Adjustable LED blinking speed using STM8 Nucleo-64 boards and STM8 Nucleo-32 boards

Introduction

The NUCLEO-8S208RB (built around the STM8S208RBT6 device) and NUCLEO-8L152R8 (built around the STM8L152R8T6 device) STM8 Nucleo-64 boards, and the NUCLEO-8S207K8 (built around the STM8S207K8T6C device) STM8 Nucleo-32 board allow the evaluation of the main features of all the microcontrollers in the STM8S Series and STM8L Series.

This application note provides a short description of the demonstration firmware *Discover*, which is preprogrammed in the Flash memory of the STM8S208RBT6, STM8L152R8T6 and STM8S207K8T6C microcontrollers.

This demonstration firmware makes use of the STM8S Series and STM8L Series basic 8-bit timer configured as a time-base generator to change the blinking speed of LED LDx(1) each time the user push-button is pressed (for STM8 Nucleo-64 boards) or jumper is present between CN3 PIN 4 (GND) and CN3 PIN 5 (D2) (for STM8 Nucleo-32 boards).

Once the STM8 Nucleo-64 board or STM8 Nucleo-32 board is powered-up through a standard USB cable connected to the host PC, LED LDx(1) blinks slowly, meaning that the programming has been completed successfully.

1: LDx = LD1 for STM8 Nucleo-64 boards

LDx = LD3 for STM8 Nucleo-32 boards

Table 1. Applicable products

Type	Part number
Evaluation boards	NUCLEO-8L152R8
	NUCLEO-8S207K8
	NUCLEO-8S208RB

Reference documents

- *STM8 Nucleo-64 boards* data brief (DB3591)
- *STM8L152R8T6 Nucleo-64 board* user manual (UM2351)
- *STM8S208RBT6 Nucleo-64 board* user manual (UM2364)
- *STM8 Nucleo-32 board* data brief (DB4017)
- *STM8 Nucleo-32 board (MB1442)* user manual (UM2391)

1 Application description

1.1 Hardware requirements

The following STM8 Nucleo-64 and STM8 Nucleo-32 on-board resources are used:

- LED LDx(1)
- User push-button (for STM8 Nucleo-64 boards), or jumper present between CN3 PIN 4 (GND) and CN3 PIN 5 (D2) (for STM8 Nucleo-32 boards)

No additional hardware is required to make this application software run on the STM8 Nucleo-64 or STM8 Nucleo-32 boards.

1: LDx = LD1 for STM8 Nucleo-64 boards
LDx = LD3 for STM8 Nucleo-32 boards

1.2 Application schematics

Refer to the documents below for implementation details:

- *STM8L152R8T6 Nucleo-64 board* user manual (UM2351)
- *STM8S208RBT6 Nucleo-64 board* user manual (UM2364)
- *STM8 Nucleo-32 board (MB1442)* user manual (UM2391)

1.3 Application principle

This application uses the 8-bit timer TIM4 as a time-base generator to control the blinking speed of LED LDx(1). Each time the STM8S Series or STM8L Series microcontroller detects an event on user push-button B1 (for STM8 Nucleo-64 boards) or jumper presence between GND and D2 PIN (for STM8 Nucleo-32 boards), the delay (a multiple of the TIM4 time-base) between each toggle of the LED is adjusted to change the blinking frequency accordingly.

At application start-up, the blinking period is configured to 1 second and LDx(1) toggles at this rate (every second). This configuration allows the visual check of the successful programming of the STM8S Series or STM8L Series device Flash memory.

Each time a push-button event is detected on user push-button B1 (for STM8 Nucleo-64 boards), or jumper presence is detected by reading the PD0 state (for STM8 Nucleo-32 boards), the LDx(1) blinking frequency is increased according to the settings described in Table 2 for LD1 and Table 3 for LD3.

1: LDx = LD1 for STM8 Nucleo-64 boards
LDx = LD3 for STM8 Nucleo-32 boards

STM8 Nucleo-64 boards

Table 2. LED LD1 configuration

User push-button B1	LD1	Toggling period
At application start-up (only)	Toggles	1 s
1st press	Toggles	200 ms
2nd press	Toggles	100 ms
3rd press	Toggles	40 ms

STM8 Nucleo-32 boards

Table 3. LED LD3 configuration

Jumper presence	LD3	Toggling period
At application start-up	Toggles	1 s
Jumper removed	Toggles	100 ms

2 Software description

2.1 STM8 Nucleo-64 boards with STM8S Series microcontrollers

This application software uses the STM8S Series standard firmware library to control general purpose functions and peripherals:

- **Clock (CLK)**

  The clock control enables and delivers the correct clock frequency to the CPU and to the peripherals.

  At power on, the master clock source is automatically selected as HSI clock with prescaler division factor equal to 1.

  This setup is not changed by the application code: f_{MASTER} = 16 MHz.

- **GPIOs**

  The GPIOs drive the MCU I/Os to interface with external hardware.

  They configure port PC5 as output push-pull high to drive LED LD1. They configure PE4 as input pull-up with external interrupt to interface with the user push-button B1.

  This interrupt is controlled by the interrupt controller.

- **EXTI**

  The external interrupt controller is configured to control the external interrupt sensitivity on the push-button connected to PC5.

  It is configured to trigger an interrupt each time a falling edge (and only a falling edge) is detected on PC5.

- **TIM4**

  TIM4 is a basic 8-bit timer used as a 1 ms time base. This time base is used by the application to control LD1 blinking speed.

  TIM4 is configured by the application as follows:

  – Up-counting mode
  – TIM4_PSCR = 7
  – Counting frequency : Fck_cnt = F_master / 2^PSCR[2:0] = 16 MHz / 128 = 125 kHz
  – TIM4_ARR = 0x7C (124 cycles)

2.2 STM8 Nucleo-32 boards with STM8S Series microcontrollers

This application software uses the STM8S Series standard firmware library to control general purpose functions and peripherals:

- **Clock (CLK)**

  The clock control enables and delivers the correct clock frequency to the CPU and to the peripherals.

  At power on, the master clock source is automatically selected as HSI clock with prescaler division factor equal to 1.

  This setup is not changed by the application code: f_{MASTER} = 16 MHz.

- **GPIOs**

  The GPIOs drive the MCU I/Os to interface with external hardware.

  They configure port PC5 as output push-pull high to drive LED LD3. They configure PD0 as input pull-up.

- **TIM4**

  TIM4 is a basic 8-bit timer used as a 1 ms time base. This time base is used by the application to control LD3 blinking speed.

  TIM4 is configured by the application as follows:

  – Up-counting mode
  – TIM4_PSCR = 7
  – Counting frequency : Fck_cnt = F_master / 2^PSCR[2:0] = 16 MHz / 128 = 125 kHz
  – TIM4_ARR = 0x7C (124 cycles)

2.3 STM8 Nucleo-64 boards with STM8L Series microcontrollers

This application software uses the STM8L Series standard firmware library to control general purpose functions and peripherals:

- **Clock (CLK)**

  The clock control enables and delivers the correct clock frequency to the CPU and to the peripherals.

  At power on, the master clock source is automatically switched to HSE_bypasse with prescaler division factor equalt to 1.

  This setup is not changed by the application code: f_{MASTER} = 8 MHz.

- **GPIOs**

  The GPIOs drive the MCU I/Os to interface with external hardware.

  They configure port PB5 as output push-pull high to drive LED LD1. They configure PG4 as floating input with external interrupt to interface with the user push-button B1.

  This interrupt is controlled by the interrupt controller.

- **EXTI**

  The external interrupt controller is configured to control the external interrupt sensitivity on the push-button connected to PB5.

  It is configured to trigger an interrupt each time a falling edge (and only a falling edge) is detected on PB5.

- **TIM4**

  TIM4 is a basic 8-bit timer used as a 1 ms time base. This time base is used by the application to control LD1 blinking speed.

  TIM4 is configured by the application as follows:

  – Up-counting mode
  – TIM4_PSCR = 5
  – Counting frequency: Fck_cnt = F_master / 2^PSCR[3:0] = 8 MHz / 32 = 250 kHz
  – TIM4_ARR = 0xF9 (249 cycles)

2.4 Application software flowcharts

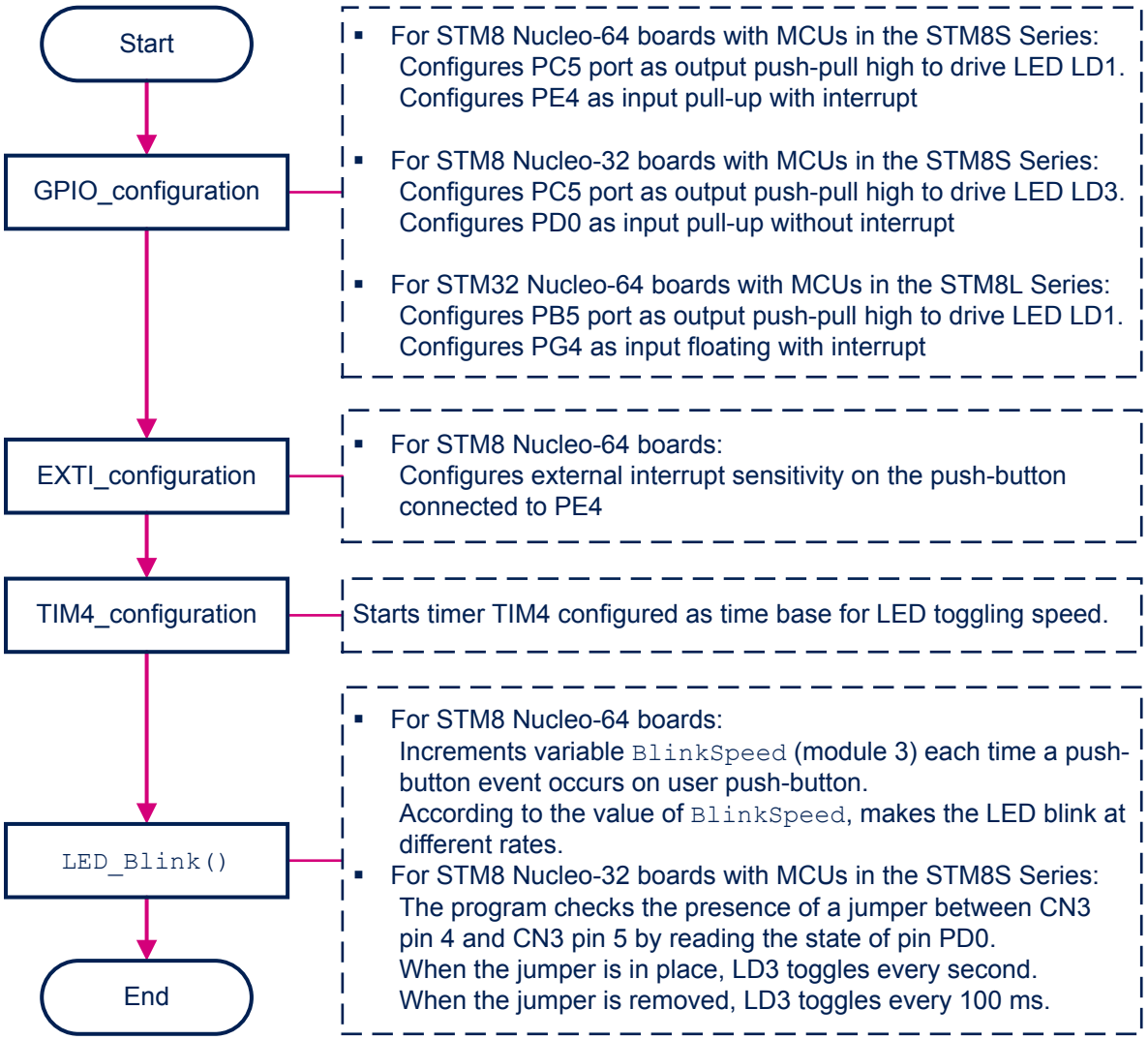
This section gives an overview of the application software main loop as well as of the function that controls LDx(1) blinking speed.

1: LDx = LD1 for STM8 Nucleo-64 boards
LDx = LD3 for STM8 Nucleo-32 boards

2.4.1 Main loop flowchart

Figure 1 shows the flowchart of the application software main loop.

Figure 1. Main loop flowchart



2.4.2 LED_Blink() flowchart

STM8 Nucleo-64 boards

For STM8 Nucleo-64 boards, Figure 2 shows the detailed flowchart of the `LED_Blink()` function part of the main routine. The `LED_Blink()` function implements the algorithm that controls the LED blinking speed depending on the state selected by the push-button.

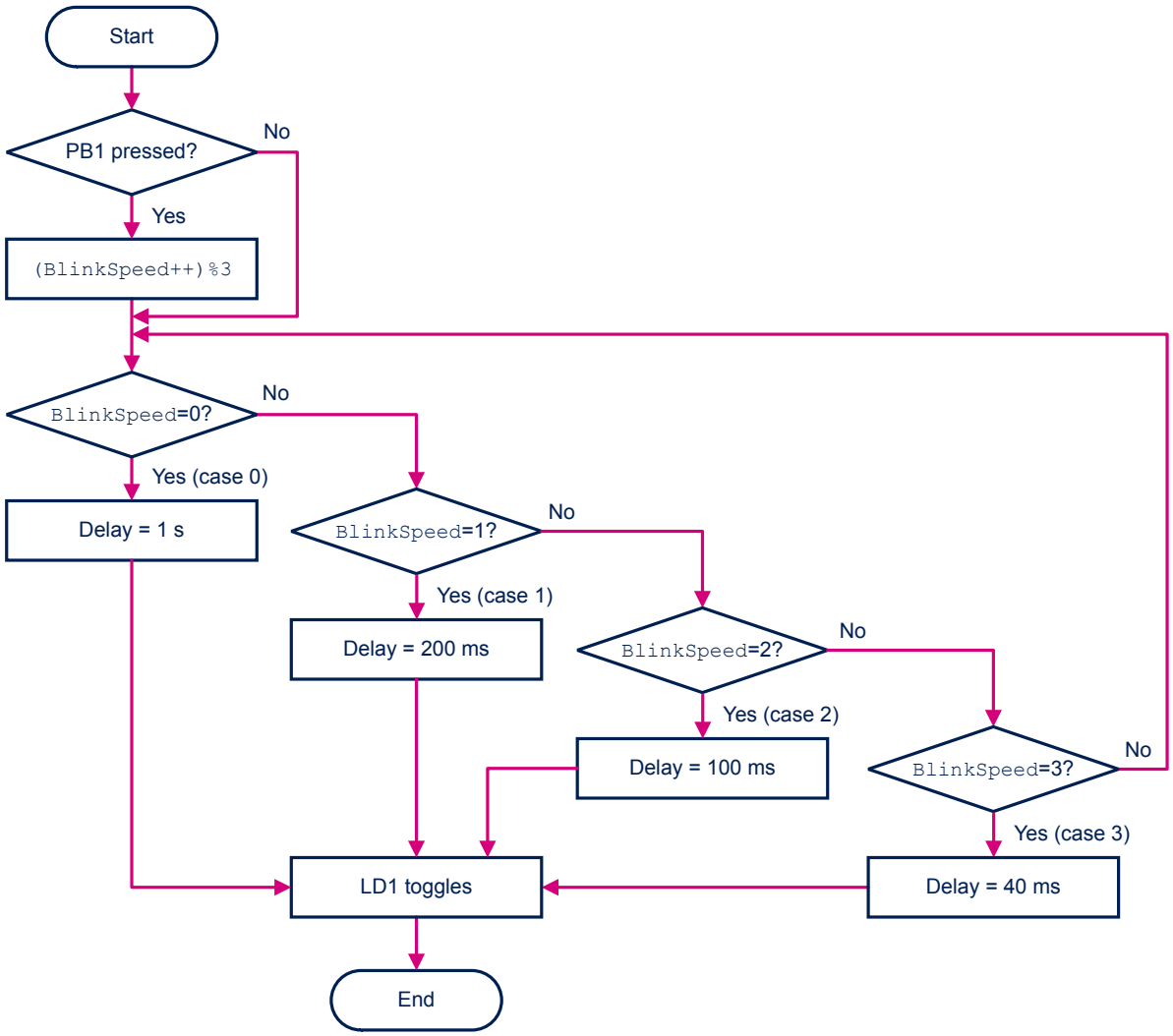
At application start-up, the state machine is in its default state, LD1 toggles every 1 s, then `BlinkSpeed` is incremented at each push-button detection. In state 1 and state 2 of the state machine, the programmed blinking frequency is changed.

The blinking frequency of LED LD1 is defined using the 8-bit timer TIM4 configured as a time-base generator to assert an update interrupt every 1 ms.

The toggling period depends on the value of `PeriodNumber`. This variable defines the number of times the timer interrupt is to be asserted (reach overflow) before toggling LED LD1.

As a result, the LED blinking frequency can only be a multiple of 1 ms (refer to Table 2 in Section 1.3 Application principle).

Figure 2. LED_Blink() flowchart for STM8 Nucleo-64 boards



STM8 Nucleo-32 boards

For STM8 Nucleo-32 boards, Figure 3 shows the detailed flowchart of the `LED_Blink()` function part of the main routine. The `LED_Blink()` function implements the algorithm that controls the LED blinking speed depending on the state selected by the jumper position.

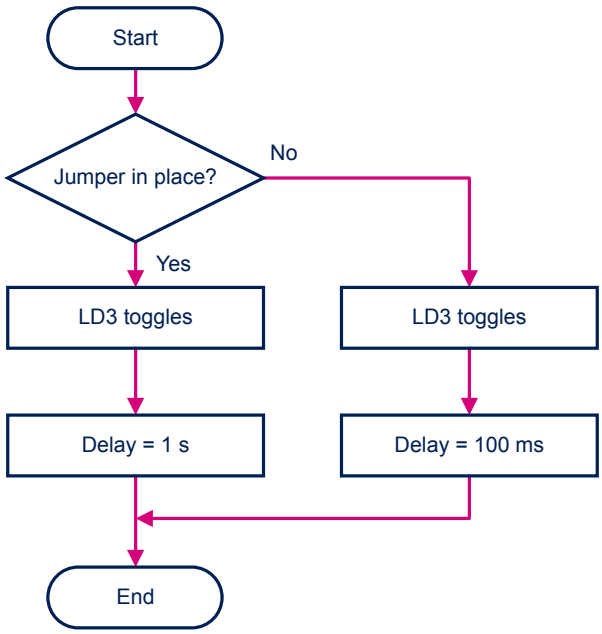
The program checks the presence of the jumper between CN3 PIN 4 and CN3 PIN5: if the jumper is present, LD3 toggles every 1 s, else it blinks every 100 ms.

LED LD3 blinking frequency is defined using the 8-bit timer TIM4 configured as a time-base generator to assert an update interrupt every 1 ms.

The toggling period depends on the value of `PeriodNumber`. This variable defines the number of times the timer interrupt is to be asserted (reach overflow) before toggling LED LD3.

As a result, the LED blinking frequency can only be a multiple of 1 ms (refer to Table 3 in Section 1.3 Application principle).

Figure 3. LED_Blink() flowchart for STM8 Nucleo-32 boards



Revision history

Table 4. **Document revision history**

Date	Version	Changes
27-Jun-2018	1	Initial release.
5-Dec-2019	2	Added board NUCLEO-8S207K8. Updated the entire document to differentiate settings and behaviours between STM8 Nucleo-64 boards and STM8 Nucleo-32 boards.

Contents

1 **Application description** 2
1.1 Hardware requirements 2
1.2 Application schematics 2
1.3 Application principle 2
2 **Software description** 4
2.1 STM8 Nucleo-64 boards with STM8S Series microcontrollers 4
2.2 STM8 Nucleo-32 boards with STM8S Series microcontrollers 4
2.3 STM8 Nucleo-64 boards with STM8L Series microcontrollers 4
2.4 Application software flowcharts 6
2.4.1 Main loop flowchart 6
2.4.2 LED_Blink() flowchart 6
Revision history 9

List of tables

Table 1. Applicable products . . . 1
Table 2. LED LD1 configuration . . . 2
Table 3. LED LD3 configuration . . . 3
Table 4. Document revision history . . . 9

List of figures

Figure 1. Main loop flowchart 6
Figure 2. LED_Blink() flowchart for STM8 Nucleo-64 boards 7
Figure 3. LED_Blink() flowchart for STM8 Nucleo-32 boards 8