**(CDD)**

LED String Animation

Contents

[**1.** **Document History** 3](#_Toc33138863)

[**1.1.** **Revision History Table** 3](#_Toc33138864)

[**1.2.** **Current** **Document** **Status** 3](#_Toc33138865)

[**2.** **Project Description** 3](#_Toc33138866)

[**3.** **Block Diagram** 4](#_Toc33138867)

[**4.** **Feature Description** 5](#_Toc33138868)

[**4.1.** **Start Up Requirements** 5](#_Toc33138869)

[**4.2.** **Tail Function Requirements** 8](#_Toc33138870)

[**4.3. Turn Indicator (TI) Requirements** 10](#_Toc33138871)

[**5.** **Reference Documents Table** 13](#_Toc33138872)

# **Document History**

## **Current Document Status**

|  |  |  |  |
| --- | --- | --- | --- |
| Version | Status | Author | **Date** |
| 1.0 | Draft | Caroline | 07/03/2020 |
| 1.1 | Draft | Caroline | 08/03/2020 |
| 1.2 | Draft | Hesham | 09/03/2020 |
| 1.3 | Draft | Hesham – Mirna | 10/03/2020 |

## **Revision History Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Version | Author | Date | Change |
| 1.0 | Caroline | 07/03/2020 | Initial Creation |
| 1.1 | Caroline | 08/03/2020 | Adding LED APIs’ flowcharts. |
| 1.2 | Hesham | 09/03/2020 | Flowcharts of SWITCH APIs are added. |
| 1.3 | Hesham – Mirna | 10/03/2020 | Flowcharts of LED\_Animation APIs are added. |

# **Reference Documents Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Ref. number | Doc. Name | Version | Status |
| 1 | LED\_String\_GDD | 1.7 | proposed |

# **Project Description**

The project is composed of 3 sets of LED Strings Simulating the animation of LEDs in a Car, One set is named “Tail” and it simulates the animation of car’s back LEDs while the other 2 sets are named “Left TI” and “Right TI” is simulating the animation of left and right turn indicator in a car.

Each one of the 3 functions operates based on input signals coming from 3 switches named “Tail Switch”, “Left TI” and “Right TI” respectively in addition to “Welcome Mode” which shall operates one of 2 different modes based on the status of the mode switch. System layout is as shown in **Figure 1** below.



Figure 1: layout of the system

# **Software Context Diagram**

LEDs Manager

Switches Status

Handler

LEDs Status

LED Handler

Switch Manager

# **APIs**

* Delay

|  |  |  |
| --- | --- | --- |
| Name | void DELAY\_ms(uint32\_t time) | |
| Parameters | uint32\_t time | 0-4,294,967,295 |
| Return Value | Void | |
| Description | Delays for a certain amount of time measured in milliseconds | |
| Req ID | Req\_ PO5\_LSAN\_1\_LED\_STRING\_GDD | |

* Std\_Types

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t | |
| Type | Enumeration | |
| Range | OK | 0 |
| NOK | 1 |
| Description | This User-defined data structure shall hold the Status of the returned error level form each API indicating success or failure of function completion and it should be either OK or Not OK. | |
| Req ID | Req\_ PO5\_LSAN\_2\_LED\_STRING\_GDD | |

* LED\_Animation
  + User-defined Data Types

|  |  |
| --- | --- |
| Name | LEDString\_t |
| Type | Structure |
| Range | - |
| Description | Data structure containing the set of configuration parameters required for setting the leds status |
| Req ID | Req\_ PO5\_LSAN\_3\_LED\_STRING\_GDD |

|  |  |  |
| --- | --- | --- |
| Name | LED\_Animation\_Tail\_State | |
| Type | Enumeration | |
| Range | LED\_ANIMATION\_TAIL\_ON | 0 |
| LED\_ANIMATION\_TAIL\_OFF | 1 |
| Description | The state of the tail LEDs | |
| Req ID | Req\_ PO5\_LSAN\_4\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | LED\_Animation\_Running\_Mode | |
| Type | Enumeration | |
| Range | LED\_ANIMATION\_MODE\_WELCOME\_1 | 0 |
| LED\_ANIMATION\_MODE\_WELCOME \_2 | 1 |
| LED\_ANIMATION\_MODE\_TI\_1 | 2 |
| LED\_ANIMATION\_MODE\_TI\_2 | 3 |
| LED\_ANIMATION\_MODE\_NONE | 4 |
| Description | The state of the TI LEDs | |
| Req ID | Req\_ PO5\_LSAN\_5\_LED\_STRING\_GDD | |

* + Function definitions

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Animation\_Init(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Initializes all the LEDs and Switches required for the application | |
| Flow Chart |  | |
| Req ID | Req\_ PO5\_LSAN\_6\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Animation\_SetFlags(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Reads all the switches status and sets all the flags that represents the LEDs animation | |
| Flow Chart |  | |
| Req ID | Req\_ PO5\_LSAN\_7\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Animation\_StartAnimationMode(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Reads all the flags status and starts the suitable animation mode according to switches status | |
| Flow Chart |  | |
| Covers | Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 1\_02-V02  Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 2\_02-V02 | |
| Req ID | Req\_ PO5\_LSAN\_8\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Animation\_SetTailLeds(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Sets the tail leds on and off according to the tail flag state | |
| Flow Chart |  | |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_03\_V01]  [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_04\_V01] | |
| Req ID | Req\_ PO5\_LSAN\_9\_LED\_STRING\_GDD | |

|  |  |
| --- | --- |
| Name | Void LED\_Animation\_RunModeOne(void) |
| Parameters | Void |
| Return Value | Void |
| Description | Runs the animation of mode 1 which is described in the LED\_STRING\_ANIMATION\_CYRS |
| Flow Chart |  |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_01\_V01] |
| Req ID | Req\_ PO5\_LSAN\_10\_LED\_STRING\_GDD |

|  |  |
| --- | --- |
| Name | Void LED\_Animation\_RunModeTwo(void) |
| Parameters | Void |
| Return Value | Void |
| Description | Runs the animation of mode 2 which is described in the LED\_STRING\_ANIMATION\_CYRS |
| Flow Chart |  |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_02\_V01] |
| Req ID | Req\_ PO5\_LSAN\_11\_LED\_STRING\_GDD |

|  |  |
| --- | --- |
| Name | Void LED\_Animation\_RunTI\_Right(void) |
| Parameters | Void |
| Return Value | Void |
| Description | Runs the animation of TI right mode which is described in the LED\_STRING\_ANIMATION\_CYRS until the TI right switch is released |
| Flow Chart |  |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_05\_V02]  [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_06\_V01] |
| Req ID | Req\_ PO5\_LSAN\_12\_LED\_STRING\_GDD |

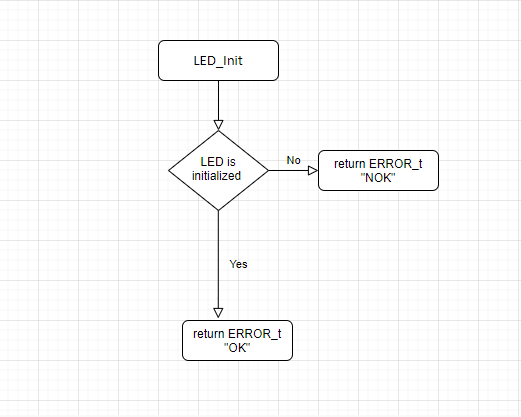
|  |  |
| --- | --- |
| Name | Void LED\_Animation\_RunTI\_Left(void) |
| Parameters | Void |
| Return Value | Void |
| Description | Runs the animation of TI left mode which is described in the LED\_STRING\_ANIMATION\_CYRS until the TI left switch is released |
| Flow Chart |  |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_07\_V02]  [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_08\_V01] |
| Req ID | Req\_ PO5\_LSAN\_13\_LED\_STRING\_GDD |

* LED
  + User-defined Data Types

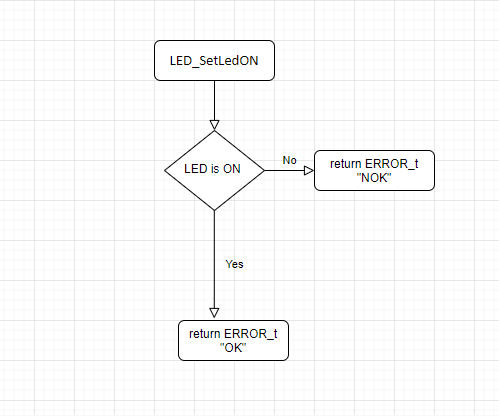
|  |  |  |
| --- | --- | --- |
| Name | LED\_t | |
| Type | Structure | |
| Attributes | Uint8\_t pinNum | 0-8 |
| Uint8\_t portName | ‘A’-‘D’ |
| Uint8\_t activeState | 0-1 |
| Description | This User-defined data structure shall hold the configurations of the LED pin. | |
| Req ID | Req\_ PO5\_LSAN\_14\_LED\_STRING\_GDD | |

* + Function definitions

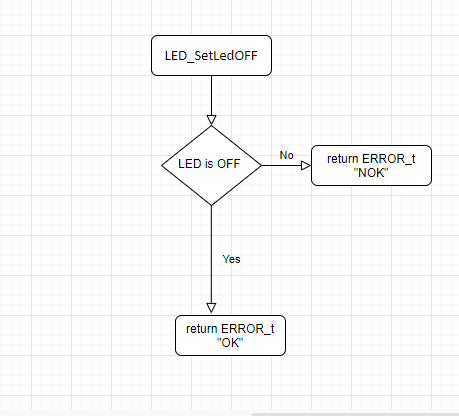
|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Init(uint8\_t ledNumber) | |
| Parameters | Uint8\_t ledNumber | 0-255 |
| Return Type | ERROR\_t | 0-1 |
| Description | This API shall take the led number of a certain led and initialize DIO pins according to the data included in that structure like the pin number and port name. This API should return OK in case of successful pin configuration and NOK in case of invalid input configurations. | |
| Req ID | Req\_ PO5\_LSAN\_15\_LED\_STRING\_GDD | |



|  |  |  |
| --- | --- | --- |
| Name | ERROR\_T LED\_SetLedON(uint8\_t ledNumber) | |
| Parameters | Uint8\_t ledNumber | 0-255 |
| Return Value | ERROR\_t | 0-1 |
| Description | Turn a specific LED ON | |
| Covers | Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 1\_02-V02  Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 2\_02-V02  Req\_ PO5\_LSAN\_ SRS\_Tail function ON\_02-V02  Req\_ PO5\_LSAN\_ SRS\_Right Turn Indicator On\_02-V01  Req\_ PO5\_LSAN\_ SRS\_ Left Turn Indicator On\_02-V01 | |
| Req ID | Req\_ PO5\_LSAN\_16\_LED\_STRING\_GDD | |



|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_ SetLedOFF(uint8\_t ledNumber) | |
| Parameters | Uint8\_t ledNumber | 0-255 |
| Return Value | ERROR\_t | 0-1 |
| Description | Turn a specific LED OFF | |
| Covers | Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 1\_02-V02  Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 2\_02-V02  Req\_ PO5\_LSAN\_ SRS\_Tail function OFF\_01-V02  Req\_ PO5\_LSAN\_ SRS\_Right Turn Indicator On\_02-V01  Req\_ PO5\_LSAN\_ SRS\_ Left Turn Indicator On\_02-V01  Req\_ PO5\_LSAN\_ SRS\_ Left Turn Indicator On\_02-V01  Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_05\_V02 | |
| Req ID | Req\_ PO5\_LSAN\_17\_LED\_STRING\_GDD | |



* Switch
* User-defined Data Types

|  |  |  |
| --- | --- | --- |
| Name | SWITCH\_t | |
| Type | Structure | |
| Attributes | Uint8\_t pinNum | 0-8 |
| Uint8\_t portName | ‘A’-‘D’ |
| Uint8\_t activeState | 0-1 |
| Uint8\_t mode | 0-2 |
| Description | This User-defined data structure shall hold the configurations of the switch pin. | |
| Req ID | Req\_ PO5\_LSAN\_18\_LED\_STRING\_GDD | |

* Functions’ Description

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t SWITCH\_Init(uint8\_t switchNumber) | |
| Parameters | Uint8\_t switchNumber | 0-255 |
| Return Type | ERROR\_t | 0-1 |
| Description | This API shall take the switch number of a certain switch and initialize DIO pins according to the data included in that structure like the pin number and port name as well as the mode of switch connection either input high impedence, pull-up or pull-down configurations. This API should return OK in case of successful pin configuration and NOK in case of invalid input configurations. | |
| Flow Chart | **C:\Users\User\Downloads\Switch_Init.png** | |
| Req ID | Req\_ PO5\_LSAN\_19\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t SWITCH\_Read(uint8\_t switchNum, uint8\_t\* status) | |
| Parameters | Uint8\_t switchNum | 0-255 |
| Uint8\_t\* status | Address of (0-1) |
| Return Type | ERROR\_t | 0-1 |
| Description | This API shall read the status of a certain switch and assign its status (High/Low) to the pointer taken and return indication of Success/Failure of the reading operation or the validity of inputs. | |
| Flow Chart | **C:\Users\User\Downloads\Switch_Read2.png** | |
| Covers | Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 1/2\_01-V02  Req\_ PO5\_LSAN\_ SRS\_Start welcome mode 2\_01-V02  Req\_ PO5\_LSAN\_ SRS\_Tail function(ON/OFF)\_01-V02  Req\_ PO5\_LSAN\_ SRS\_Right Turn Indicator On\_01-V01  Req\_ PO5\_LSAN\_ SRS\_ Left Turn Indicator On\_02-V01 | |
| Req ID | Req\_ PO5\_LSAN\_20\_LED\_STRING\_GDD | |

* DIO
  + Functions’ Description

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t DIO\_SetPinDir(uint8\_t pinNum, uint8\_t portName, uint8\_t direction) | |
| Parameters | Uint8\_t pinNum | 0-8 |
| Uint8\_t portName | ‘A’-‘D’ |
| Uint8\_t direction | 0-1 |
| Return Value | ERROR\_t | 0-1 |
| Description | Configures the Pin Direction Input/Output | |
| Req ID | Req\_ PO5\_LSAN\_21\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t DIO\_SetPinVal(uint8\_t pinNum, uint8\_t portName, uint8\_t value) | |
| Parameters | Uint8\_t pinNum | 0-8 |
| Uint8\_t portName | ‘A’-‘D’ |
| Uint8\_t value | 0-1 |
| Return Value | ERROR\_t | 0-1 |
| Description | Configures the Pin Value High/ Low | |
| Req ID | Req\_ PO5\_LSAN\_22\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t DIO\_GetPinVal(uint8\_t pinNum, uint8\_t portName, uint8\_t\* value) | |
| Parameters | Uint8\_t pinNum | 0-8 |
| Uint8\_t portName | ‘A’-‘D’ |
| Uint8\_t\* value | Address of (0-1) |
| Return Value | ERROR\_t | 0-1 |
| Description | Reads the Pin Value High/Low | |
| Req ID | Req\_ PO5\_LSAN\_23\_LED\_STRING\_GDD | |

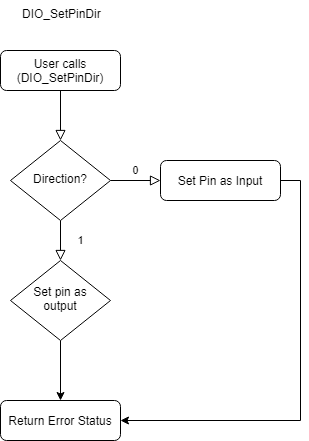
* External Interrupt

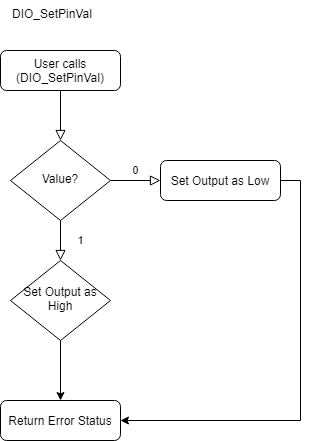
|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t E\_IRQ\_Init(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Initializes the external interrupt pins configured. | |
| Req ID | Req\_ PO5\_LSAN\_24\_LED\_STRING\_GDD | |

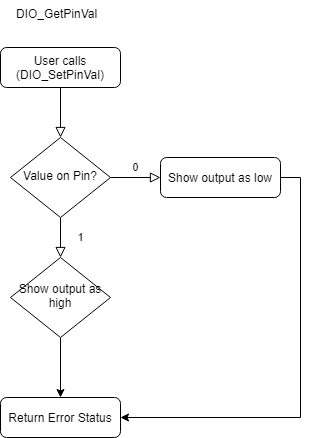
|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t E\_IRQ\_SetCallback(Void (\*callback)(void)) | |
| Parameters | Void (\*callback)(void) | - |
| Return Value | ERROR\_t | 0-1 |
| Description | Sets The Callback Function | |
| Req ID | Req\_ PO5\_LSAN\_25\_LED\_STRING\_GDD | |

# Flowcharts

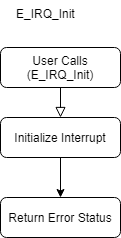
* DIO

DIO\_SetPinDir:

DIO\_SetPinVal:

DIO\_GetPinVal:

* **IRQ**

IRQ\_Init:

IRQ\_SetCallback:

