01A

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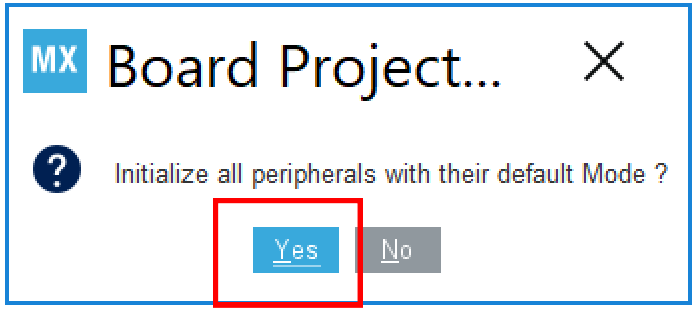
|---|---|---|---|---|---|---|
| ☆ | | B-L475E-IOT01A | Discovery | Active | 53.0 | STM32L475VGTx |

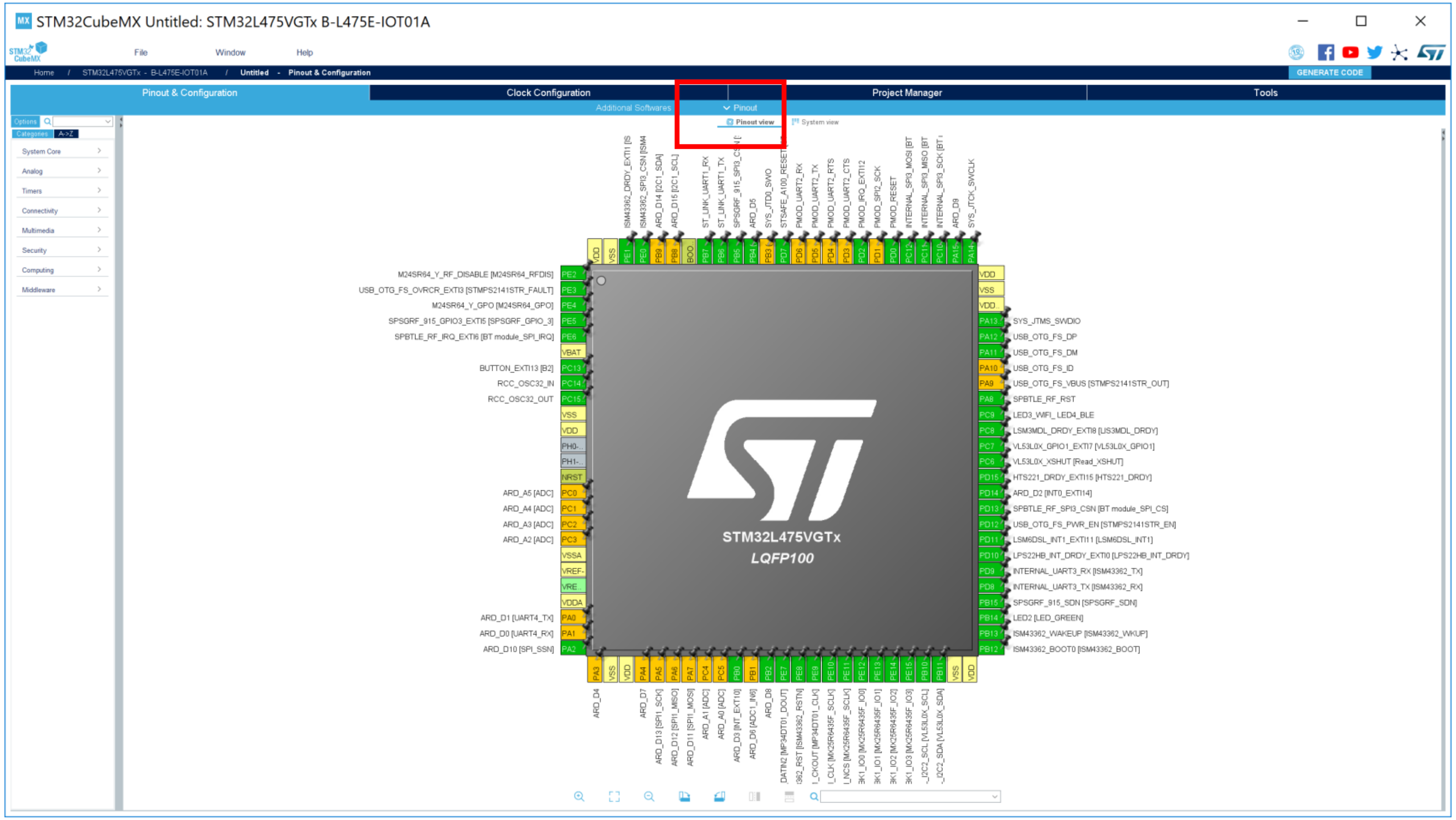
# Step 6. Select **YES** (initialize all peripherals with the default mode)



Board Project...

Initialize all peripherals with their default Mode ?

# Step 7. Observe Results (Pinout View)



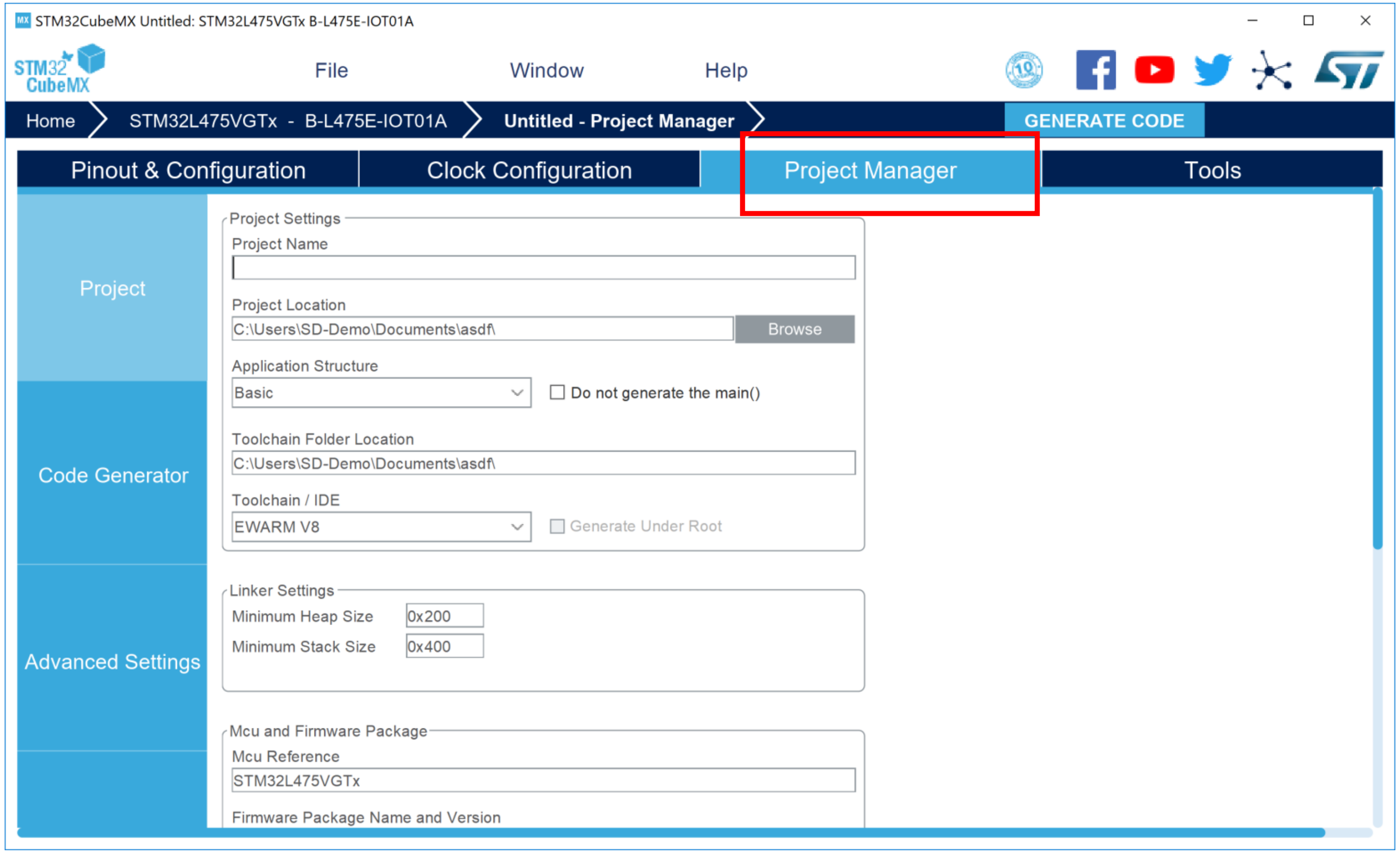
VDD
VSS
PE1 ISM43362_DRDY_EXTI1 [IS
PE0 ISM43362_SPI3_CSN [ISM4
PB9 ARD_D14 [I2C1_SDA]
PB8 ARD_D15 [I2C1_SCL]
BOO..
PB7 ST_LINK_UART1_RX
PB6 ST_LINK_UART1_TX
PB5 SPSGRF_915_SPI3_CSN [
PB4 ARD_D5
PB3 SYS_JTD0_SWO
PD7 STSAFE_A100_RESET
PD6 PMOD_UART2_RX
PD5 PMOD_UART2_TX
PD4 PMOD_UART2_RTS
PD3 PMOD_UART2_CTS
PD2 PMOD_IRQ_EXTI12
PD1 PMOD_SPI2_SCK
PD0 PMOD_RESET
PC12 INTERNAL_SPI3_MOSI [BT
PC11 INTERNAL_SPI3_MISO [BT
PC10 INTERNAL_SPI3_SCK [BT
PA15 ARD_D9
PA14 SYS_JTCK_SWCLK

M24SR64_Y_RF_DISABLE [M24SR64_RFDIS] PE2
USB_OTG_FS_OVRCR_EXTI3 [STMPS2141STR_FAULT] PE3
M24SR64_Y_GPO [M24SR64_GPO] PE4
SPSGRF_915_GPIO3_EXTI5 [SPSGRF_GPIO_3] PE5
SPBTLE_RF_IRQ_EXTI6 [BT module_SPI_IRQ] PE6
VBAT
BUTTON_EXTI13 [B2] PC13
RCC_OSC32_IN PC14..
RCC_OSC32_OUT PC15..
VSS
VDD
PH0-..
PH1-..
NRST
ARD_A5 [ADC] PC0
ARD_A4 [ADC] PC1
ARD_A3 [ADC] PC2
ARD_A2 [ADC] PC3
VSSA
VREF-
VRE..
VDDA
ARD_D1 [UART4_TX] PA0
ARD_D0 [UART4_RX] PA1
ARD_D10 [SPI_SSN] PA2

VDD
VSS
VDD..
PA13.. SYS_JTMS_SWDIO
PA12 USB_OTG_FS_DP
PA11 USB_OTG_FS_DM
PA10 USB_OTG_FS_ID
PA9 USB_OTG_FS_VBUS [STMPS2141STR_OUT]
PA8 SPBTLE_RF_RST
PC9 LED3_WIFI_ LED4_BLE
PC8 LSM3MDL_DRDY_EXTI8 [LIS3MDL_DRDY]
PC7 VL53L0X_GPIO1_EXTI7 [VL53L0X_GPIO1]
PC6 VL53L0X_XSHUT [Read_XSHUT]
PD15 HTS221_DRDY_EXTI15 [HTS221_DRDY]
PD14 ARD_D2 [INT0_EXTI14]
PD13 SPBTLE_RF_SPI3_CSN [BT module_SPI_CS]
PD12 USB_OTG_FS_PWR_EN [STMPS2141STR_EN]
PD11 LSM6DSL_INT1_EXTI11 [LSM6DSL_INT1]
PD10 LPS22HB_INT_DRDY_EXTI0 [LPS22HB_INT_DRDY]
PD9 INTERNAL_UART3_RX [ISM43362_TX]
PD8 INTERNAL_UART3_TX [ISM43362_RX]
PB15 SPSGRF_915_SDN [SPSGRF_SDN]
PB14 LED2 [LED_GREEN]
PB13 ISM43362_WAKEUP [ISM43362_WKUP]
PB12 ISM43362_BOOT0 [ISM43362_BOOT]

PA3 ARD_D4
VSS
VDD
PA4 ARD_D7
PA5 ARD_D13 [SPI1_SCK]
PA6 ARD_D12 [SPI1_MISO]
PA7 ARD_D11 [SPI1_MOSI]
PC4 ARD_A1 [ADC]
PC5 ARD_A0 [ADC]
PB0 ARD_D3 [INT_EXT10]
PB1 ARD_D6 [ADC1_IN6]
PB2 ARD_D8
PE7 _DATIN2 [MP34DT01_DOUT]
PE8 362_RST [ISM43362_RSTN]
PE9 I_CKOUT [MP34DT01_CLK]
PE10 I_CLK [MX25R6435F_SCLK]
PE11 I_NCS [MX25R6435F_SCLK]
PE12 3K1_IO0 [MX25R6435F_IO0]
PE13 3K1_IO1 [MX25R6435F_IO1]
PE14 3K1_IO2 [MX25R6435F_IO2]
PE15 3K1_IO3 [MX25R6435F_IO3]
PB10 _I2C2_SCL [VL53L0X_SCL]
PB11 _I2C2_SDA [VL53L0X_SDA]
VSS
VDD

# Step 8. Select Project Manager Tab



Project Settings

Project Name

Project Location
C:\Users\SD-Demo\Documents\asdf\

Application Structure
Basic

□ Do not generate the main()

Toolchain Folder Location
C:\Users\SD-Demo\Documents\asdf\

Toolchain / IDE
EWARM V8

□ Generate Under Root

Linker Settings

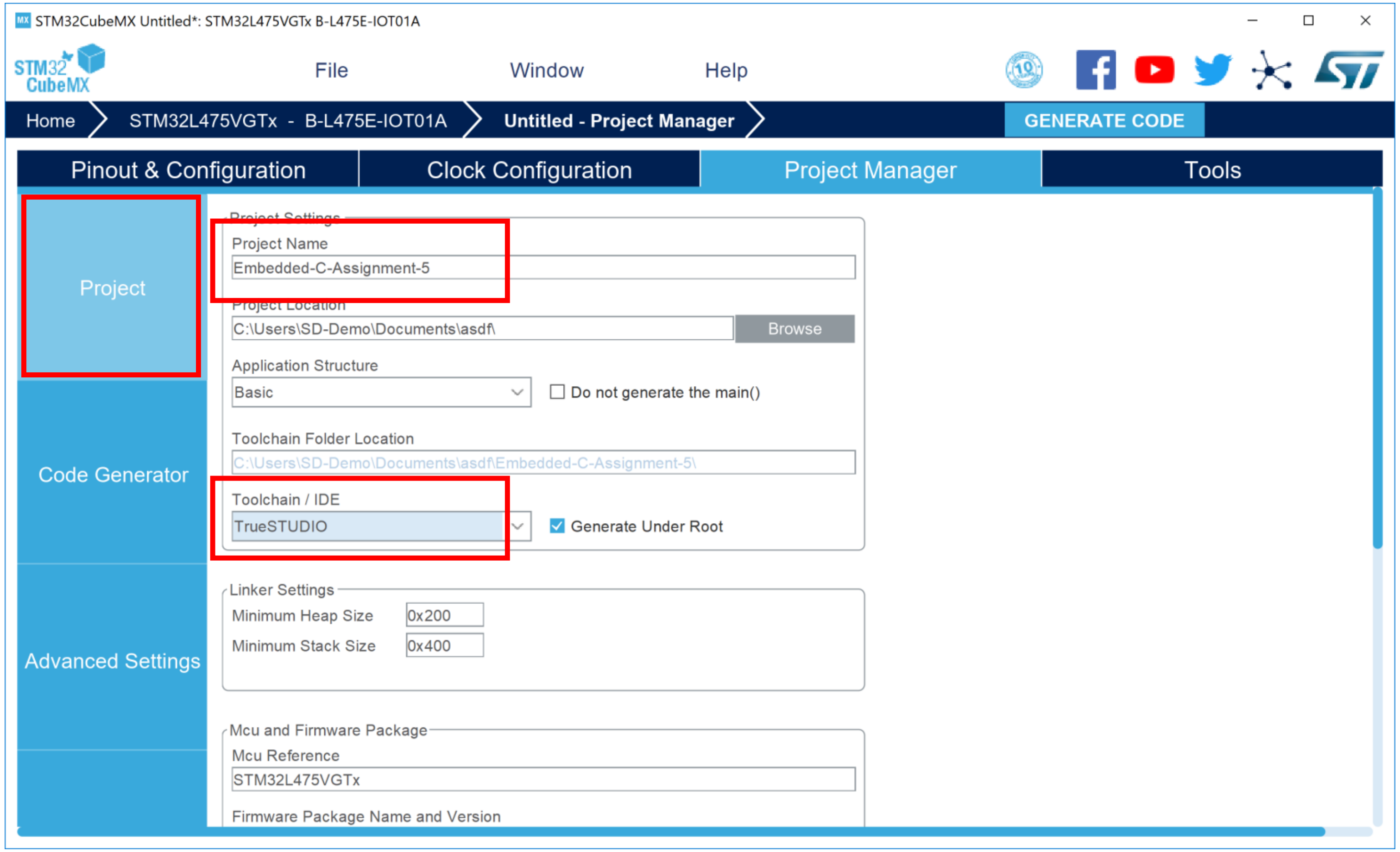
| | |
|---|---|
| Minimum Heap Size | 0x200 |
| Minimum Stack Size | 0x400 |

Mcu and Firmware Package

Mcu Reference
STM32L475VGTx

Firmware Package Name and Version

# Step 9. Enter “Embedded-C-Assigment-5” and select TrueStudio as IDE



Project Settings

Project Name: Embedded-C-Assignment-5

Project Location: C:\Users\SD-Demo\Documents\asdf\

Application Structure: Basic

☐ Do not generate the main()

Toolchain Folder Location: C:\Users\SD-Demo\Documents\asdf\Embedded-C-Assignment-5\

Toolchain / IDE: TrueSTUDIO

☑ Generate Under Root

Linker Settings

Minimum Heap Size: 0x200

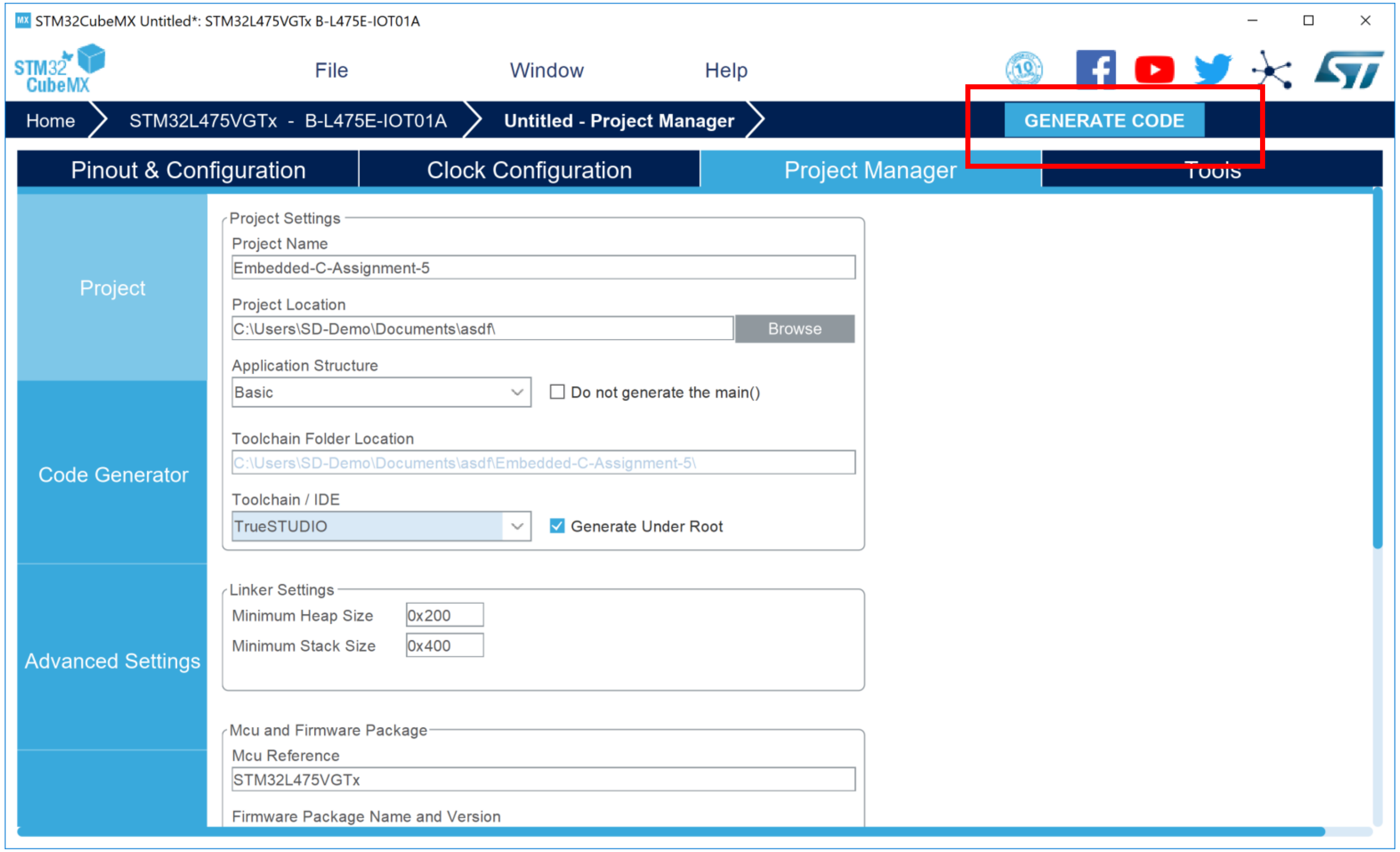
Minimum Stack Size: 0x400

Mcu and Firmware Package

Mcu Reference: STM32L475VGTx

Firmware Package Name and Version

# Step 10. Select “Generate Code”



Project Settings

Project Name

Embedded-C-Assignment-5

Project Location

C:\Users\SD-Demo\Documents\asdf\

Application Structure

Basic

□ Do not generate the main()

Toolchain Folder Location

C:\Users\SD-Demo\Documents\asdf\Embedded-C-Assignment-5\

Toolchain / IDE

TrueSTUDIO

☑ Generate Under Root

Linker Settings

Minimum Heap Size 0x200

Minimum Stack Size 0x400

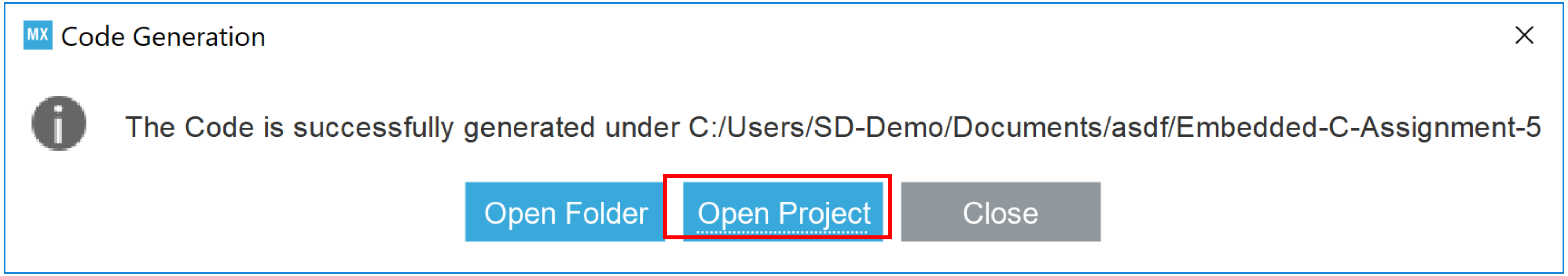
Mcu and Firmware Package

Mcu Reference

STM32L475VGTx

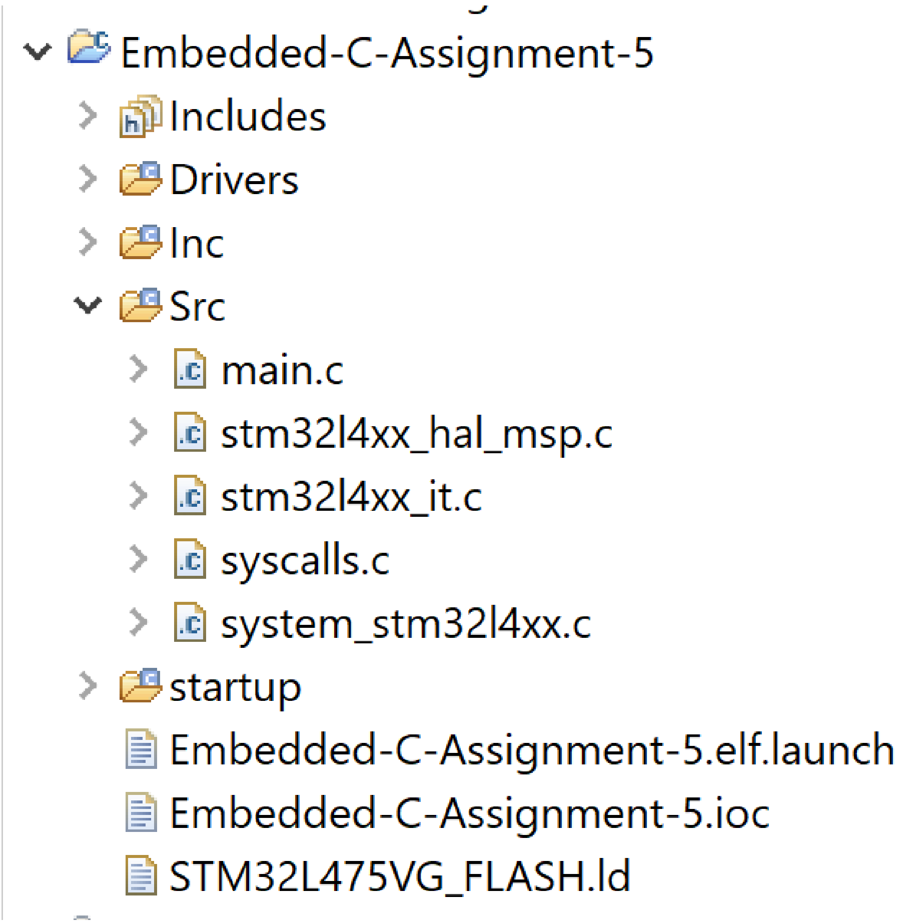
Firmware Package Name and Version

# Step 11. Select “Open Project”



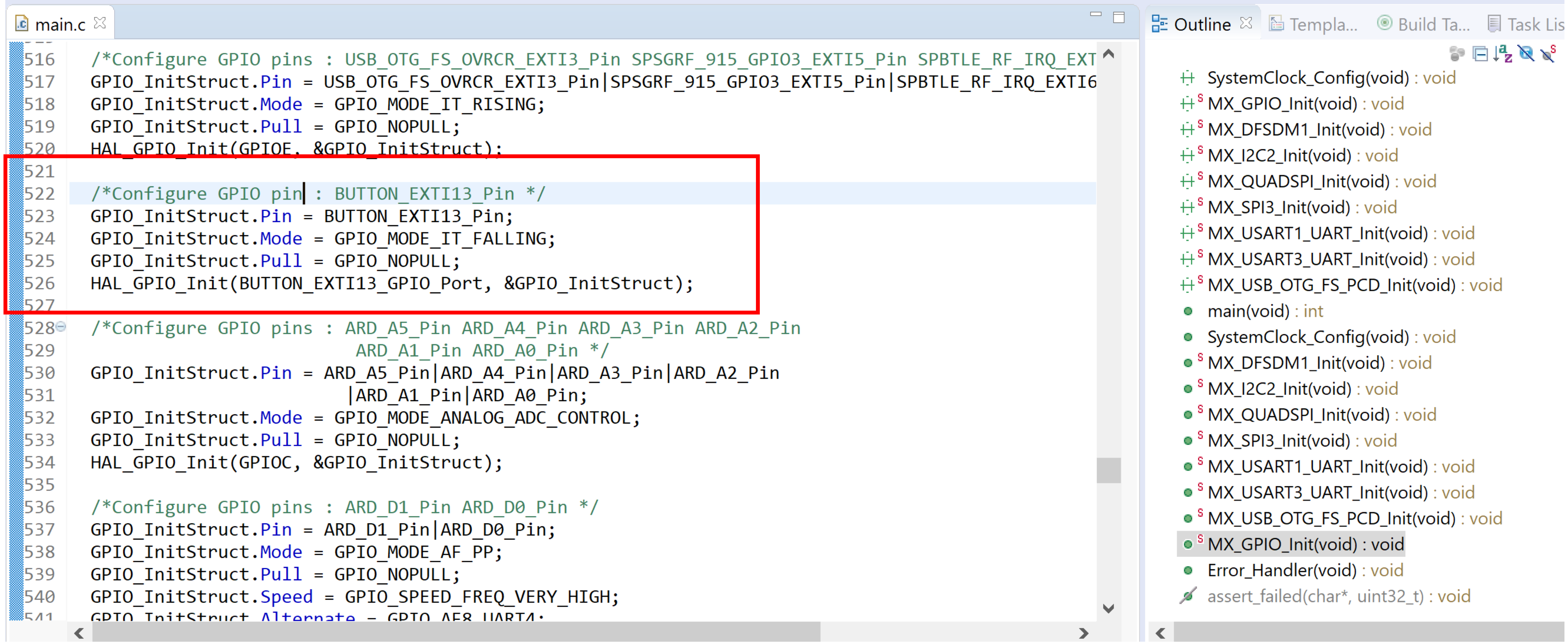
The Code is successfully generated under C:/Users/SD-Demo/Documents/asdf/Embedded-C-Assignment-5

# Step 12. Resulting Project



```
Embedded-C-Assignment-5
    Includes
    Drivers
    Inc
    Src
        main.c
        stm32l4xx_hal_msp.c
        stm32l4xx_it.c
        syscalls.c
        system_stm32l4xx.c
    startup
    Embedded-C-Assignment-5.elf.launch
    Embedded-C-Assignment-5.ioc
    STM32L475VG_FLASH.ld
```

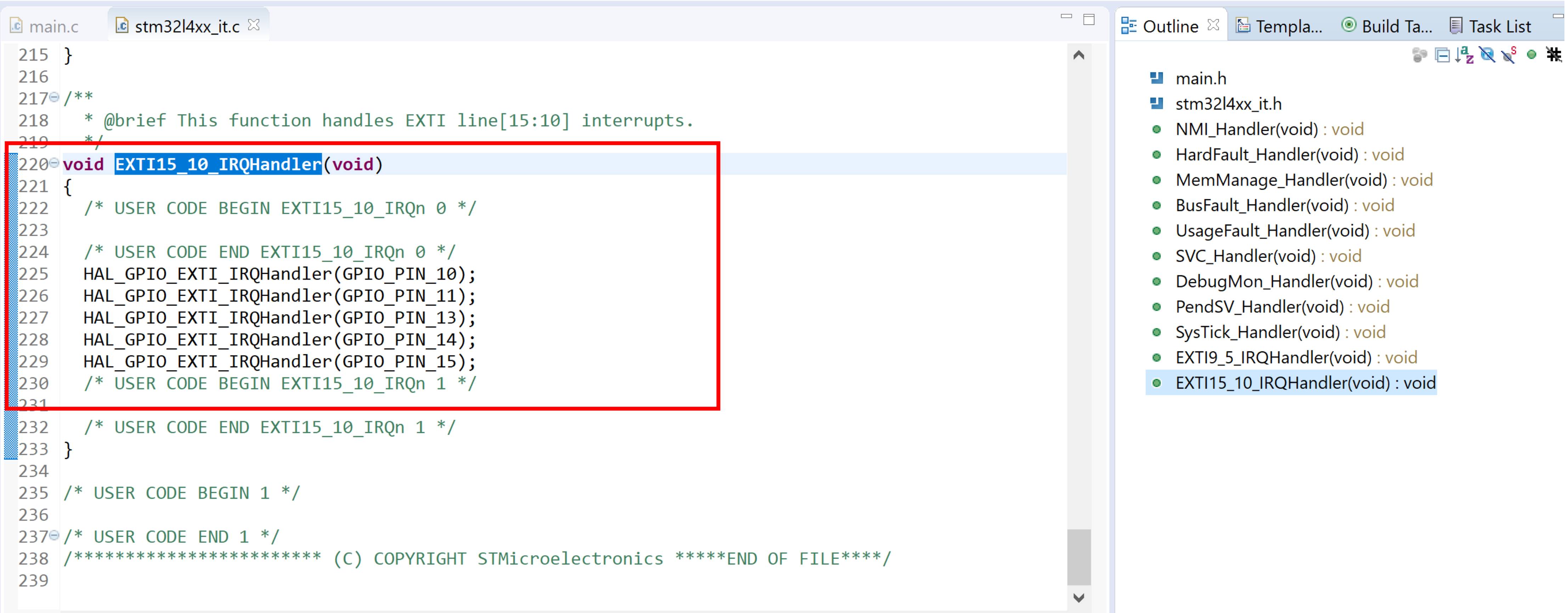
# Step 13. In main.c, find code that initializes the Button interrupt handler.



```
  /*Configure GPIO pins : USB_OTG_FS_OVRCR_EXTI3_Pin SPSGRF_915_GPIO3_EXTI5_Pin SPBTLE_RF_IRQ_EXT
  GPIO_InitStruct.Pin = USB_OTG_FS_OVRCR_EXTI3_Pin|SPSGRF_915_GPIO3_EXTI5_Pin|SPBTLE_RF_IRQ_EXTI6
  GPIO_InitStruct.Mode = GPIO_MODE_IT_RISING;
  GPIO_InitStruct.Pull = GPIO_NOPULL;
  HAL_GPIO_Init(GPIOE, &GPIO_InitStruct);

  /*Configure GPIO pin : BUTTON_EXTI13_Pin */
  GPIO_InitStruct.Pin = BUTTON_EXTI13_Pin;
  GPIO_InitStruct.Mode = GPIO_MODE_IT_FALLING;
  GPIO_InitStruct.Pull = GPIO_NOPULL;
  HAL_GPIO_Init(BUTTON_EXTI13_GPIO_Port, &GPIO_InitStruct);

  /*Configure GPIO pins : ARD_A5_Pin ARD_A4_Pin ARD_A3_Pin ARD_A2_Pin
                           ARD_A1_Pin ARD_A0_Pin */
  GPIO_InitStruct.Pin = ARD_A5_Pin|ARD_A4_Pin|ARD_A3_Pin|ARD_A2_Pin
                          |ARD_A1_Pin|ARD_A0_Pin;
  GPIO_InitStruct.Mode = GPIO_MODE_ANALOG_ADC_CONTROL;
  GPIO_InitStruct.Pull = GPIO_NOPULL;
  HAL_GPIO_Init(GPIOC, &GPIO_InitStruct);

  /*Configure GPIO pins : ARD_D1_Pin ARD_D0_Pin */
  GPIO_InitStruct.Pin = ARD_D1_Pin|ARD_D0_Pin;
  GPIO_InitStruct.Mode = GPIO_MODE_AF_PP;
  GPIO_InitStruct.Pull = GPIO_NOPULL;
  GPIO_InitStruct.Speed = GPIO_SPEED_FREQ_VERY_HIGH;
  GPIO_InitStruct.Alternate = GPIO_AF8_UART4;
```

main.c
Outline
Templa...
Build Ta...
Task Lis
SystemClock_Config(void) : void
MX_GPIO_Init(void) : void
MX_DFSDM1_Init(void) : void
MX_I2C2_Init(void) : void
MX_QUADSPI_Init(void) : void
MX_SPI3_Init(void) : void
MX_USART1_UART_Init(void) : void
MX_USART3_UART_Init(void) : void
MX_USB_OTG_FS_PCD_Init(void) : void
main(void) : int
SystemClock_Config(void) : void
MX_DFSDM1_Init(void) : void
MX_I2C2_Init(void) : void
MX_QUADSPI_Init(void) : void
MX_SPI3_Init(void) : void
MX_USART1_UART_Init(void) : void
MX_USART3_UART_Init(void) : void
MX_USB_OTG_FS_PCD_Init(void) : void
MX_GPIO_Init(void) : void
Error_Handler(void) : void
assert_failed(char*, uint32_t) : void

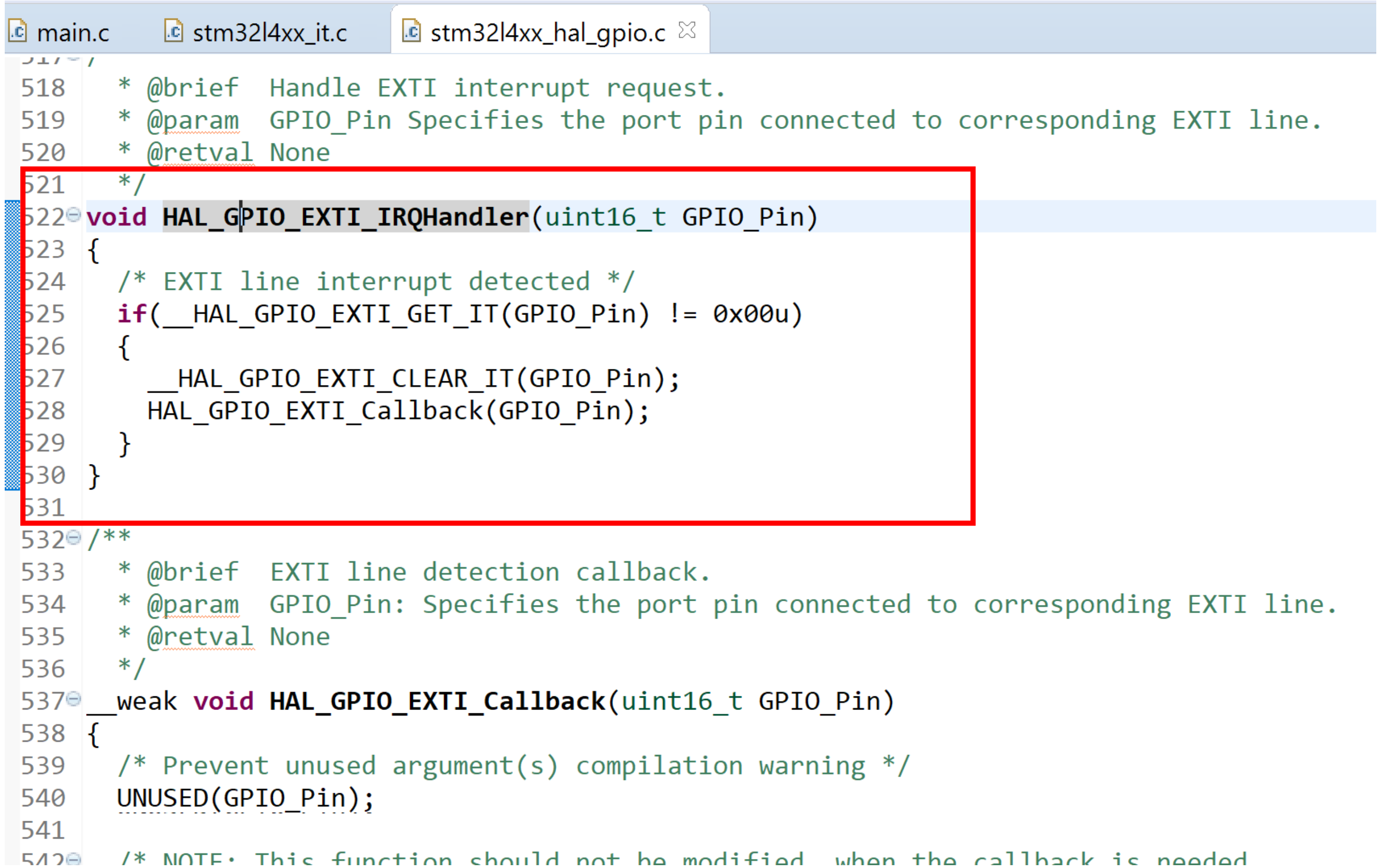
# Step 14. In stm32l4xx_it.c, find interrupt handler code – Part 1



main.c
stm32l4xx_it.c
Outline
Templa...
Build Ta...
Task List
main.h
stm32l4xx_it.h
NMI_Handler(void) : void
HardFault_Handler(void) : void
MemManage_Handler(void) : void
BusFault_Handler(void) : void
UsageFault_Handler(void) : void
SVC_Handler(void) : void
DebugMon_Handler(void) : void
PendSV_Handler(void) : void
SysTick_Handler(void) : void
EXTI9_5_IRQHandler(void) : void
EXTI15_10_IRQHandler(void) : void

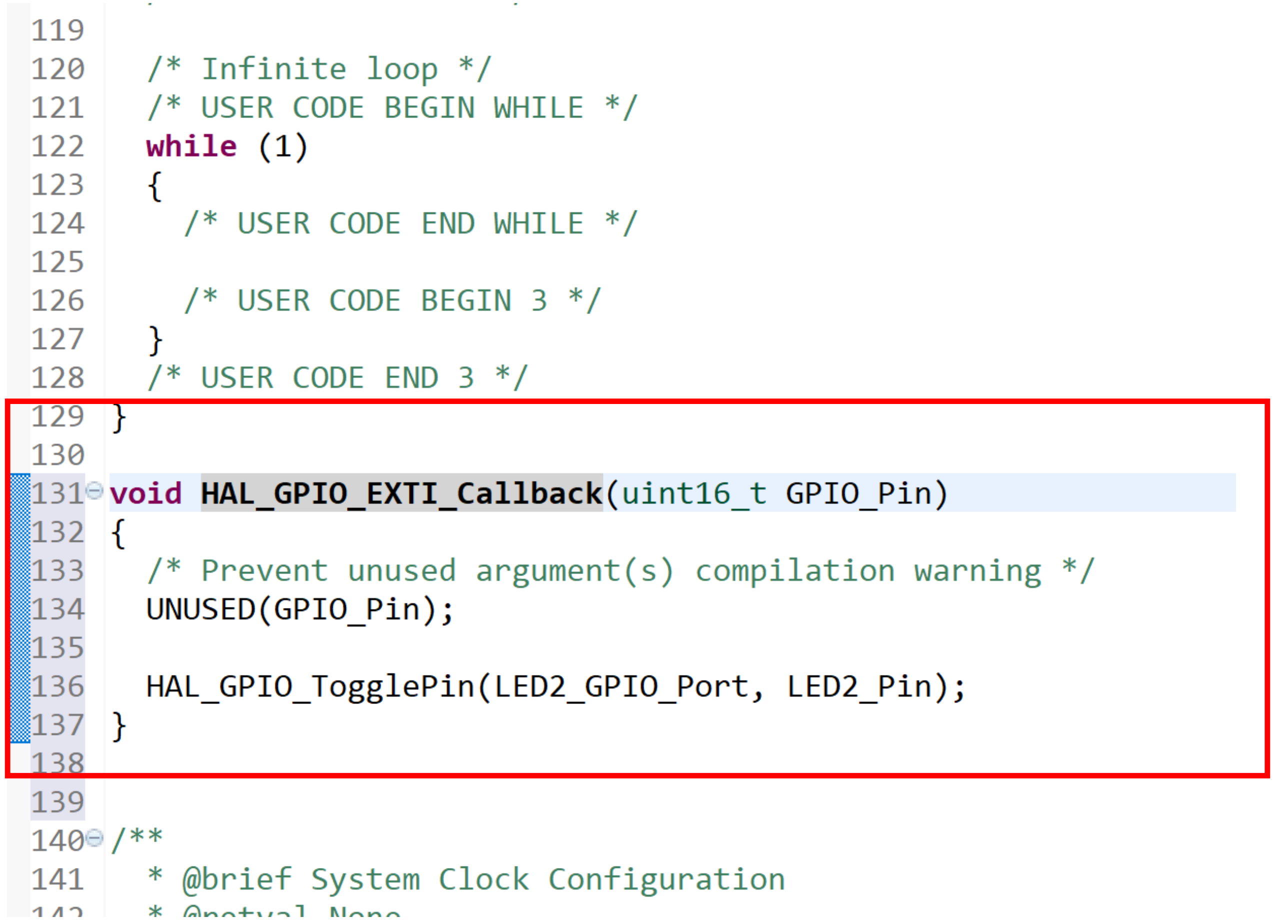
```c
}

/**
  * @brief This function handles EXTI line[15:10] interrupts.
  */
void EXTI15_10_IRQHandler(void)
{
  /* USER CODE BEGIN EXTI15_10_IRQn 0 */

  /* USER CODE END EXTI15_10_IRQn 0 */
  HAL_GPIO_EXTI_IRQHandler(GPIO_PIN_10);
  HAL_GPIO_EXTI_IRQHandler(GPIO_PIN_11);
  HAL_GPIO_EXTI_IRQHandler(GPIO_PIN_13);
  HAL_GPIO_EXTI_IRQHandler(GPIO_PIN_14);
  HAL_GPIO_EXTI_IRQHandler(GPIO_PIN_15);
  /* USER CODE BEGIN EXTI15_10_IRQn 1 */

  /* USER CODE END EXTI15_10_IRQn 1 */
}

/* USER CODE BEGIN 1 */

/* USER CODE END 1 */
/************************ (C) COPYRIGHT STMicroelectronics *****END OF FILE****/

```

# Step 15. In stm32l4xx_it.c, find interrupt handler code – Part 2



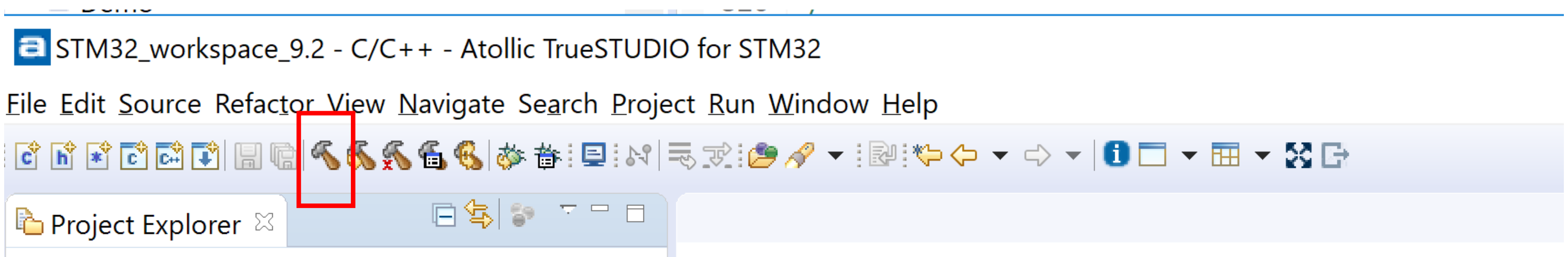
```
/
  * @brief  Handle EXTI interrupt request.
  * @param  GPIO_Pin Specifies the port pin connected to corresponding EXTI line.
  * @retval None
  */
void HAL_GPIO_EXTI_IRQHandler(uint16_t GPIO_Pin)
{
  /* EXTI line interrupt detected */
  if(__HAL_GPIO_EXTI_GET_IT(GPIO_Pin) != 0x00u)
  {
    __HAL_GPIO_EXTI_CLEAR_IT(GPIO_Pin);
    HAL_GPIO_EXTI_Callback(GPIO_Pin);
  }
}

/**
  * @brief  EXTI line detection callback.
  * @param  GPIO_Pin: Specifies the port pin connected to corresponding EXTI line.
  * @retval None
  */
__weak void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
  /* Prevent unused argument(s) compilation warning */
  UNUSED(GPIO_Pin);

  /* NOTE: This function should not be modified, when the callback is needed,
```

# Step 16. In main.c, add interrupt code to toggle LED on interrupt

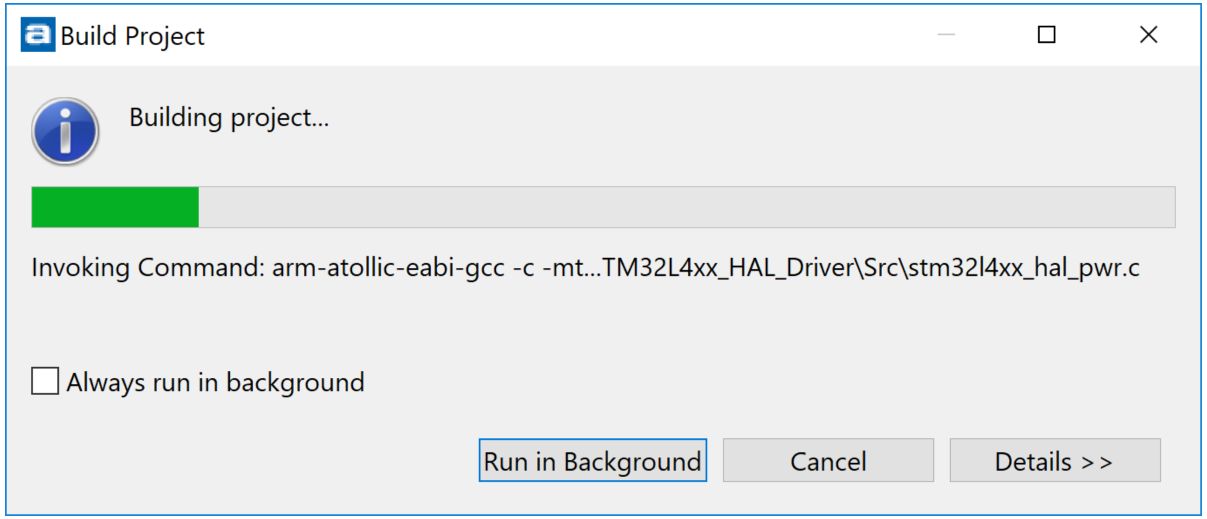


```

  /* Infinite loop */
  /* USER CODE BEGIN WHILE */
  while (1)
  {
    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
  }
  /* USER CODE END 3 */
}

void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
  /* Prevent unused argument(s) compilation warning */
  UNUSED(GPIO_Pin);

  HAL_GPIO_TogglePin(LED2_GPIO_Port, LED2_Pin);
}


/**
  * @brief System Clock Configuration
  * @retval None
```

# Step 17. Build Project



STM32_workspace_9.2 - C/C++ - Atollic TrueSTUDIO for STM32
File Edit Source Refactor View Navigate Search Project Run Window Help
Project Explorer

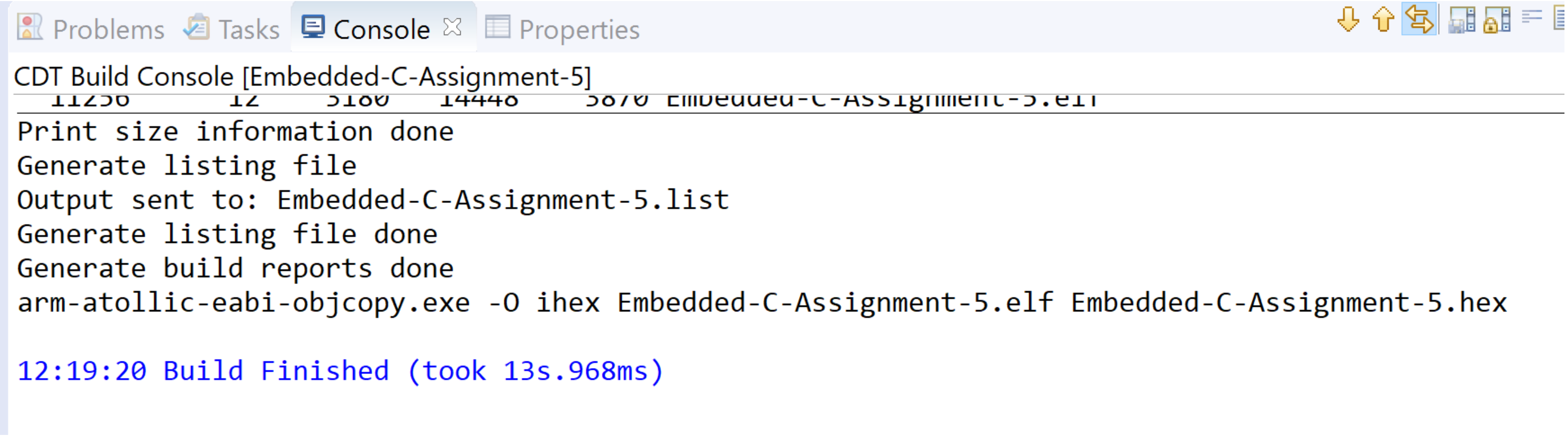


Build Project

Building project...

Invoking Command: arm-atollic-eabi-gcc -c -mt...TM32L4xx_HAL_Driver\Src\stm32l4xx_hal_pwr.c

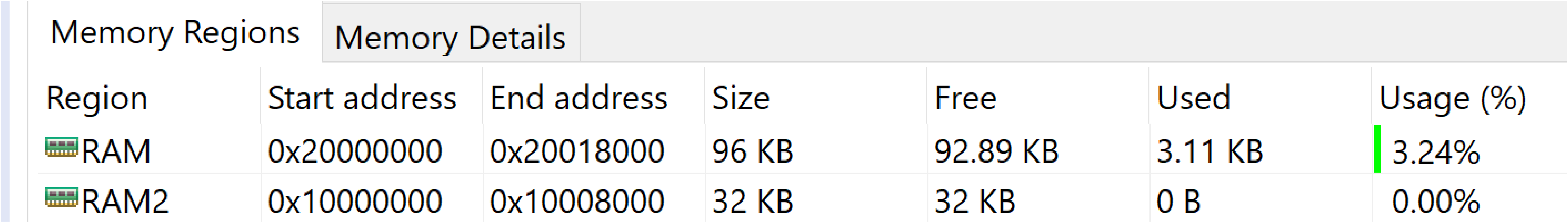
# Step 18. Results of Build – Part 1



CDT Build Console [Embedded-C-Assignment-5]

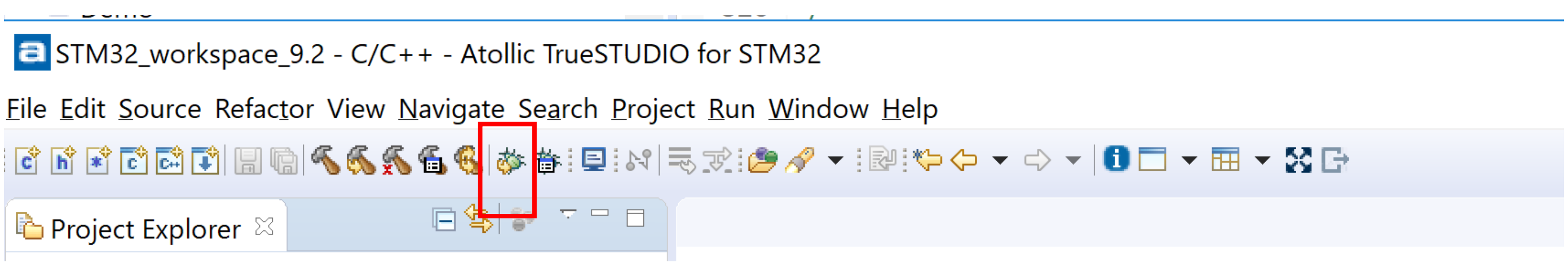
```
  11256        12     3180    14448      3870 Embedded-C-Assignment-5.elf
Print size information done
Generate listing file
Output sent to: Embedded-C-Assignment-5.list
Generate listing file done
Generate build reports done
arm-atollic-eabi-objcopy.exe -O ihex Embedded-C-Assignment-5.elf Embedded-C-Assignment-5.hex

12:19:20 Build Finished (took 13s.968ms)
```

# Step 19. Results of Build – Part 2



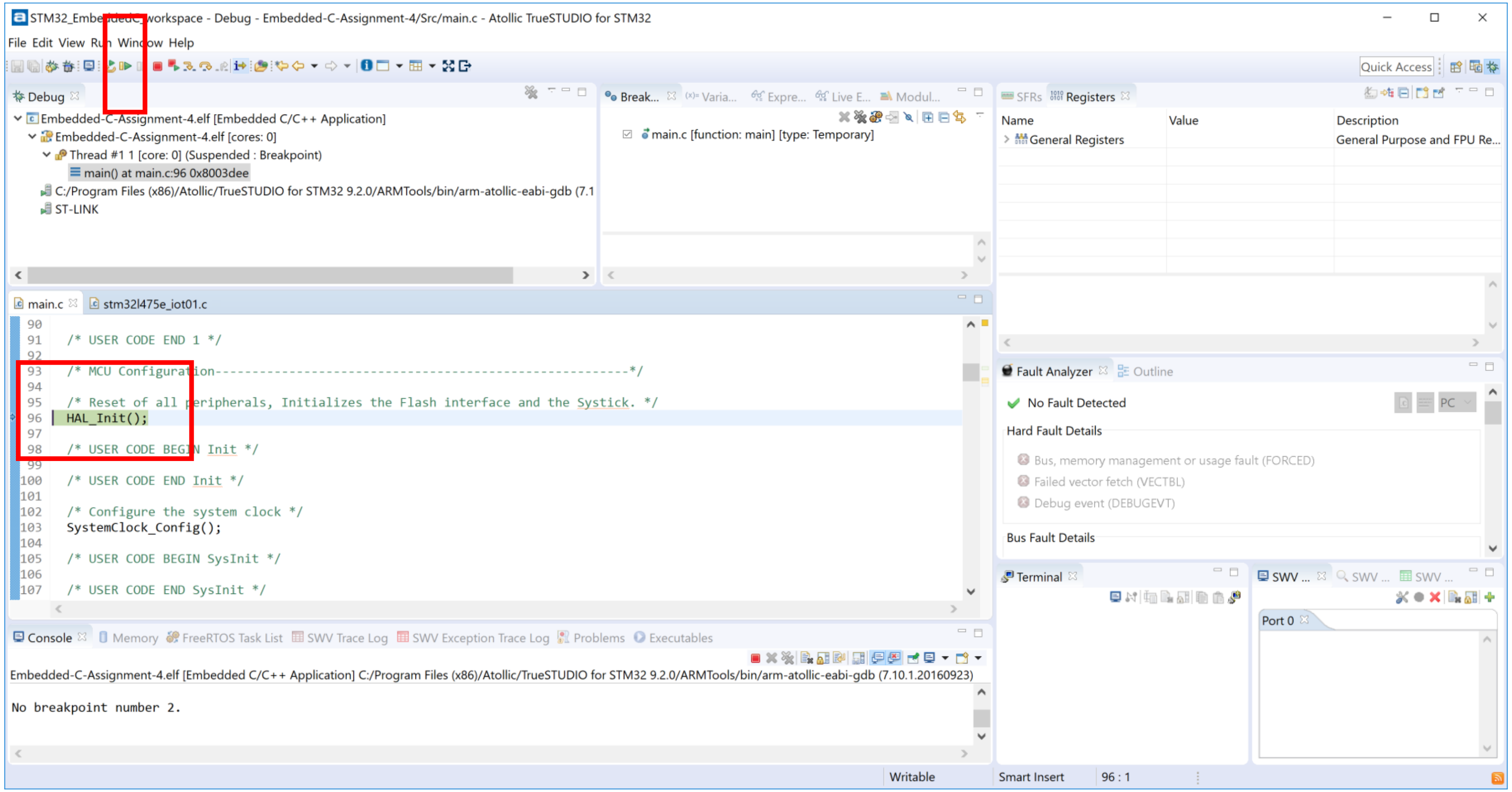
| Region | Start address | End address | Size | Free | Used | Usage (%) |
|---|---|---|---|---|---|---|
| RAM | 0x20000000 | 0x20018000 | 96 KB | 92.89 KB | 3.11 KB | 3.24% |
| RAM2 | 0x10000000 | 0x10008000 | 32 KB | 32 KB | 0 B | 0.00% |

# Step 20. Run in Debug



STM32_workspace_9.2 - C/C++ - Atollic TrueSTUDIO for STM32
File Edit Source Refactor View Navigate Search Project Run Window Help
Project Explorer

# Step 21. Hit Breakpoint, then click Resume



```
Embedded-C-Assignment-4.elf [Embedded C/C++ Application]
  Embedded-C-Assignment-4.elf [cores: 0]
    Thread #1 1 [core: 0] (Suspended : Breakpoint)
      main() at main.c:96 0x8003dee
  C:/Program Files (x86)/Atollic/TrueSTUDIO for STM32 9.2.0/ARMTools/bin/arm-atollic-eabi-gdb (7.1
  ST-LINK
```

☑ main.c [function: main] [type: Temporary]

| Name | Value | Description |
|---|---|---|
| General Registers | | General Purpose and FPU Re... |

No Fault Detected

Hard Fault Details

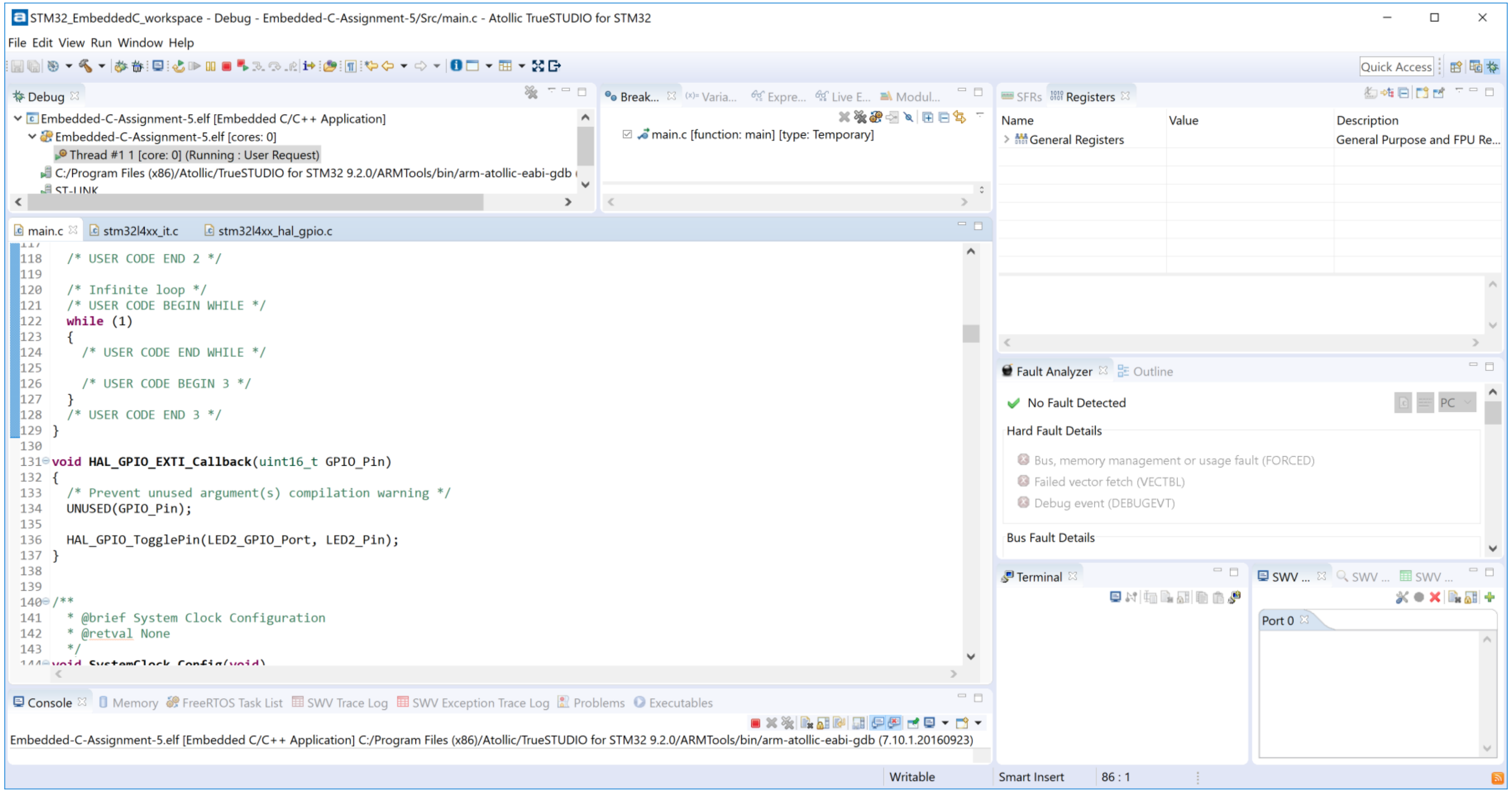
- Bus, memory management or usage fault (FORCED)
- Failed vector fetch (VECTBL)
- Debug event (DEBUGEVT)

Bus Fault Details

```c

  /* USER CODE END 1 */

  /* MCU Configuration----------------------------------------------------------*/

  /* Reset of all peripherals, Initializes the Flash interface and the Systick. */
  HAL_Init();

  /* USER CODE BEGIN Init */

  /* USER CODE END Init */

  /* Configure the system clock */
  SystemClock_Config();

  /* USER CODE BEGIN SysInit */

  /* USER CODE END SysInit */
```

```
Embedded-C-Assignment-4.elf [Embedded C/C++ Application] C:/Program Files (x86)/Atollic/TrueSTUDIO for STM32 9.2.0/ARMTools/bin/arm-atollic-eabi-gdb (7.10.1.20160923)

No breakpoint number 2.
```

# Step 22. Touching Button should turn LED on/off, based on interrupt service routine



STM32_EmbeddedC_workspace - Debug - Embedded-C-Assignment-5/Src/main.c - Atollic TrueSTUDIO for STM32

Embedded-C-Assignment-5.elf [Embedded C/C++ Application]
Embedded-C-Assignment-5.elf [cores: 0]
Thread #1 1 [core: 0] (Running : User Request)
C:/Program Files (x86)/Atollic/TrueSTUDIO for STM32 9.2.0/ARMTools/bin/arm-atollic-eabi-gdb
ST-LINK

☑ main.c [function: main] [type: Temporary]

| Name | Value | Description |
|---|---|---|
| General Registers | | General Purpose and FPU Re... |

```
  /* USER CODE END 2 */

  /* Infinite loop */
  /* USER CODE BEGIN WHILE */
  while (1)
  {
    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
  }
  /* USER CODE END 3 */
}

void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
  /* Prevent unused argument(s) compilation warning */
  UNUSED(GPIO_Pin);

  HAL_GPIO_TogglePin(LED2_GPIO_Port, LED2_Pin);
}


/**
  * @brief System Clock Configuration
  * @retval None
  */
void SystemClock_Config(void)
```

✓ No Fault Detected

Hard Fault Details

- Bus, memory management or usage fault (FORCED)
- Failed vector fetch (VECTBL)
- Debug event (DEBUGEVT)

Bus Fault Details

```
Embedded-C-Assignment-5.elf [Embedded C/C++ Application] C:/Program Files (x86)/Atollic/TrueSTUDIO for STM32 9.2.0/ARMTools/bin/arm-atollic-eabi-gdb (7.10.1.20160923)
```