Automotive door control system design
Static Design Report

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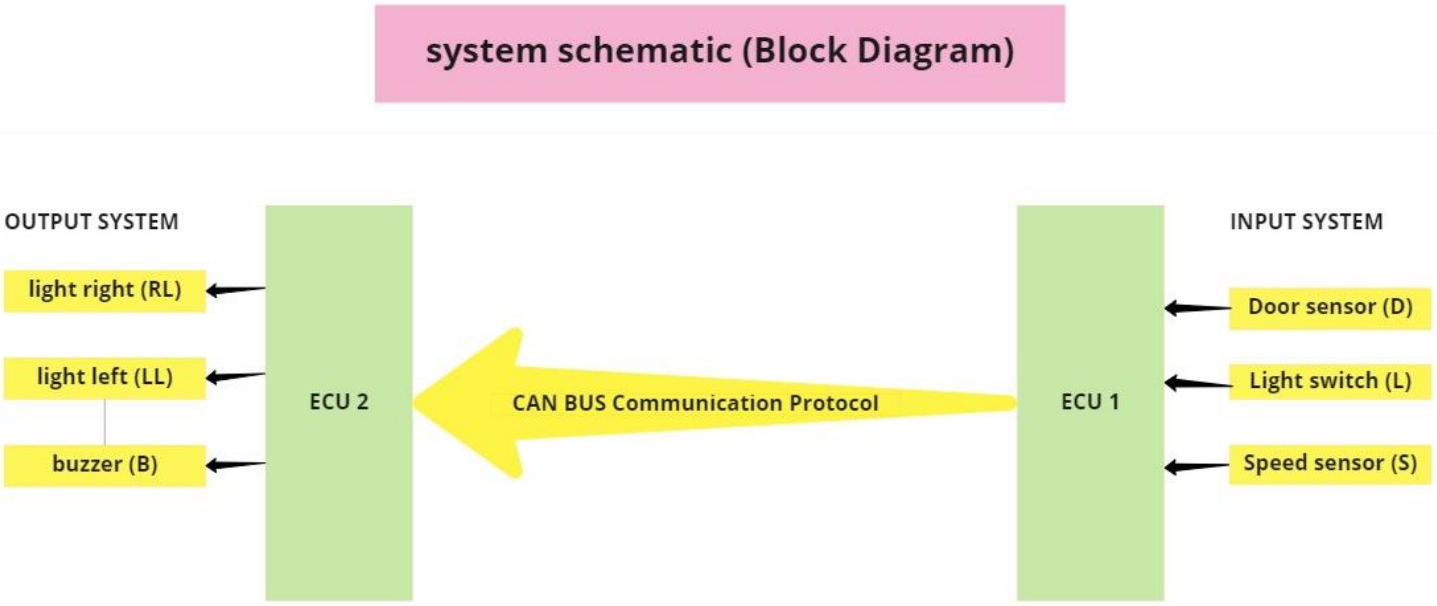
System Schematic (Block Diagram)

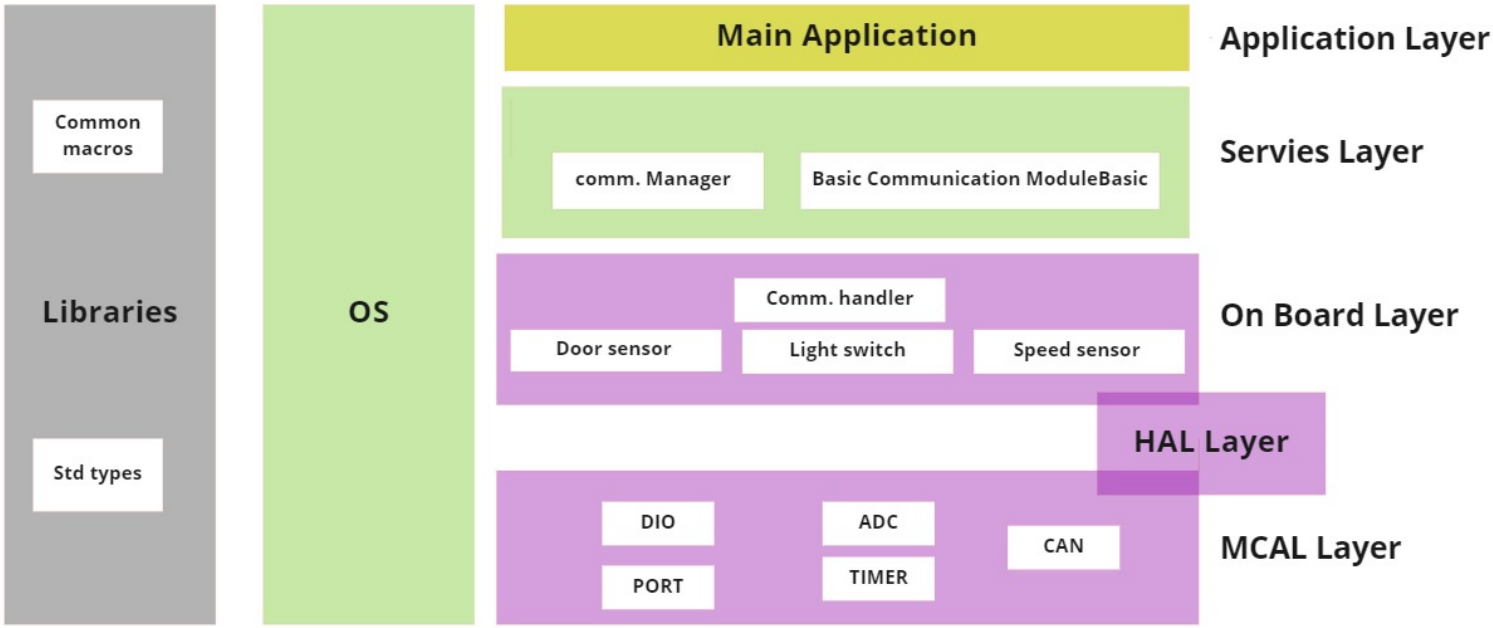


Static Design:

➢ For ECU 1:

1- The Layered Architecture:

Layered Architecture ECU 1



2- ECU components and modules

Components Connected:

1. CAN BUS Communication Protocol (for communication between the two ECUs)
2. Light switch
3. Speed Sensor
4. Door Sensor

Modules:

External hardware:

1. CAN transiver module
2. Switch module
3. Speed Sensor module
4. Door Sensor module

Internal hardware:

1. Port Module (initialize all pins required with modes)
2. DIO Module (switch module, Door Sensor module)
3. TIMER module (timer for application)
4. ADC module (for speed sensor)
5. CAN Module (for can transiver data)

3- APIs

3.1 Tasks in Application Layer

Layer	Module	APIs	API Details	
Application Layer	Main Application	DoorSensorTask		
			Syntax:	void DoorSensorTask(void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Manage Door Sensor Task

Layer	Module	APIs	API Details	
Application Layer	Main Application	LightSwitchTask		
			Syntax:	void LightSwitchTask(void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Manage Light Switch Task
		SpeedSensorTask		
			Syntax:	void SpeedSensorTask(void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Manage Speed Sensor Task

3.2 Modules in Service Layer:

Layer	Module	APIs	API Details	
Servies Layer	Basic Communication ModuleBasic (BCM Manager)	BCM_Manager		
			Syntax:	void BCM_Manager (uint8_t Id_Bus, uint64_t Data);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Id_Bus**: that the ID commutation protocol want to connect it, **Data** :that the data want to send by BCM manager
			Return:	None
			Description:	Manage request the data Transmitter by CAN Bus W.R.T Id Bus selection
Servies Layer	comm. Manager	Sensor_Manager (do Monitoring Sensors)	**Syntax:**	Level_States Sensor_Manager (Id_sensor Id_Sensor_read);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Id_Sensor_read** : that id Sensor selection want to read states
			Return:	Date of states Read from sensor
			Description:	Manage request read states of data from sensor selection

Types define of argument of APIs:

Types	Define
typedef unsigned char uint8_t	Used in armament Id_Bus to select bus connect range{0,255 } that range depended commutation to managed by BCM ,size 8bit
typedef unsigned long long uint64_t	used because max width of data in CAN frame is 64 bits and used in argument Data transmitter API BCM_manager and Handler
Level_States	typedef enum {Low, High } Level_States range{0,1} size 1bit
Id_sensor	typedef enum {Sensor_1, sensor_2, sensor_3} Id_sensor range{0,2 max sensor in project } size 2 bit

3.3 Modules in On Board Layer

Layer	Module	APIs	API Details	
On Board Layer	Comm. Handler	BCM_Handler		
			Syntax:	void BCM_ Handler (uint8_t Id_Bus, uint64_t Data);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Id_Bus**: that the ID commutation protocol want to connect it, **Data** :that the data want to send by BCM manager
			Return:	None
			Description:	Manage request the data Transmitter by CAN Bus W.R.T Id Bus selection but deals with Hardware directly
On Board Layer	Comm. Handler	Sensor Handler	**Syntax:**	Level_States Sensor_Handler (Id_sensor Id_Sensor_read);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Id_Sensor_read** : that id Sensor selection want to read states
			Return:	Date of states Read from sensor
			Description:	Manage request read states of data from sensor selection but deals with Hardware directly
On Board Layer	Door Sensor	DoorSensor_Init	**Syntax:**	void DoorSensor_Init (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins for digital input
		DoorSensor_ReadStatus	**Syntax:**	Status_door DoorSensor_ReadStatus (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	Status of the sensor door closed or opened
			Description:	Get the status of the sensor door (closed or not)

<table>
<tr><td>On Board Layer</td><td>Light Switch</td><td>LightSwitch_Init</td><td></td></tr>
<tr><td></td><td></td><td></td><td><table>
<tr><td>Syntax:</td><td>Void LightSwitch_Init (void);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>None</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize the used DIO pins for digital input</td></tr>
</table></td></tr>
<tr><td></td><td></td><td>LightSwitch_ReadStatus</td><td><table>
<tr><td>Syntax:</td><td>Status_switch LightSwitch_ReadStatus (void);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>None</td></tr>
<tr><td>Return:</td><td>Status of the light switch
Pressed or unpressed)</td></tr>
<tr><td>Description:</td><td>Get the status of the Light Switch
(Pressed or unpressed)</td></tr>
</table></td></tr>
<tr><td>On Board Layer</td><td>Speed Sensor</td><td>SpeedSensor_Init</td><td><table>
<tr><td>Syntax:</td><td>void SpeedSensor_Init (void);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>None</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize the used DIO pins for analog input
For (ADC)</td></tr>
</table></td></tr>
<tr><td></td><td></td><td>SpeedSensor_ReadStatus</td><td><table>
<tr><td>Syntax:</td><td>Status_speed SpeedSensor_ReadStatus (void);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>None</td></tr>
<tr><td>Return:</td><td>Status of the sensor speed of car that can be moving or stopped</td></tr>
<tr><td>Description:</td><td>Read the Status value of the speed sensor (moving or stop)</td></tr>
</table></td></tr>
</table>

Types define of argument of APIs:

Types	Define
typedef unsigned char uint8_t	Used in armament Id_Bus to select bus connect range{0,255 } that range depended commutation to managed by BCM ,size 8bit
typedef unsigned long long uint64_t	used because max width of data in CAN frame is 64 bits and used in argument Data transmitter API BCM_manager and Handler

Level_States	typedef enum {Low, High} Level_States range{0,1} size 1bit
Id_sensor	typedef enum {Sensor_1, sensor_2, sensor_3} Id_sensor range{0,2 max sensor in project } size 2 bit
Status_door	typedef enum {closed, opened} Status_door range{0,1} size 1bit
Status_switch	typedef enum {undressed, pressed} Status_switch range{0,1} size 1bit
Status_speed	typedef enum {stopped, moving} Status_speed range{0,1} size 1bit after convert value adc

3.4 Modules in MCAL Layer

Layer	Module	APIs	API Details	
MCAL Layer	DIO	DIO_Init	**Syntax:**	Void DIO_Init (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins with required configuration file .
		DIO_ReadChannel	**Syntax:**	LevelType DIO_ReadChannel(Id_channel channel);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Channel**: the value of channel want to read it the value of enum **Id_channel**
			Return:	Status of pin High or low that value from Dio_LevelType
			Description:	Read the channel required
		DIO_WriteChannel	**Syntax:**	void DIO_WriteChannel (LevelType Level);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Level** : Level want to write channel high level or low level
			Return:	None
			Description:	Write the level of the channel required

<table>
<tr>
<td>MCAL Layer</td>
<td>PORT</td>
<td>Port_init(*Port_cfg_ptr)</td>
<td>
<table>
<tr><td>Syntax:</td><td>void Port_init(*Port_cfg_ptr)</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>This API takes pointer to the configuration container of the port driver to initialize the configured pins</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize the used Port with required configuration of the pointer</td></tr>
</table>
</td>
</tr>
<tr>
<td>MCAL Layer</td>
<td>PORT</td>
<td>void SetPinValue(port_of_Id port_Id,Pin_of_num Pin_num, Dio_LevelType level)</td>
<td>
<table>
<tr><td>Syntax:</td><td>void SetPinValue(port_of_Id port_Id,Pin_of_num Pin_num, Dio_LevelType level)</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>This API takes to the configuration port_Id that type of port_of_Id to port_1 or port_2 …. , Pin_num the number of pin want to configure, level that initiation of level of pin high or low</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize the used Port with required configuration of the Parameters.</td></tr>
</table>
</td>
</tr>
<tr>
<td>MCAL Layer</td>
<td>Timer</td>
<td>Timer_Init

Timer_Start</td>
<td>
<table>
<tr><td>Syntax:</td><td>void Timer_Init (void);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>None</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize timer required configuration</td></tr>
</table>
<table>
<tr><td>Syntax:</td><td>void Timer_Start (timer_ChannelType channel, timer_ValueType value_count);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>Channel: that the channel wanted to start timer , value_count value of counter to count tick the mix value depend of over flow timer count</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize timer required configuration of Parameters to start count</td></tr>
</table>
</td>
</tr>
</table>

MCAL Layer	Timer	Timer_Stop	**Syntax:**	Void Timer_Stop (timer_ChannelType channel);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Channel:** channel Id of timer wanted to stopped
			Return:	None
			Description:	Stop timer required configuration id channel
MCAL Layer	CAN	CAN_Init	**Syntax:**	void CAN_Init (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize CAN bus required configuration and Hardware pin CAN
		CAN_Transmiter	**Syntax:**	void CAN_Transmiter (uint8_t Pin_Id,uint64_t Data);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Data transmitter by the can bus , Pin_id the agreement to selection the id of bus wanted connected
			Return:	None
			Description:	Transmitter data by CAN Bus
MCAL Layer	ADC	ADC_Init	**Syntax:**	void ADC_Init (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize ADC required configuration and Hardware pin ADC connect speed sensor
		ADC_ReadChannel	**Syntax:**	uint16_tADC_ReadChannel(Pin_of_num Pin_Id);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Pin_Id of ADC to read value
			Return:	The value of channel ADC
			Description:	Read the value of channel ADC

Types define of argument of APIs:

<table>
<tr><th>Types</th><th colspan="2">Define</th></tr>
<tr><td>LevelType</td><td colspan="2">typedef enum {LOW, HIGH} Dio_LevelType
range{0,1} size 1bit</td></tr>
<tr><td>Id_channel</td><td colspan="2">typedef enum {Channel_1, Channel_2, Channel_3,
Channel_4, Channel_5, Channel_6, Channel_7,
Channel_8}Dio_LevelType
range{0,8} size 1bit</td></tr>
<tr><td rowspan="6">Port_cfg_ptr that of struct to configuration
Typedef struct{uint8_t Port_Pin_Direction,
uint8_t PORT_PIN_INTERNAL_ATTACH,
uint8_t PORT_PIN_LEVEL_VALUE ,
uint8_t PORT_def_PORTx,
uint8_t PORT_def_PINx,
uint8_t PORT_def_Mode_x}port_config;</td><td>Port_Pin_Direction</td><td>Used to set the direction input or output</td></tr>
<tr><td>PORT_PIN_INTERNAL_ATTACH</td><td>Used to select the internal resistance</td></tr>
<tr><td>PORT_PIN_LEVEL_VALUE</td><td>Used to specify the initial value</td></tr>
<tr><td>PORT_def_PORTx</td><td>This typedef used to point to specific port , if x equal A then this is portA</td></tr>
<tr><td>PORT_def_PINx</td><td>This typedef used to point to specific pin , if x equal 0 then this is pin0</td></tr>
<tr><td>PORT_def_Mode_x</td><td>This typedef used to point to specific mode , if x equal adc then this is adc mode</td></tr>
<tr><td>port_of_Id</td><td colspan="2">typedef enum {Port_1, Port _2 Port _3,Port l_4, Port _5, Port _6 Port _7} port_of_Id range{0,8} size 1bit</td></tr>
<tr><td>,Pin_of_num</td><td colspan="2">typedef enum {Pin_1, Pin _2 Pin _3,Pin l_4, Pin _5, Pin_6, Pin _7,Pin_8} Pin_of_num range{0,8} size 1bit</td></tr>
<tr><td>typedef uint32_t T timer_ValueType;</td><td colspan="2">Value of tick range from 0 to 2^32 -1 size 32 bit</td></tr>
<tr><td>Typedef enum {T1 = T1PR,T2 = T2PR,Etc:}
timer_ChannelType;</td><td colspan="2">This enum types stores the identifier for the Channel like its name.</td></tr>
</table>

4- Folder Structure according to the previous points:

Application folder	Servies folder	On Board Layer
main.c	Operting_system.c	BCM_Handler.c
	BCM_Manager.c	Sensor_Handler.c
	Sensor_Manager.c	Door_sensor.c
		Light_switch.c
		Speed_sensor.c

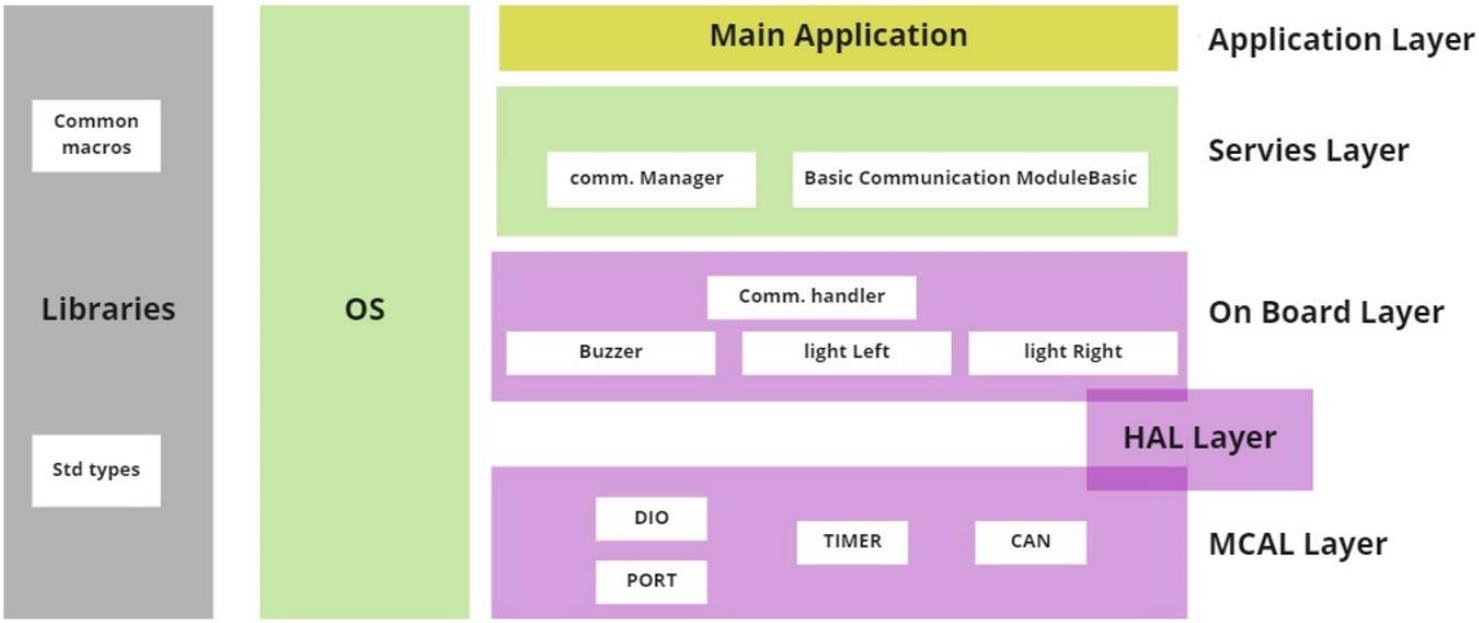
MCAL folder	Configure folder
dio.c	Timer_config.c
port.c	Adc_config.c
adc.c	Can_config.c
Timer.c	Port_config.c
can.c	Dio_config.c
	Door_sensorconfig.c
	Light_switchconfig.c
	Speed_sensorconfig.c

Commen folder (all the header (name.h))
Mainapp.h / os.h / servies.h
BCS_manager.h/Sonser_manager.h
Light_switch.h / speed_sonser.h / Door_sensor.h
Dio.h / port.h / timer.h /can.h/adc.h
dio_config.h/port_config.h / timer_config.h /can_config.h /adc_config.h
Stdtypes.h /comman_macro.h /Hw.h

➢ For ECU 2:

1- The Layered Architecture:

Layered Architecture ECU 2



2- ECU Components & Modules

Components Connected:

1. CAN BUS Communication Protocol (for communication between the two ECUs)
2. Light right
3. Light left
4. Buzzer

Modules:

External hardware:

1. CAN transiver module
2. Light left module
3. Light right module
4. Buzzer module

Internal hardware:

1. Port Module (initialize all pins required with modes)
2. DIO Module (switch module, Door Sensor module)
3. TIMER module (timer for application)
4. CAN Module (for can transiver data)

3- APIs

3.1 Modules in Application Layer

Layer	Module	APIs	API Details	
Application Layer	Main Application	PeriodicReceive_Status		
			Syntax:	Void PeriodicReceive_Status(uint64_t * data ,uint8_t* id_CAN);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Pointer to data act as buffer for data ,pointer of CAN bus id to id cheek it
			Return:	None
			Description:	Manage received data periodicity status of ECU1

3.2 Modules in Servies Layer

Layer	Module	APIs	API Details	
Servies Layer	Basic Communication ModuleBasic (BCM Manager)	BCM_Manager		
			Syntax:	uint64_t BCM_Manager (uint8_t Id_Bus);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Id_Bus**: that the ID commutation protocol want to connect it to received data
			Return:	Return Data frame of CAN bus that the data want to receive by CAN bus from ECU1
			Description:	Manage request the data received by CAN Bus W.R.T Id Bus selection
Servies Layer	comm. Manager	Actuator_Manager (do Monitoring Action)		
			Syntax:	Void Actuator_Manager (actuator_Id actuator , action_status_action);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**actuator_id** selection want to do action states , **action** want to do(on ,off) Actuator
			Return:	None
			Description:	Monitoring action request to do actuator selection

Types define of argument of APIs:

Types	Define
typedef unsigned char uint8_t	Used in armament Id_Bus to select bus connect range{0,255 } that range depended commutation to managed by BCM ,size 8bit
typedef unsigned long long uint64_t	used because max width of data in CAN frame is 64 bits and used in argument Data received API BCM_manager and Handler
Status_action	typedef enum {OFF,ON } status_action range{0,1} size 1bit
actuator_Id	typedef enum { actuator_1, actuator_2} actuator_Id range{0,1} max actuator in project Buzzer and light } size 1 bit

3.3 Modules in On Board Layer

Layer	Module	APIs	API Details	
On Board Layer	Comm. Handler	BCM_Handler		
			Syntax:	uint64_t BCM_Handler (uint8_t Id_Bus);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Id_Bus**: that the ID commutation protocol want to connect it to received data
			Return:	Return Data frame of CAN bus that the data want to receive by CAN bus from ECU1
			Description:	Handler request the data received by CAN Bus W.R.T Id Bus selection but deals with Hardware directly
On Board Layer	Comm. Handler	Actuator_Handler	**Syntax:**	Void Actuator_Handler (actuator_Id actuator , action_status_action);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**actuator_id** selection want to do action states , **action** want to do(on ,off) Actuator
			Return:	None
			Description:	Handler request to do action actuartor selection but deals with Hardware directly
On Board Layer	Buzzer	Buzzer_Init		
			Syntax:	**Void Buzzer_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins for digital output respect to configuration
		Buzzer_on	**Syntax:**	**void Buzzer_on(void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Set Buzzer to turn on states

		Buzzer_off	**Syntax:**	**void Buzzer_off(void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Set Buzzer to turn off states
On Board Layer	Light Switch	Light_Init		
			Syntax:	**Void Light_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins for digital output base the configuration
		Light_off	**Syntax:**	**void Light_off(void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Set Light to turn off states
		Light_on	**Syntax:**	**Void Light_on(void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Set light to turn on states

Types define of argument of APIs:

Types	Define
typedef unsigned char uint8_t	Used in armament Id_Bus to select bus connect range{0,255 } that range depended commutation to managed by BCM ,size 8bit
typedef unsigned long long uint64_t	used because max width of data in CAN frame is 64 bits and used in argument Data received API BCM_manager and Handler
Status_action	typedef enum {OFF,ON } status_action range{0,1} size 1bit
actuator_Id	typedef enum { actuator_1, actuator_2} actuator_Id range{0,1} max actuator in project Buzzer and light } size 1 bit

3.4 Modules in MCAL Layer

Layer	Module	APIs	API Details	
MCAL Layer	DIO	DIO_Init	**Syntax:**	Void DIO_Init (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins with required configuration file .
		DIO_ReadChannel	**Syntax:**	LevelType DIO_ReadChannel(Id_channel channel);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Channel**: the value of channel want to read it the value of enum **Id_channel**
			Return:	Status of pin High or low that value from Dio_LevelType
			Description:	Read the channel required
		DIO_WriteChannel	**Syntax:**	void DIO_WriteChannel (LevelType Level);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Level** : Level want to write channel high level or low level
			Return:	None
			Description:	Write the level of the channel required

<table>
<tr><td>MCAL Layer</td><td>PORT</td><td>Port_init(*Port_cfg_ptr)</td><td><table>
<tr><td>Syntax:</td><td>void Port_init(*Port_cfg_ptr)</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>This API takes pointer to the configuration container of the port driver to initialize the configured pins</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize the used Port with required configuration of the pointer</td></tr>
</table></td></tr>
<tr><td>MCAL Layer</td><td>PORT</td><td>void SetPinValue(port_of_Id port_Id,Pin_of_num Pin_num, Dio_LevelType level)</td><td><table>
<tr><td>Syntax:</td><td>void SetPinValue(port_of_Id port_Id,Pin_of_num Pin_num, Dio_LevelType level)</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>This API takes to the configuration port_Id that type of port_of_Id to port_1 or port_2 …. , Pin_num the number of pin want to configure, level that initiation of level of pin high or low</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize the used Port with required configuration of the Parameters.</td></tr>
</table></td></tr>
<tr><td>MCAL Layer</td><td>Timer</td><td>Timer_Init</td><td><table>
<tr><td>Syntax:</td><td>void Timer_Init (void);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>None</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize timer required configuration</td></tr>
</table></td></tr>
<tr><td></td><td></td><td>Timer_Start</td><td><table>
<tr><td>Syntax:</td><td>void Timer_Start (timer_ChannelType channel, timer_ValueType value_count);</td></tr>
<tr><td>Sync/Async:</td><td>Synchronous</td></tr>
<tr><td>Reentrancy:</td><td>Non-Reentrant</td></tr>
<tr><td>Parameters:</td><td>Channel: that the channel wanted to start timer , value_count value of counter to count tick the mix value depend of over flow timer count</td></tr>
<tr><td>Return:</td><td>None</td></tr>
<tr><td>Description:</td><td>Initialize timer required configuration of Parameters to start count</td></tr>
</table></td></tr>
</table>

MCAL Layer	Timer	Timer_Stop	**Syntax:**	Void Timer_Stop (timer_ChannelType channel);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Channel:** channel Id of timer wanted to stopped
			Return:	None
			Description:	Stop timer required configuration id channel
MCAL Layer	CAN	CAN_Init	**Syntax:**	void CAN_Init (void);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize CAN bus required configuration and Hardware pin CAN
		CAN_ReceivedData	**Syntax:**	uint64_t CAN_ReceivedData (uint8_t Pin_Id);
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	**Pin_id** the agreement to selection the id of bus wanted connected to received Data
			Return:	Data Received by the can bus
			Description:	Received data from CAN Bus

Types define of argument of APIs:

Types	Define	
LevelType	typedef enum {LOW, HIGH} Dio_LevelType range{0,1} size 1bit	
Id_channel	typedef enum {Channel_1, Channel_2, Channel_3, Channel_4, Channel_5, Channel_6, Channel_7, Channel_8}Dio_LevelType range{0,8} size 1bit	
Port_cfg_ptr that of struct to configuration Typedef struct{uint8_t Port_Pin_Direction, uint8_t PORT_PIN_INTERNAL_ATTACH, uint8_t PORT_PIN_LEVEL_VALUE , uint8_t PORT_def_PORTx, uint8_t PORT_def_PINx, uint8_t PORT_def_Mode_x}port_config;	Port_Pin_Direction	Used to set the direction input or output
	PORT_PIN_INTERNAL_ATTACH	Used to select the internal resistance
	PORT_PIN_LEVEL_VALUE	Used to specify the initial value
	PORT_def_PORTx	This typedef used to point to specific port , if x equal A then this is portA
	PORT_def_PINx	This typedef used to point to specific pin , if x equal 0 then this is pin0
	PORT_def_Mode_x	This typedef used to point to specific mode , if x equal adc then this is adc mode

port_of_Id	typedef enum {Port_1, Port _2 Port _3,Port l_4, Port _5, Port _6 Port _7} port_of_Id range{0,8} size 1bit
,Pin_of_num	typedef enum {Pin_1, Pin _2 Pin _3,Pin l_4, Pin _5, Pin_6, Pin _7,Pin_8} Pin_of_num range{0,8} size 1bit
typedef uint32_t T timer_ValueType;	Value of tick range from 0 to 2^32 -1 size 32 bit
Typedef enum {T1 = T1PR, T2 = T2PR,Etc:} timer_ChannelType;	This enum types stores the identifier for the Channel like its name.

4- Folder Structure according to the previous points:

Application folder	Servies folder	On Board Layer
main.c	Operting_system.c	BCM_Handler.c
	BCM_Manager.c	Actuator_Handler.c
	Actuator_Manager.c	Buzzer_sensor.c
		Light.c

MCAL folder	Configure folder
dio.c	Timer_config.c
port.c	Can_config.c
can.c	Dio_config.c
Timer.c	Port_config.c
	Light_config.c
	Buzzer_config.c

Commen folder (all the header (name.h))
Mainapp.h / os.h / servies.h
BCS_manager.h/ Actuator_manager.h
Light_.h / light.h
Dio.h / port.h / timer.h /can.h
dio_config.h/port_config.h / timer_config.h /can_config.h