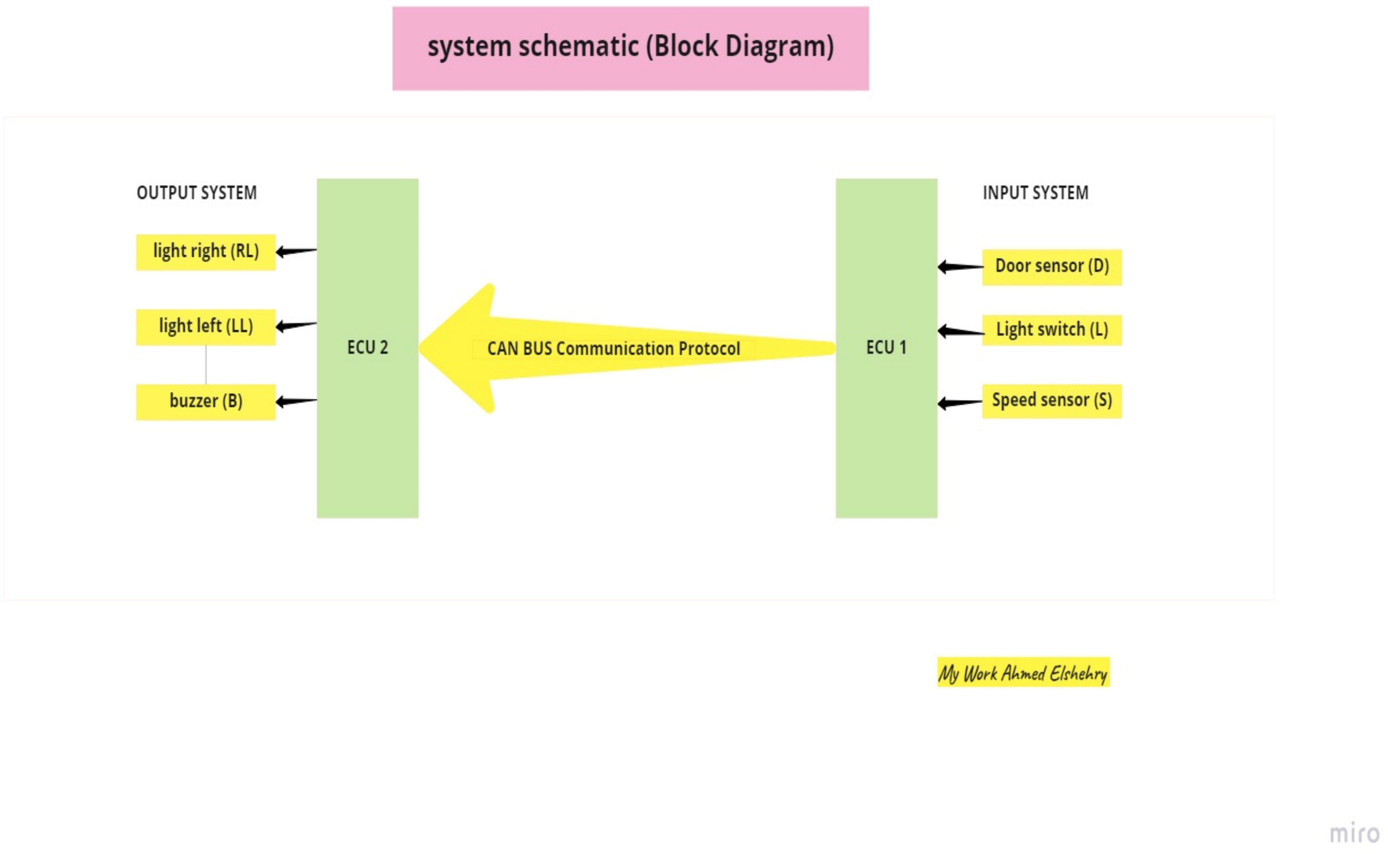
Automotive door control system design

Static design Report

Name: **Ahmed Mohamed Hussein Elshehry**

Email : elshehry97@gmail.com

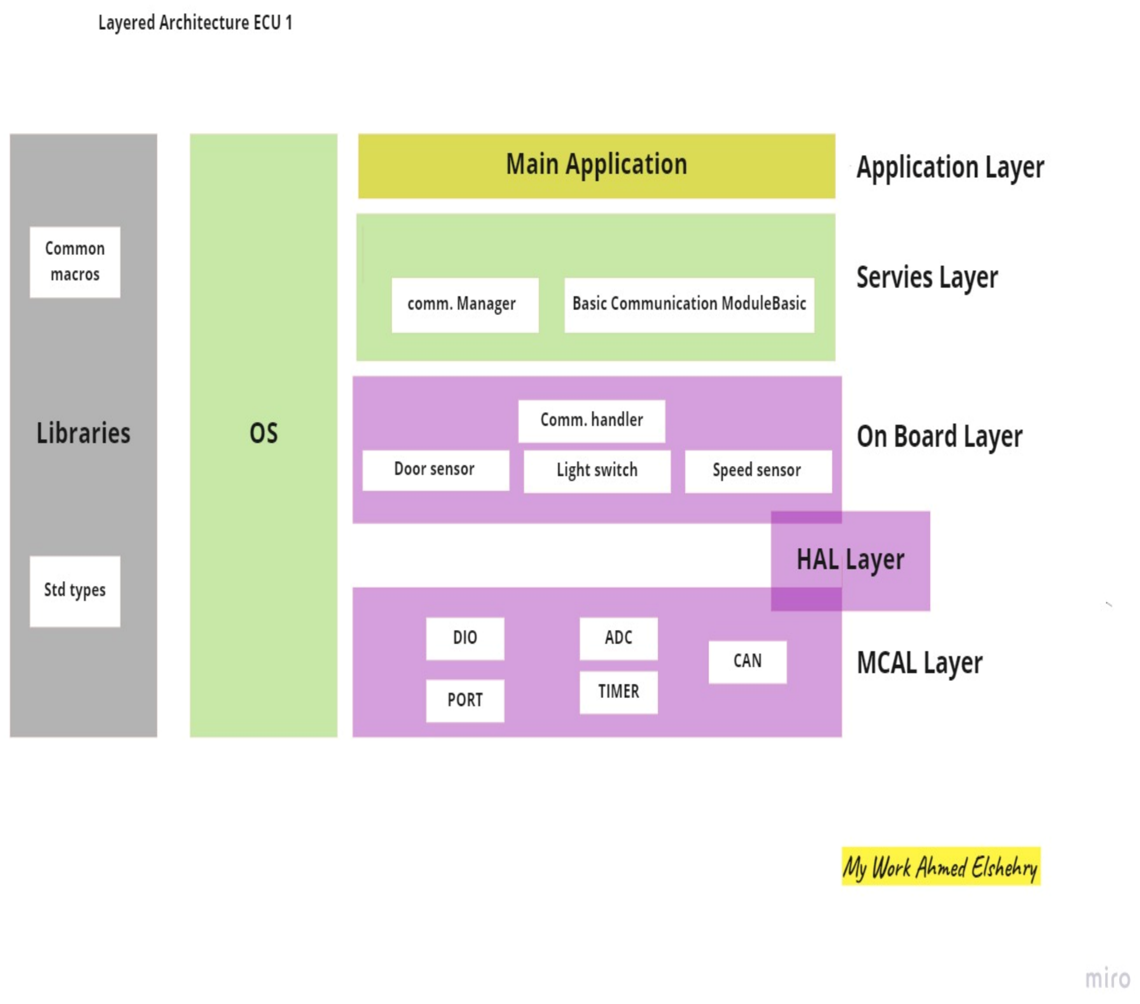
system schematic (Block Diagram) according to your requirements understanding.



Static Design:

➢ For ECU 1:

1- the layered architecture:



2- Specify 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- Provide full detailed APIs for each module as well as a detailed description

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
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:	Data transmitter , Id Bus selection
			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:**	**uint8_t Sensor_Manager (uint8_t Id_Sensor);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Sensor selection want read states
			Return:	Date Read from sensor
			Description:	Manage request read states of data from sensor selection
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:	Data transmitter , Id Bus selection
			Return:	None
			Description:	Handler request the data Transmitter by CAN BUS but deals with Hardware directly

		Sensor_Handler	**Syntax:**	**void Sensor_Handler (uint8_t Id_ Sensor);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Sensor selection want read states
			Return:	None
			Description:	Handler 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:**	**uint8_t DoorSensor_ReadStatus (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	Status of the sensor door
			Description:	Get the status of the sensor door (closed or not)
On Board Layer	Light Switch	LightSwitch_Init	**Syntax:**	**Void LightSwitch_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins for digital input
		LightSwitch_ReadStatus	**Syntax:**	**uint8_t LightSwitch_ReadStatus (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	Status of the sensor door
			Description:	Get the status of the Light Switch (Pressed or unpressed)

On Board Layer	Speed Sensor	SpeedSensor_Init	**Syntax:**	**void SpeedSensor_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used DIO pins for analog input For (ADC)
		SpeedSensor_ReadStatus	**Syntax:**	**uint8_t SpeedSensor_ReadStatus (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	Status of the sensor door
			Description:	Read the value of the speed sensor (moving or stop)
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
		DIO_ReadChannel	**Syntax:**	**uint8_t DIO_ReadChannel(uint8_t Id_channel);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Id channel want read
			Return:	Status of pin High or low
			Description:	Read the channel required
		DIO_WriteChannel	**Syntax:**	**void DIO_WriteChannel (uint8_t Level);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Level want to write channel
			Return:	None
			Description:	Write the level of the channel required

MCAL Layer	PORT	PORT_init	**Syntax:**	**void RORT_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used Port with required configuration
MCAL Layer	Timer	Timer_Init	**Syntax:**	**void Timer_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize timer required configuration
		Timer_Start	**Syntax:**	**void Timer_Start (uint8_t channel_Id,uint_32 value count);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	channel_Id / value count tick
			Return:	None
			Description:	Initialize timer required configuration
		Timer_Stop	**Syntax:**	**Void Timer_Stop (uint8_t channel_Id);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Channel _Id of timer
			Return:	None
			Description:	Initialize timer required configuration

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 , Pin_id
			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(uint8_tPin_Id);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Pin_Id of ADC
			Return:	The value of channel ADC
			Description:	Read the value of channel ADC

4- folder structure according to the previous points:

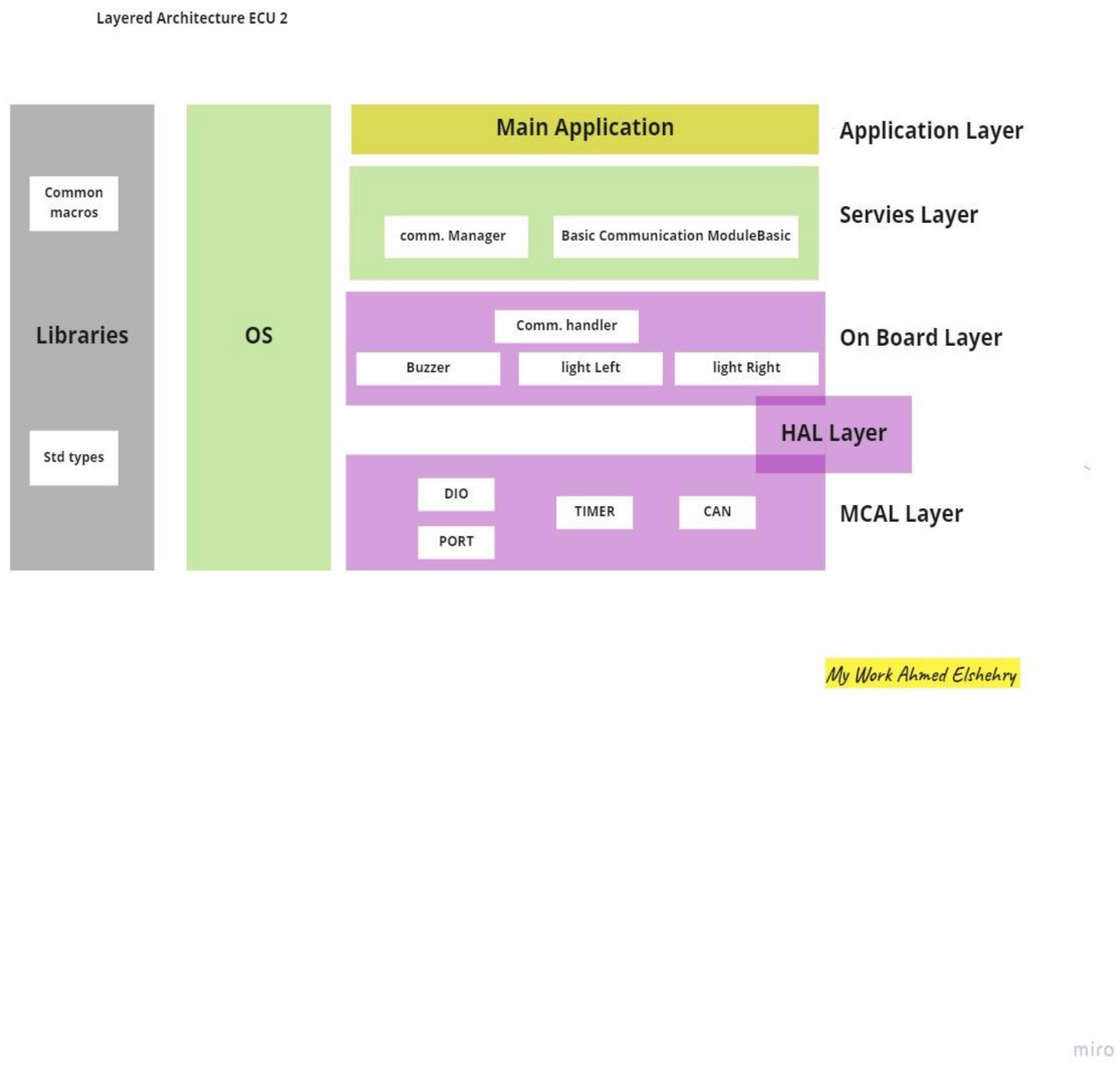
Application folder	Servies folder	On Board Layer
main.c	Operting_system.c	BCM_Handler.c
	BCM_Manager.c	Sensor_Handler.c
	Sensor_Manager.c	Door_sensor.c
		Light_switch.c
		Speed_sensor.c

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

➢ <u>**For ECU 2:**</u>

1- the layered architecture:



2- Specify ECU components and 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- Provide full detailed APIs for each module as well as a detailed description

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

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 selection want read data from bus **Return:** Data received from ECU 1 By can bus **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 (uint8_t actuator_id ,uint8_t action);** **Sync/Async:** Synchronous **Reentrancy:** Non-Reentrant **Parameters:** actuator_id selection want to do action states , action to do(on ,off) **Return:** Nona **Description:** Monitoring action request to do actuator selection
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 selection want received data from CAN BUS **Return:** Data received from can bus **Description:** Handler request the data Received by CAN BUS but deals with Hardware directly
		Sensor_Handler	**Syntax:** **Void Actuator _Handler (uint8_t Id_ actuator , uint8_t action);** **Sync/Async:** Synchronous **Reentrancy:** Non-Reentrant **Parameters:** actuator_id selection want to do action states , action to do(on ,off) **Return:** None **Description:** Handler request to do action actuartor selection but deals with Hardware directly

On Board Layer	Door Sensor	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 on states
		Buzzer_off	**Syntax:**	**void Buzzer_off(void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Set Buzzer to 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 off states
		Light_on	**Syntax:**	**Void Light_on(void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Set light to on states

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
		DIO_ReadChannel	**Syntax:**	**uint8_t DIO_ReadChannel(uint8_t id_channel);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	id_channel
			Return:	Status of pin High or low
			Description:	Read the channel required
		DIO_WriteChannel	**Syntax:**	**void DIO_WriteChannel (uint8_t Level);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Level want to write channel
			Return:	None
			Description:	Write the level of the channel required
MCAL Layer	PORT	PORT_init	**Syntax:**	**void RORT_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize the used Port with required configuration
MCAL Layer	Timer	Timer_Init	**Syntax:**	**void Timer_Init (void);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	None
			Return:	None
			Description:	Initialize timer required configuration

		Timer_Start	**Syntax:**	**Void Timer_Start (uint8_t channel_Id,uint_32 value count);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	channel_Id / value count
			Return:	None
			Description:	Initialize timer required configuration
		Timer_Stop	**Syntax:**	**Void Timer_Stop (uint8_t channel_Id);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Channel _Id of timer
			Return:	None
			Description:	Initialize timer required configuration
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_IdCAn);**
			Sync/Async:	Synchronous
			Reentrancy:	Non-Reentrant
			Parameters:	Pin_idcan
			Return:	Data Recivered from Can bus
			Description:	Received data from CAN Bus

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
Stdtypes.h /comman_macro.h /Hw.h