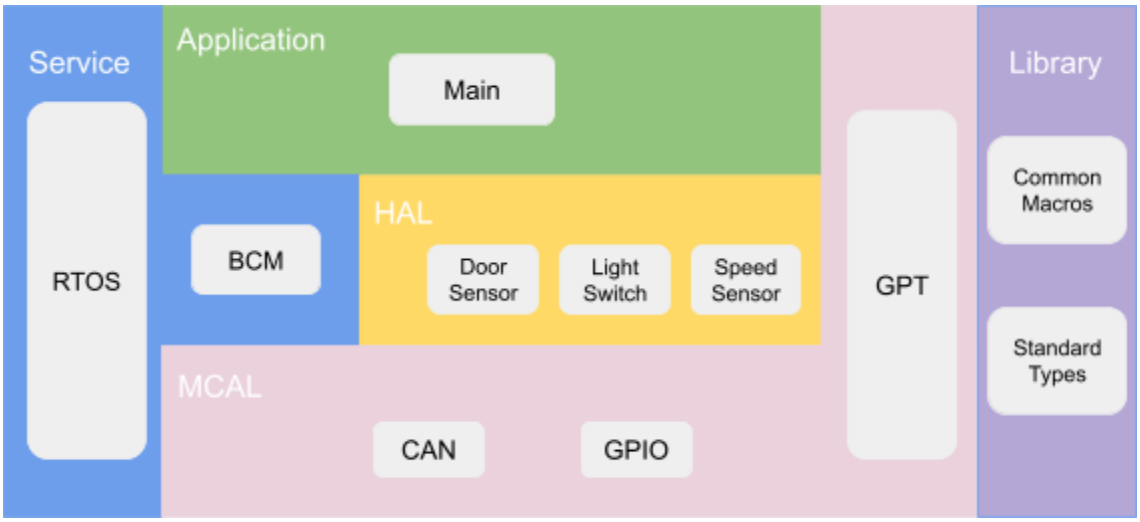
Name: Yasser Waleed Date: 12 Oct 2022

PROJECT 3
Automotive Door Control System Design
<u>Static Design</u>

- For ECU 1:

1. Make the layered architecture



2. Specify ECU components and modules

- Components: Door Sensor, Light Switch, Speed Sensor
- Modules:

Service (1):
- Basic Communication Module

HAL (1):
- Door Sensor Module
- Light Switch Module
- Speed Sensor Module

MCAL (1):
- GPIO Module
- CAN Module
- GPT Module

3. Provide full detailed APIs for each module as well as a detailed description for the used typedefs

Service (1): Basic Communication Module

APIs:

➔ BCM_Init (BCM_Config_t * ConfigPtr)

Function Name	BCM_Init	
Argument(s)	BCM_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the BCM	

➔ BCM_Send (BCM_Data_t Data)

Function Name	BCM_Send	
Argument(s)	BCM_Data_t Data	The target data for sending
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Send data	

➔ BCM_Receive (void)

Function Name	BCM_Receive	
Argument(s)	-	-
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Receive data	

Typedefs:

Name	Type	Description
BCM_Config_t	struct	Holds the set of configurations for the BCM
BCM_Data_t	uint8_t	Holds the data as an integer.

HAL (1): Door Sensor Module

APIs:

➔ DoorSensor_Init (DSensor_Config_t * ConfigPtr)

Function Name	DoorSensor_Init	
Argument(s)	Door_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the Door Sensor	

➔ DoorSensor_Read (void)

Function Name	DoorSensor_Read	
Argument(s)	-	-
Return	DSensor_State_t State … opened or closed	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Read door state	

Typedefs:

Name	Type	Description
DSensor_State_t	enum	Defines OPENED and CLOSED
DSensor_Config_t	struct	Holds the set of configurations for the Door Sensor

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HAL (1): Light Switch Module

APIs:

➔ LightSwitch_Init (LSwitch_Config_t * ConfigPtr)

Function Name	LightSwitch_Init	
Argument(s)	LSwitch_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the Light Switch	

➔ LightSwitch_Read (void)

Function Name	LightSwitch_Read	
Argument(s)	-	-
Return	LSwitch_State_t State… pressed or not pressed	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Read light switch state	

Typedefs:

Name	Type	Description
LSwitch_State_t	enum	Defines PRESSED and NOT PRESSED
LSwitch_Config_t	struct	Holds the set of configurations for the Light Switch

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HAL (1): Speed Sensor Module

➔ SpeedSensor_Init (SSensor_Config_t * ConfigPtr)

Function Name	SpeedSensor_Init	
Argument(s)	SSensor_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the Speed Sensor	

➔ SpeedSensor_Read (void)

Function Name	SpeedSensor_Read	
Argument(s)	-	-
Return	SSensor_State_t State … Moving or Stopped	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Read speed sensor state	

Typedefs:

Name	Type	Description
SSensor_State_t	enum	Defines STOPPED and MOVING
SSensor_Config_t	struct	Holds the set of configurations for the Speed Sensor

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MCAL (1): GPIO Module

APIs:

➔ GPIO_Init (GPIO_Config_t * ConfigPtr)

Function Name	GPIO_Init	
Argument(s)	GPIO_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the GPIO port	

➔ GPIO_Write (GPIO_Port_t Port, GPIO_Pin_t Pin, GPIO_Level_t Level)

Function Name	GPIO_Write	
Argument(s)	GPIO_Port_t Port	The target port
	GPIO_Pin_t Pin	The target pin
	GPIO_Level_t Level	High or Low
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Writes a level to a target GPIO pin	

➔ GPIO_Read(GPIO_Port_t Port, GPIO_Pin_t Pin)

Function Name	GPIO_Write	
Argument(s)	GPIO_Port_t Port	The target port
	GPIO_Pin_t Pin	The target pin
Return	GPIO_Level_t Level (High or Low)	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Reads the level of a target GPIO pin	

Typedefs:

Name	Type	Description
GPIO_Port_t	enum	Defines the available ports
GPIO_Pin_t	enum	Defines the available pins
GPIO_Level_t	enum	Defines LOW and HIGH
GPIO_Config_t	struct	Holds the set of configurations for the GPIO

MCAL (1): CAN Module

APIs:

➔ CAN_Init (CAN_Config_t * ConfigPtr)

Function Name	CAN_Init	
Argument(s)	CAN_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the CAN	

➔ CAN_Transmit (CAN_Channel_t Channel, uint8_t Data)

Function Name	CAN_Transmit	
Argument(s)	CAN_Channel_t Channel	The target channel
	CAN_Data_t Data	The target data for transmission
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Transmit data	

➔ CAN_Receive(CAN_Channel_t Channel)

Function Name	CAN_Receive	
Argument(s)	CAN_Channel_t Channel	The target channel
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Receive data	

Typedefs:

Name	Type	Description
CAN_Channel_t	enum	Defines the available channels
CAN_Data_t	uint8_t	Holds the data as an integer.
CAN_Config_t	struct	Holds the set of configurations for the CAN

MCAL (1): GPT Module

APIs:

➔ GPT_Init (GPT_Config_t * ConfigPtr)

Function Name	GPT_Init	
Argument(s)	GPT_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the timer	

➔ GPT_Start (GPT_Channel_t Channel, GPT_Value_t Time)

Function Name	GPT_Start	
Argument(s)	GPT_Channel_t Channel	The target channel
	GPT_Value_t Time	The target time (tick count)
Return	-	
Reentrancy	Reentrant (but not for the same channel)	
Synchronicity	Synchronous	
Description	Starts the timer in a target channel	

➔ GPT_Stop (GPT_Channel_t Channel)

Function Name	GPT_Stop	
Argument(s)	GPT_Channel_t Channel	The target channel
Return	-	
Reentrancy	Reentrant (but not for the same channel)	
Synchronicity	Synchronous	
Description	Stops the timer in a target channel	

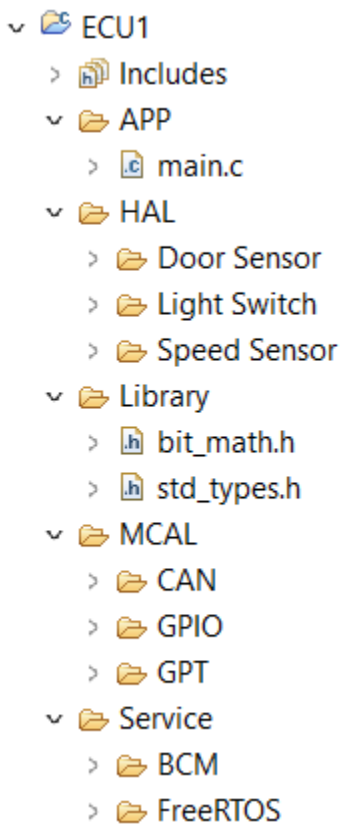
➔ GPT_NotificationCtrl (GPT_Channel_t Channel, GPT_Mode_t Mode)

Function Name	GPT_NotificationCtrl	
Argument(s)	GPT_Channel_t Channel	The target channel
	GPT_Mode_t Mode	Enable / Disable
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Enable/Disable the interrupt for a target channel	

Typedefs:

Name	Type	Description
GPT_Config_t	struct	Holds the set of configurations for the GPT
GPT_Value_t	uint_32	Holds the value of time as an integer.
GPT_Channel_t	enum	Defines the available channels
GPT_Mode_t	enum	Defines DISABLE and ENABLE

4. Prepare your folder structure according to the previous points



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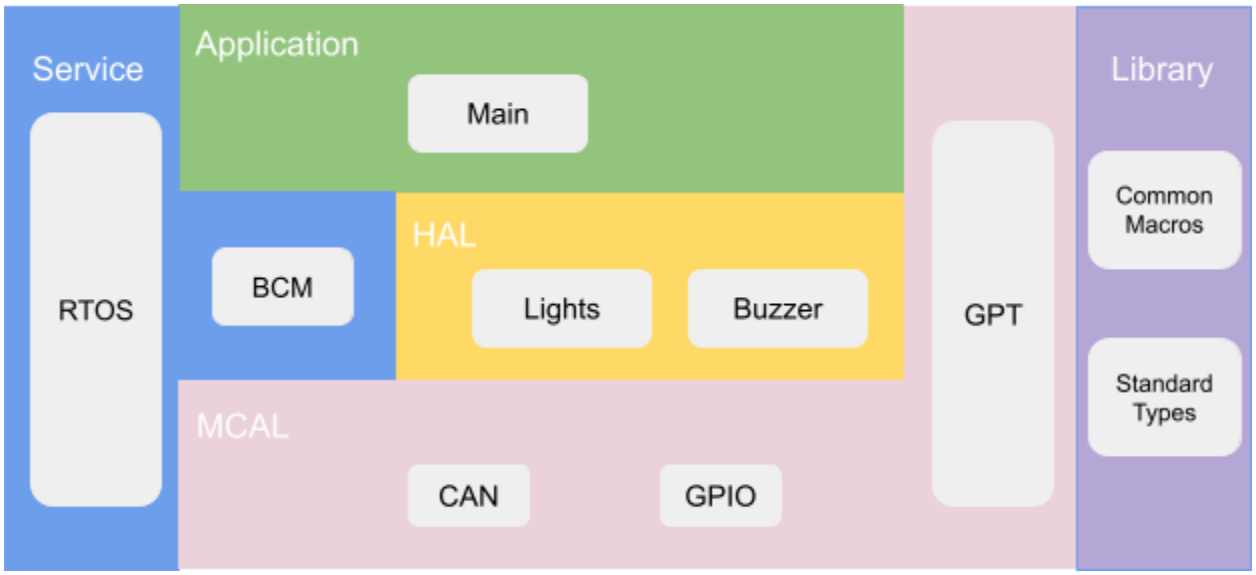
- For ECU 2:

1. Make the layered architecture



2. Specify ECU components and modules

   - Components: Buzzer, Lights (Right and Left lights are in sync, so treated as one output)
   - Modules:

     Service (2):
     - Basic Communication Module

     HAL (2):
     - Buzzer Module
     - Lights Module

     MCAL (2):
     - GPIO Module
     - CAN Module
     - GPT Module

3. Provide full detailed APIs for each module as well as a detailed description for the used typedefs

Service (2): Basic Communication Module

APIs:

➔ BCM_Init (BCM_Config_t * ConfigPtr)

Function Name	BCM_Init	
Argument(s)	BCM_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the BCM	

➔ BCM_Send (BCM_Data_t Data)

Function Name	BCM_Send	
Argument(s)	BCM_Data_t Data	The target data for sending
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Send data	

➔ BCM_Receive (void)

Function Name	BCM_Receive	
Argument(s)	-	-
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Receive data	

Typedefs:

Name	Type	Description
BCM_Config_t	struct	Holds the set of configurations for the BCM
BCM_Data_t	uint8_t	Holds the data as an integer.

HAL (2): Buzzer Module

a) Buzzer_Init (Buzzer_Config_t * ConfigPtr)

Function Name	Buzzer_Init	
Argument(s)	Buzzer_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the Buzzer	

b) Buzzer_Write (Buzzer_Mode_t Mode)

Function Name	Buzzer_Write	
Argument(s)	Buzzer_Mode_t Mode	On or Off
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Switches the buzzer to the target mode	

Typedefs:

Name	Type	Description
Buzzer_Mode_t	enum	Defines OFF and ON
Buzzer_Config_t	struct	Holds the set of configurations for the Buzzer

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HAL (2): Lights Module

➔ Lights_Init (Lights_Config_t * ConfigPtr)

Function Name	Lights_Init	
Argument(s)	Lights_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the Lights	

➔ Lights_Write (Lights_Mode_t Mode)

Function Name	Lights_Write	
Argument(s)	Lights_Mode_t Mode	On or Off
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Switches the Lights to the target mode	

Typedefs:

Name	Type	Description
Lights_Mode_t	enum	Defines OFF and ON
Lights_Config_t	struct	Holds the set of configurations for the Lights

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MCAL (2): GPIO Module

APIs:

- ➔ GPIO_Init (GPIO_Config_t * ConfigPtr)

Function Name	GPIO_Init	
Argument(s)	GPIO_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the GPIO port	

- ➔ GPIO_Write (GPIO_Port_t Port, GPIO_Pin_t Pin, GPIO_Level_t Level)

Function Name	GPIO_Write	
Argument(s)	GPIO_Port_t Port	The target port
	GPIO_Pin_t Pin	The target pin
	GPIO_Level_t Level	High or Low
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Writes a level to a target GPIO pin	

- ➔ GPIO_Read (GPIO_Port_t Port, GPIO_Pin_t Pin)

Function Name	GPIO_Write	
Argument(s)	GPIO_Port_t Port	The target port
	GPIO_Pin_t Pin	The target pin
Return	GPIO_Level_t Level (High or Low)	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Reads the level of a target GPIO pin	

Typedefs:

Name	Type	Description
GPIO_Port_t	enum	Defines the available ports
GPIO_Pin_t	enum	Defines the available pins
GPIO_Level_t	enum	Defines LOW and HIGH
GPIO_Config_t	struct	Holds the set of configurations for the GPIO

MCAL (2): CAN Module

APIs:

➔ CAN_Init (CAN_Config_t * ConfigPtr)

Function Name	CAN_Init	
Argument(s)	CAN_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the CAN	

➔ CAN_Transmit (CAN_Channel_t Channel, CAN_Data_t Data)

Function Name	CAN_Transmit	
Argument(s)	CAN_Channel_t Channel	The target channel
	CAN_Data_t Data	The target data for transmission
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Transmit data	

➔ CAN_Receive (CAN_Channel_t Channel)

Function Name	CAN_Receive	
Argument(s)	CAN_Channel_t Channel	The target channel
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Receive data	

Typedefs:

Name	Type	Description
CAN_Channel_t	enum	Defines the available channels
CAN_Data_t	uint8_t	Holds the data as an integer.
CAN_Config_t	struct	Holds the set of configurations for the CAN

MCAL (2): GPT Module

APIs:

➔ GPT_Init (GPT_Config_t * ConfigPtr)

Function Name	GPT_Init	
Argument(s)	GPT_Config_t * ConfigPtr	Points to a config struct
Return	-	
Reentrancy	Non-Reentrant	
Synchronicity	Synchronous	
Description	Initializes the timer	

➔ GPT_Start (GPT_Channel_t Channel, GPT_Value_t Time)

Function Name	GPT_Start	
Argument(s)	GPT_Channel_t Channel	The target channel
	GPT_Value_t Time	The target time (tick count)
Return	-	
Reentrancy	Reentrant (but not for the same channel)	
Synchronicity	Synchronous	
Description	Starts the timer in a target channel	

➔ GPT_Stop (GPT_Channel_t Channel)

Function Name	GPT_Stop	
Argument(s)	GPT_Channel_t Channel	The target channel
Return	-	
Reentrancy	Reentrant (but not for the same channel)	
Synchronicity	Synchronous	
Description	Stops the timer in a target channel	

➔ GPT_NotificationCtrl (GPT_Channel_t Channel, GPT_Mode_t Mode)

Function Name	GPT_NotificationCtrl	
Argument(s)	GPT_Channel_t Channel	The target channel
	GPT_Mode_t Mode	Enable / Disable
Return	-	
Reentrancy	Reentrant	
Synchronicity	Synchronous	
Description	Enable/Disable the interrupt for a target channel	

Typedefs:

Name	Type	Description
GPT_Value_t	uint_32	Holds the value of time as an integer.
GPT_Channel_t	enum	Defines the available channels
GPT_Mode_t	enum	Defines DISABLE and ENABLE
GPT_Config_t	struct	Holds the set of configurations for the GPT

4. Prepare your folder structure according to the previous points