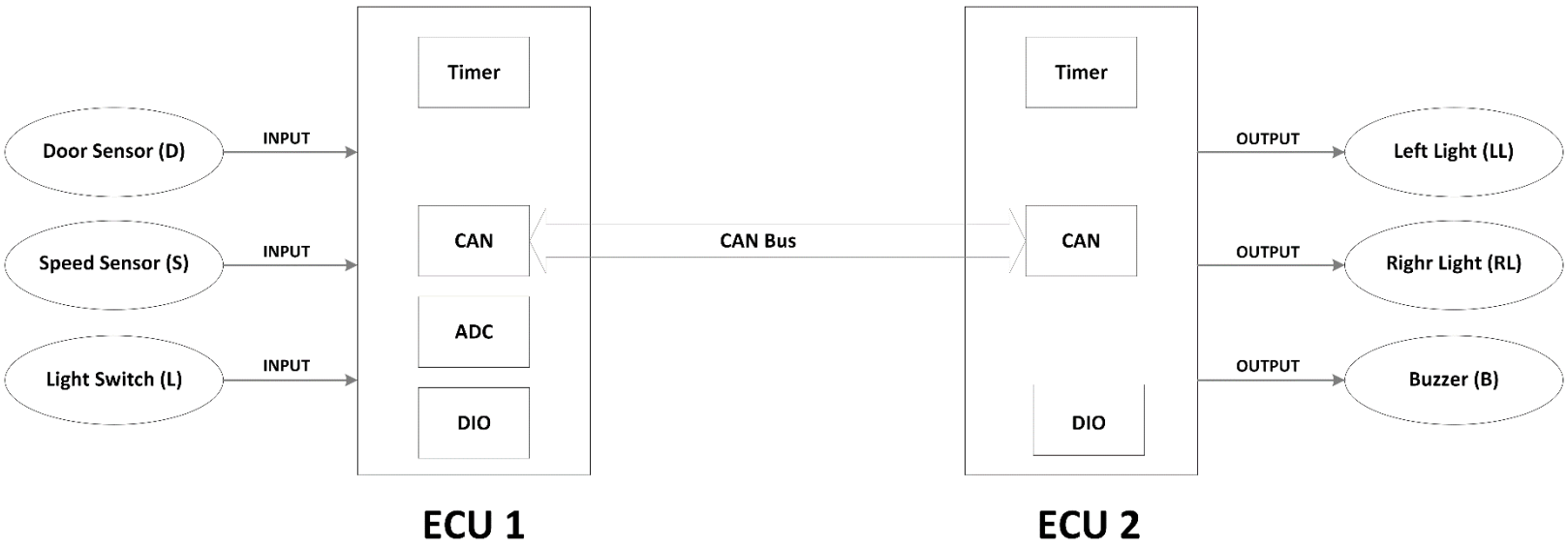
Static Design

By: Hassan Mahmoud

Schematic (Block Diagram)



ECU 1

Layered Architecture

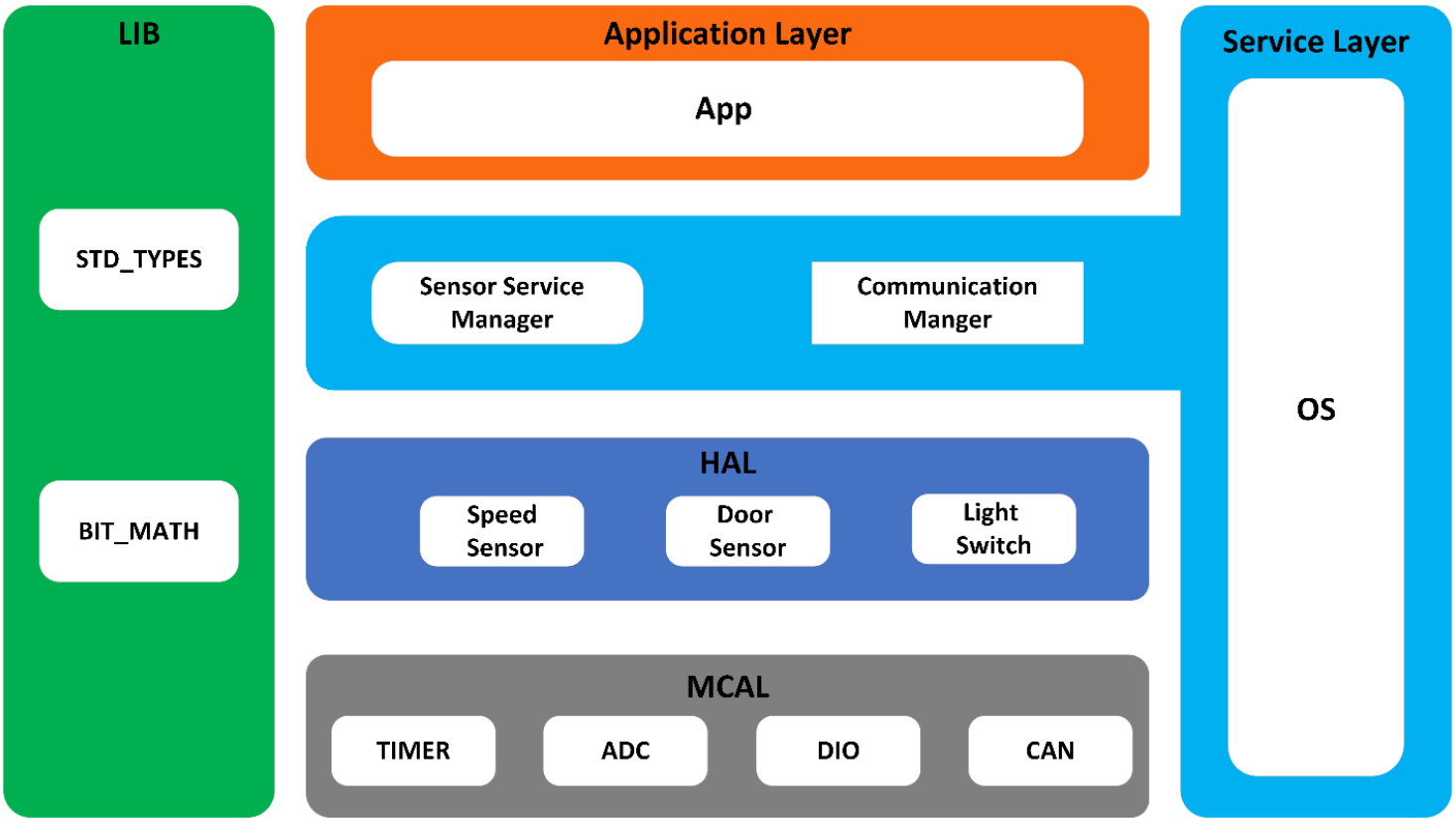


Figure 1: ECU1 Layered Architecture

ECU1 components and APIs

-> MCAL Drivers

- DIO Driver:

Name	Pin_Direction
Type	Enum
Range	INPUT, OUTPUT
Description	Pin direction whether input or output

Name	Pin_Value
Type	Enum
Range	LOW, HIGH
Description	Pin Value whether low or high

Name	PORTS
Type	Enum
Range	PORTA ---> PORTF
Description	Choosing port Number

Name	MDIO_Init	
Arguments	Input	Void
	Output	N/A
Return	OK	Void
	NOK	
Description	Initialize DIO peripheral	
Type	Synchronous / Non-Reentrant	

Name	MDIO_SetPinDirection		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
		Direction	Pin_Direction
		choose pin direction (Input/Output)	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Define the direction of a pin (Input/Output)		
Type	Synchronous / Non-Reentrant		

Name	MDIO_SetPinValue		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
		Value	Pin_Value
		choose pin Value (High/Low)	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Set the logical state of the pin (High/Low)		
Type	Synchronous / Non-Reentrant		

Name	MDIO_TogglePin		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Toggle the logical state of a pin High to Low and vice versa		
Type	Synchronous / Non-Reentrant		

Name	MDIO_ReadPin		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
	Output	N/A	
Return	OK	-	Pin_Value
	NOK	Void	
Description	Read the logical state of a pin High or Low		
Type	Synchronous / Non-Reentrant		

• ADC Driver:

Name	ADC_ID
Type	Enum
Range	ADC0, ADC1
Description	Choose ADC to work

Name	ADC_Channel
Type	Enum
Range	PE3, PE2, PE1, PE0, PD3, PD2, PD1, PD0, PE5, PE4, PB4, PB5
Description	Choose ADC channel

Name	MADC_Init	
Arguments	Input	Void
	Output	N/A
Return	OK	Void
	NOK	
Description	Initialize ADC peripheral	
Type	Synchronous / Non-Reentrant	

Name	MADC_Convert		
Arguments	Input	ADC_n	ADC_ID
		Choose ADC peripheral	
		Cahnnel_n	ADC_Channel
		Choose channel to convert	
	Output	N/A	
Return	OK	-	U32
	NOK	Void	
Description	Start the conversion of a defined channel and get its reading		
Type	Synchronous / Non-Reentrant		

• CAN Driver:

Name	BitRate_Config_Struct
Type	Struct
Elements	uint8 BRP uint8 SJW uint8 TSEG1 uint8 TSEG2
Description	Configure bit rate by the user

Name	CAN_Config_Struct
Type	Struct
Elements	uint8 CANID uint8 MODE uint32 BitRate
Description	Choose the mode of CAN

Name	CAN_MSG_Object
Type	Struct
Elements	u32 MsgID u8 MsgObjectNumber u8 MsgIDExtension u8 MsgLen u32 MsgIDMask
Description	Message object structure

Name	CAN_Init		
Arguments	Input	*ConfigPtr	CAN_Config_Struct
		Input configurations for CAN Bus	
		*Bit_Rate_Ptr	BitRate_Config_Struct
		Input configurations for Bit Rate	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for initializing the CAN drive		
Type	Synchronous / Non-Reentrant		

Name	CAN_Transmit_SetObject		
Arguments	Input	CAN_ID	U8
		Choose channel	
		*MsgObject	CAN_MSG_Object
		Struct that holds the message	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for configuring transmit message object		
Type	Synchronous / Non-Reentrant		

Name	CAN_Transmit_Object		
Arguments	Input	CAN_ID	U8
		Choose channel	
		MsgObjNum	U8
		Message object number from 1 to 32	
		*data_pt	U8
		Points to data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for transmitting message object		
Type	Synchronous / Non-Reentrant		

Name	CAN_Receive_SetObject		
Arguments	Input	CAN_ID	U8
		Choose channel	
		*MsgObject	CAN_MSG_Object
		Struct that holds the message	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for configuring receive message object		
Type	Synchronous / Non-Reentrant		

Name	CAN_Receive_Object		
Arguments	Input	CAN_ID	U8
		Choose channel	
		MsgObjNum	U8
		Message object number from 1 to 32	
		*data_pt	U8
		Points to data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for receiving message object		
Type	Synchronous / Non-Reentrant		

• TIMER Driver:

Name	GPT_ChannelID
Type	Enum
Range	Channel_0 ---> Channel_11
Description	Choose the GPT channel

Name	GPT_Mode
Type	Enum
Range	GPT_ONE_SHOT, GPT_MODE_PERIODIC
Description	Choose the GPT channel

Name	GPT_TIM_TYPE
Type	Enum
Range	GPT_PREDEF_TIMER_1US_16BIT = 4 GPT_PREDEF_TIMER_1US_24BIT = 4 GPT_PREDEF_TIMER_1US_32BIT = 0
Description	Choose the GPT channel

Name	GPT_ConfigType
Type	Struct
Elements	Gpt_ChannelID Channel_ID Gpt_Mode Channel_Mode GPT_TIM_TYPE Timer_Type
Description	Configuration of Timer

Name	MGPT_Init

Arguments	Input	ConfigPtr	GPT_ConfigType
		Struct that contains configurations	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialize GPT peripheral		
Type	Synchronous / Non-Reentrant		

Name	MGPT_StartTimer		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
		Time	U32
		Time to count	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Start the timer		
Type	Synchronous / Non-Reentrant		

Name	MGPT_StopTimer		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Stop the timer		
Type	Synchronous / Non-Reentrant		

Name	MGPT_EnableNotif

Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Enable notification when the timer finish or start		
Type	Synchronous / Non-Reentrant		

Name	MGPT_DisableNotif		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Disable notification when the timer finish or start		
Type	Synchronous / Non-Reentrant		

Name	MGPT_HasFinished		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Check if the flag is up or not		
Type	Synchronous / Non-Reentrant		

Name	MGPT_GetTimeElapsed		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	-	U32
	NOK	Void	
Description	Get the information of time elapsed from GPT		
Type	Synchronous / Non-Reentrant		

Name	MGPT_GetTimeRemaining		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	-	U32
	NOK	Void	
Description	Get the information of time remaining from GPT		
Type	Synchronous / Non-Reentrant		

Name	MGPT_ClearFlag		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Clear the flag after the finished time		
Type	Synchronous / Non-Reentrant		

-> HAL Drivers

• Door Driver:

Name	HDoor_Init		
Arguments	Input	Door_ID	U32
		Holding door ID	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialization the door module		
Type	Synchronous / Non-Reentrant		

Name	HDoor_GetDoorState		
Arguments	Input	Door_ID	U32
		Holding Door ID	
	Output	Door is open or door is close	
Return	OK	0	
	NOK	1	
Description	Get the door state		
Type	Synchronous / Non-Reentrant		

• Light Driver:

Name	HLight_Init		
Arguments	Input	Switch_ID	U32
		Holding Switch ID	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialization the Light module		
Type	Synchronous / Non-Reentrant		

Name	HLight_GetSwitchState		
Arguments	Input	Door_ID	U32
		Holding Light ID	
	Output	Switch is pressed or switch is not pressed	
Return	OK	0	
	NOK	1	
Description	Get the switch state		
Type	Synchronous / Non-Reentrant		

• Speed Sensor Driver:

Name	HSpeedSen _Init		
Arguments	Input	Sensor_ID	U32
		Holding Sensor ID	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialization the Sensor module		
Type	Synchronous / Non-Reentrant		

Name	HSpeedSen_CalcSpeed		
Arguments	Input	Sensor_ID	U32
		Holding Sensor ID	
	Output	Speed	
Return	OK	Void	
	NOK		
Description	Calculate speed		
Type	Synchronous / Non-Reentrant		

Name	HSpeedSen_GetSpeed		
Arguments	Input	Door_ID	U32
		Holding Door ID	
	Output	Speed	
Return	OK	0	
	NOK	1	
Description	Get the Speed		
Type	Synchronous / Non-Reentrant		

-> Service Layer Drivers

- Communication Module:

Name	SendDoorState		
Arguments	Input	Data	U32
		Door data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Send data of door every 10ms		
Type	Synchronous / Non-Reentrant		

Name	SendLightSWState		
Arguments	Input	Data	U32
		Light Switch data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Send data of light switch every 20ms		
Type	Synchronous / Non-Reentrant		

Name	SendSpeed		
Arguments	Input	Data	U32
		Holding speed value	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Send data of speed every 5ms		
Type	Synchronous / Non-Reentrant		

ECU 2

Layered Architecture

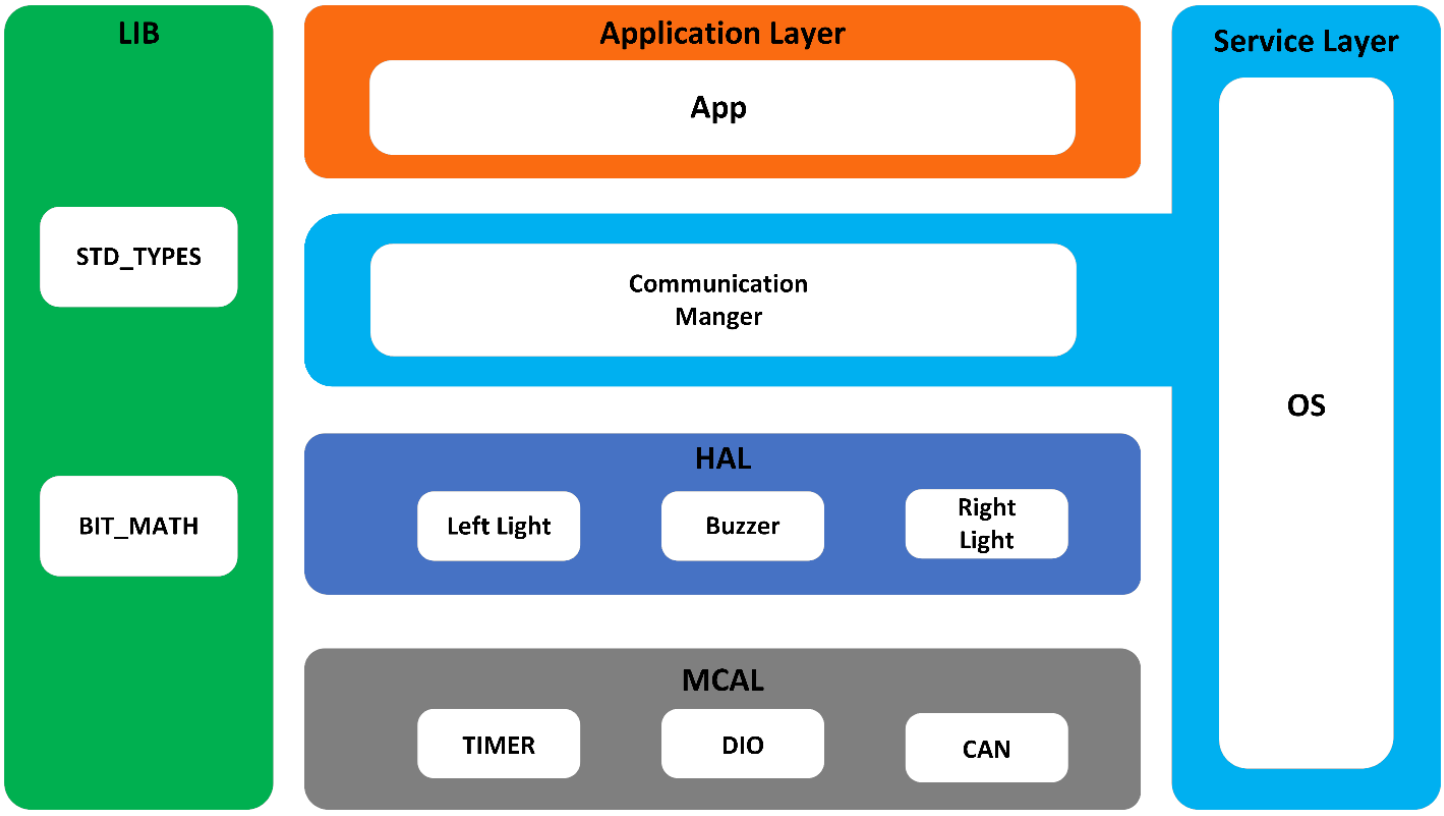


Figure 2; ECU2 Layered Architecture

ECU1 components and APIs

-> MCAL Drivers

- DIO Driver:

Name	Pin_Direction
Type	Enum
Range	INPUT, OUTPUT
Description	Pin direction whether input or output

Name	Pin_Value
Type	Enum
Range	LOW, HIGH
Description	Pin Value whether low or high

Name	PORTS
Type	Enum
Range	PORTA ---> PORTF
Description	Choosing port Number

Name	MDIO_Init	
Arguments	Input	Void
	Output	N/A
Return	OK	Void
	NOK	
Description	Initialize DIO peripheral	
Type	Synchronous / Non-Reentrant	

Name	MDIO_SetPinDirection		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
		Direction	Pin_Direction
		choose pin direction (Input/Output)	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Define the direction of a pin (Input/Output)		
Type	Synchronous / Non-Reentrant		

Name	MDIO_SetPinValue		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
		Value	Pin_Value
		choose pin Value (High/Low)	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Set the logical state of the pin (High/Low)		
Type	Synchronous / Non-Reentrant		

Name	MDIO_TogglePin		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Toggle the logical state of a pin High to Low and vice versa		
Type	Synchronous / Non-Reentrant		

Name	MDIO_ReadPin		
Arguments	Input	PortNumber	PORTS
		choose port number	
		PinNumber	U8
		choose pin number	
	Output	N/A	
Return	OK	-	Pin_Value
	NOK	Void	
Description	Read the logical state of a pin High or Low		
Type	Synchronous / Non-Reentrant		

• ADC Driver:

Name	ADC_ID
Type	Enum
Range	ADC0, ADC1
Description	Choose ADC to work

Name	ADC_Channel
Type	Enum
Range	PE3, PE2, PE1, PE0, PD3, PD2, PD1, PD0, PE5, PE4, PB4, PB5
Description	Choose ADC channel

Name	MADC_Init	
Arguments	Input	Void
	Output	N/A
Return	OK	Void
	NOK	
Description	Initialize ADC peripheral	
Type	Synchronous / Non-Reentrant	

Name	MADC_Convert		
Arguments	Input	ADC_n	ADC_ID
		Choose ADC peripheral	
		Cahnnel_n	ADC_Channel
		Choose channel to convert	
	Output	N/A	
Return	OK	-	U32
	NOK	Void	
Description	Start the conversion of a defined channel and get its reading		
Type	Synchronous / Non-Reentrant		

• CAN Driver:

Name	BitRate_Config_Struct
Type	Struct
Elements	uint8 BRP uint8 SJW uint8 TSEG1 uint8 TSEG2
Description	Configure bit rate by the user

Name	CAN_Config_Struct
Type	Struct
Elements	uint8 CANID uint8 MODE uint32 BitRate
Description	Choose the mode of CAN

Name	CAN_MSG_Object
Type	Struct
Elements	u32 MsgID u8 MsgObjectNumber u8 MsgIDExtension u8 MsgLen u32 MsgIDMask
Description	Message object structure

Name	CAN_Init		
Arguments	Input	*ConfigPtr	CAN_Config_Struct
		Input configurations for CAN Bus	
		*Bit_Rate_Ptr	BitRate_Config_Struct
		Input configurations for Bit Rate	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for initializing the CAN drive		
Type	Synchronous / Non-Reentrant		

Name	CAN_Transmit_SetObject		
Arguments	Input	CAN_ID	U8
		Choose channel	
		*MsgObject	CAN_MSG_Object
		Struct that holds the message	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for configuring transmit message object		
Type	Synchronous / Non-Reentrant		

Name	CAN_Transmit_Object		
Arguments	Input	CAN_ID	U8
		Choose channel	
		MsgObjNum	U8
		Message object number from 1 to 32	
		*data_pt	U8
		Points to data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for transmitting message object		
Type	Synchronous / Non-Reentrant		

Name	CAN_Receive_SetObject		
Arguments	Input	CAN_ID	U8
		Choose channel	
		*MsgObject	CAN_MSG_Object
		Struct that holds the message	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for configuring receive message object		
Type	Synchronous / Non-Reentrant		

Name	CAN_Receive_Object		
Arguments	Input	CAN_ID	U8
		Choose channel	
		MsgObjNum	U8
		Message object number from 1 to 32	
		*data_pt	U8
		Points to data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Responsible for receiving message object		
Type	Synchronous / Non-Reentrant		

• TIMER Driver:

Name	GPT_ChannelID
Type	Enum
Range	Channel_0 ---> Channel_11
Description	Choose the GPT channel

Name	GPT_Mode
Type	Enum
Range	GPT_ONE_SHOT, GPT_MODE_PERIODIC
Description	Choose the GPT channel

Name	GPT_TIM_TYPE
Type	Enum
Range	GPT_PREDEF_TIMER_1US_16BIT = 4 GPT_PREDEF_TIMER_1US_24BIT = 4 GPT_PREDEF_TIMER_1US_32BIT = 0
Description	Choose the GPT channel

Name	GPT_ConfigType
Type	Struct
Elements	Gpt_ChannelID Channel_ID Gpt_Mode Channel_Mode GPT_TIM_TYPE Timer_Type
Description	Configuration of Timer

Name	MGPT_Init

Arguments	Input	ConfigPtr	GPT_ConfigType
		Struct that contains configurations	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialize GPT peripheral		
Type	Synchronous / Non-Reentrant		

Name	MGPT_StartTimer		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
		Time	U32
		Time to count	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Start the timer		
Type	Synchronous / Non-Reentrant		

Name	MGPT_StopTimer		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Stop the timer		
Type	Synchronous / Non-Reentrant		

Name	MGPT_EnableNotif

Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Enable notification when the timer finish or start		
Type	Synchronous / Non-Reentrant		

Name	MGPT_DisableNotif		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Disable notification when the timer finish or start		
Type	Synchronous / Non-Reentrant		

Name	MGPT_HasFinished		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Check if the flag is up or not		
Type	Synchronous / Non-Reentrant		

Name	MGPT_GetTimeElapsed		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	-	U32
	NOK	Void	
Description	Get the information of time elapsed from GPT		
Type	Synchronous / Non-Reentrant		

Name	MGPT_GetTimeRemaining		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	-	U32
	NOK	Void	
Description	Get the information of time remaining from GPT		
Type	Synchronous / Non-Reentrant		

Name	MGPT_ClearFlag		
Arguments	Input	*ConfigPtr	GPT_ConfigType
		Struct contains needed information	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Clear the flag after the finished time		
Type	Synchronous / Non-Reentrant		

-> HAL Drivers

• Buzzer Driver:

Name	HBuzzer_Init		
Arguments	Input	Buzzer _ID	U32
		Holding Buzzer ID	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialization the buzzer module		
Type	Synchronous / Non-Reentrant		

Name	HBuzzer _ON		
Arguments	Input	Buzzer_ID	U32
		Holding Buzzer ID	
	Output	Turn ON Buzzer	
Return	OK	Void	
	NOK		
Description	Turn OFF Buzzer		
Type	Synchronous / Non-Reentrant		

Name	HBuzzer _OFF		
Arguments	Input	Buzzer _ID	U32
		Holding Buzzer ID	
	Output	Turn OFF Buzzer	
Return	OK	Void	
	NOK		
Description	Turn OFF Buzzer		
Type	Synchronous / Non-Reentrant		

• Lights Driver:

Name	HLight_Init		
Arguments	Input	Light_ID	U32
		Holding Light ID	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Initialization the Light module		
Type	Synchronous / Non-Reentrant		

Name	HLight _ON		
Arguments	Input	Light _ID	U32
		Holding Light ID	
	Output	Turn ON Light	
Return	OK	Void	
	NOK		
Description	Turn ON Light		
Type	Synchronous / Non-Reentrant		

Name	HLight _OFF		
Arguments	Input	Light _ID	U32
		Holding Light ID	
	Output	Turn OFF Light	
Return	OK	Void	
	NOK		
Description	Turn OFF Light		
Type	Synchronous / Non-Reentrant		

-> Service Layer Drivers

• Communication Module:

Name	ReceiveDoorState		
Arguments	Input	*Data	Ptr U32
		Hold Door data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Receive data of door every 10ms		
Type	Synchronous / Non-Reentrant		

Name	ReceiveLightSWState		
Arguments	Input	*Data	Ptr U32
		Light Switch data	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Receive data of light switch every 20ms		
Type	Synchronous / Non-Reentrant		

Name	ReceiveSpeed		
Arguments	Input	*Data	Ptr U32
		Holding speed value	
	Output	N/A	
Return	OK	Void	
	NOK		
Description	Receive data of speed every 5ms		
Type	Synchronous / Non-Reentrant		