**(GDD)**

LED String Animation

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# **Document History**

## **Current Document Status**

|  |  |  |  |
| --- | --- | --- | --- |
| Version | Status | Author | **Date** |
| 1.0 | Draft | Caroline - Mark | 28/02/2020 |
| 1.1 | Draft | Mahmoud Hamdy | 29/02/2020 |
| 1.2 | Draft | Caroline | 29/02/2020 |
| 1.3 | Draft | Mirna | 29/02/2020 |
| 1.4 | Draft | Hesham | 29/02/2020 |
| 1.5 | Draft | Mark | 29/02/2020 |
| 1.6 | Proposed | Mahmoud Gamal | 01/03/2020 |
| 1.7 | Proposed | Mark | 06/03/2020 |
| 1.8 | Proposed | Mahmoud Gamal | 07/03/2020 |

## **Revision History Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Version | Author | Date | Change |
| 1.0 | Caroline - Mark | 28/02/2020 | Initial Creation |
| 1.1 | Mahmoud Hamdy | 29/02/2020 | Added timer component to architecture and to APIs |
| 1.2 | Caroline | 29/02/2020 | Added DIO APIs |
| 1.3 | Mirna | 29/02/2020 | Added LED\_Animation\_voidSetLedON & LED\_Animation\_voidSetLedOFF |
| 1.4 | Hesham | 29/02/2020 | Added Description to the APIs of the SWITCH Driver Component in HAL layer. |
| 1.5 | Mark | 29/02/2020 | Units, Block Diagrams, Input Arguments and Return Types Modified |
| 1.6 | Mahmoud Gamal | 01/03/2020 | Adding the covered requirments from the SRS |
| 1.7 | Mark | 06/03/2020 | Updating APIs and fixing minor issues |
| 1.8 | Mahmoud Gamal | 07/03/2020 | Adding Req ID |

# **Reference Documents Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Ref. number | Doc. Name | Version | Status |
| 1 | LED\_String\_SRS | 1.1 | 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

# **Input Output Signals**

* Mode Signal

Mode

Handler

LED Animation Algorithm

Signal\_Mode

Signal\_LEDsData

LEDs

Switch\_Pressed

Mode

Switch

|  |  |  |
| --- | --- | --- |
| Signal | Range | Unit |
| Signal\_Mode | 0-1 | - |
| Signal\_LEDsData | 0-1 | - |

* TIR Signal

Signal\_LEDsData

Signal\_TIR\_Mode

LED Animation Algorithm

LEDs

TIR

Handler

Switch\_Pressed

TIR

Switch

|  |  |  |
| --- | --- | --- |
| Signal | Range | Unit |
| Signal\_TIR\_Mode | 0-1 | - |
| Signal\_LEDsData | 0-1 | - |

* TIL Signal

Signal\_LEDsData

Signal\_TIL\_Mode

LED Animation Algorithm

LEDs

TIL

Handler

Switch\_Pressed

TIL

Switch

|  |  |  |
| --- | --- | --- |
| Signal | Range | Unit |
| Signal\_TIL\_Mode | 0-1 | - |
| Signal\_LEDsData | 0-1 | - |

* Tail Signal

Signal\_LEDsData

Signal\_Tail\_Mode

LED Animation Algorithm

LEDs

Tail

Handler

Switch\_Pressed

Tail

Switch

|  |  |  |
| --- | --- | --- |
| Signal | Range | Unit |
| Signal\_Tail\_Mode | 0-1 | - |
| Signal\_LEDsData | 0-1 | - |

# **Software Features**

Output Feature

LEDs Control Features

Input Feature

Switches\_Status\_Signal

Signal\_LEDsData

Signal\_Mode

Signal\_Tail\_Mode

Signal\_TIR\_Mode

Signal\_TIL\_Mode

Microcontroller Feature

# **Static Architecture**

APPLICATION

LIB

Std\_Types

LED\_Animation

HAL

Switch

LED

Delay

MCAL

External Interrupt

Bit\_Man

DIO

# **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 | |
| 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 | |
| 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 | |
| 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 | |
| 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 | ERROR\_t LED\_Animation\_RunModeOne(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Runs the animation of mode 1 which is described in the LED\_STRING\_ANIMATION\_CYRS | |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_01\_V01] | |
| Req ID | Req\_ PO5\_LSAN\_10\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Animation\_RunModeTwo(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Runs the animation of mode 2 which is described in the LED\_STRING\_ANIMATION\_CYRS | |
| Covers | [Req\_ PO5\_LSAN\_ LED STRING ANIMATION\_02\_V01] | |
| Req ID | Req\_ PO5\_LSAN\_11\_LED\_STRING\_GDD | |

|  |  |  |
| --- | --- | --- |
| Name | ERROR\_t LED\_Animation\_RunTI\_Right(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Runs the animation of TI right mode which is described in the LED\_STRING\_ANIMATION\_CYRS until the TI right switch is released | |
| 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 | ERROR\_t LED\_Animation\_RunTI\_Left(void) | |
| Parameters | Void | |
| Return Value | ERROR\_t | 0-1 |
| Description | Runs the animation of TI left mode which is described in the LED\_STRING\_ANIMATION\_CYRS until the TI left switch is released | |
| 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 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. | |
| 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. | |
| 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 | |