Embedded Systems Advanced Nanodegree Program

Embedded Software Design

Project: Automotive door control system design

Static design analysis

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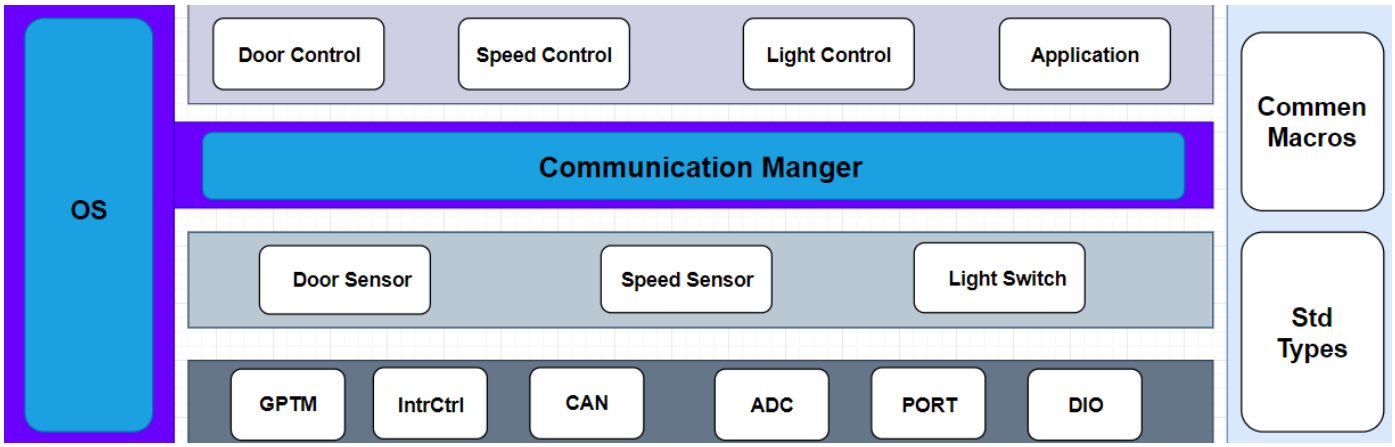

ECU1 Modules:

1- DIO Driver.
2- PORT Driver.
3- ADC Driver.
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DIO Driver

DIO typedefs:

Name:	Dio_ChannelType
Type:	uint
Range:	0 --> <Number of Channels>
Description:	Numeric ID of a DIO channel.

Name:	Dio_PortType
Type:	Unit
Range:	0 --> <Number of Ports>
Description:	Numeric ID of a DIO port.

Name:	Dio_LevelType
Type:	uint8
Range:	STD_LOW -> 0x00 (equal 0V) STD_HIGH -> 0x01 (equal 3.3V OR 5V)
Description:	possible levels of DIO channel for input or output pins

Name:	Dio_PortLevelType
Type:	uint
Range:	0 --> <Number of possible Initial levels of DIO Port>
Description:	If the MCU owns ports of different port pins

DIO Structures:

Name:	Dio_ChannelGroupType	
Type:	Structure	
Element:	mask	This element mask which defines the positions of the channel group.
	offset	This element shall be the position of the Channel Group on the port, counted from the LSB.
	port	This shall be the port on which the Channel group is defined.
Description	Type for the definition of a channel group, which consists of several adjoining channels within a port.	

Name:	Dio_ConfigChannel	
Type:	Structure	
Range:	Port_Num	Member contains the ID of the Port that this channel belongs to
	Ch_Num	Member contains the ID of the Channel
Description:	Type for the definition of a Configuration of the Channels, that contain the ID of the port and the ID of the Channel	

Name:	Dio_ConfigType
Type:	Structure
Range:	0 --> <Number of Configure Channel>
Description:	This structure contains Array of all parameters of Dio_ConfigChannel Structure in DIO driver.

DIO Function:

Function name:	Dio_Init		
Arguments:	Input	*ConfigPtr	Dio_ConfigType
		Pointer to the container	
	Output	None	None
	Input/Output	None	None
Return:	None	None	
Description:	Initializes the DIO module.		

Function name:	Dio_WriteChannel		
Arguments:	Input	ChannelId	Dio_ChannelType
		Which Pin in DIO channel	
		Level	Dio_LevelType
		Value will write in corresponding Pin	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Write Level Value in pin that chosen		

Function Name:	Dio_ReadChannel		
Arguments:	Input	ChannelId	Dio_ChannelType
		Which Pin in DIO channel	
	Output	None	
	Input/Output	None	
Return:	STD_HIGH	1	
	STD_LOW	0	
Description:	Return the Value Level of Specific Pin that chosen in Channel ID		

Port Driver

Port typedefs:

Name:	Port_PinType
Type:	uint
Range:	0 --> <number of port pins>
Description:	Data type of the name of a port pin.

Name:	Port_PinDirectionType		
Type:	Enumeration		
Range:	PORT_PIN_IN	0	Set port pin as an input
	PORT_PIN_OUT	1	Set port pin as ana output
Description:	Type for defining the direction of a Port Pin		

Name:	Port_PinModeType
Type:	uint
Range:	0 --> <number of the port pin modes>
Description:	Different port pin modes.

Name:	Pin_InitialValue
Type:	uint8
Range:	PORT_PIN_LEVEL_LOW --> 0x00 PORT_PIN_LEVEL_HIGH --> 0x01
Description:	Pin Initial Level Value

Name:	Pin_InternalResistor		
Type:	Enumeration		
Range:	OFF	0	None
	PULL_UP	1	Activation of internal pull-up
	PULL_DOWN	2	Activation of internal pull-down
Description:	Type definition for Input Pin Internal Resistor		

Port Structures:

Name:	Port_ConfigChannel	
Type:	Structure	
Elements:	port_num	Member contains ID Port (A, B, C, D, …)
	pin_num	Member contains ID Pin (1 ,2 ,3,4, …)
	direction	Member contains Pin Direction
	resistor_state	Member contains Value of internal resistor
	init_Val	Member contains Initial Level Value
	mode	Member contains the mode of the port pin
Description:	Type for the definition of a Configuration of the Channels, that contain the ID of the port and the ID of the pin, the direction, the initial value, the value of input internal resistor pins and the mode of the chosen pin.	

Name:	Port_ConfigType
Type:	Structure
Elements:	0 --> <Number of Port Configure Channel>
Description:	This structure contains Array of all parameters of Port_ConfigChannel Structure in PORT driver.

Port Function:

Function name:	Port_Init		
Arguments:	Input	*ConfigPtr	Port_ConfigType
		Pointer to the container	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Initializes the PORT module.		

Timer Driver

Timer typedefs:

Name:	Gpt_ChannelType
Type:	uint
Range:	0 --> <number of Timer in Module>
Description:	Numeric ID of a Timer channel.

Name:	Gpt_ValueType
Type:	unit
Range:	0 -> <number of ticks that can be counted in the selected timer>
Description:	Type for reading and setting the timer values (in number of ticks)

Name:	Gpt_ModeType		
Type:	Enumeration		
Range:	GPT_MODE_NORMAL	0	That a Normal Mode of the Timer Module
	GPT_MODE_SLEEP	1	This mode used to reduce power in Timer Module
Description:	Allows the selection of different power modes.		

Name:	Gpt_StateType		
Type:	Enumeration		
Range:	INITIALIZED	0	Initial state if the timer
	RUNNING	1	Timer in Running State
	STOPPED	2	Timer stopped from count ticks
	EXPIRED	3	Timer Finish count the Ticks
Description:	Allows the State of Timer		

Name:	Gpt_RunningMode		
Type:	Enumeration		
Range:	GPT_CONTINUOUS	0	Reach to Elapsed Value and repeat this operation
	GPT_ONE_SHOTT	1	Reach to Elapsed Value only one time
	GPT_CAPTURE	2	This mode use the timer act as a counter not Timer
Description:	Allows the Count Mode of the timer		

Name:	Gpt_InterruptOption		
Type:	Enumeration		
Range:	INTERRUPT_OFF	0	Disable Interrupt
	INTERRUPT_ON	1	Enable Interrupt
Description:	Enable OR Disable the Interrupt of the ID of Timer Channel		

Timer Structure:

Name:	Gpt_ConfigChannel	
Type:	Structure	
Elements:	GptChannelId	ID of timer Channel
	Gpt_ChannelMode	Mode of the Channel of the timer
	Gpt_ChannelState	State of the Channel of the Timer
	GptChannelTickFrequency	Contain the Tick Value of the Channel of the Timer
	GptChannelTickValueMax	Contain maximum Tick Value of the Channel of the Timer
	Gpt_EnableChannelNotification	Enable/Disable Interrupt
	ChannelMode	Mode of the timer (Timer / Counter)
	(*GptNotifcation)(void)	-
Description:	Type for the definition of a Configuration of the Channels, that contain all required data to initializing the GPT timer	

Name:	Gpt_ConfigType
Type:	Structure
Elements:	0 --> <Number of Timer Configure Channel>
Description:	This structure contains Array of all parameters of Gpt_ConfigChannel Structure in Timer driver.

Timer Function:

Function Name:	Gpt_init		
Arguments:	Input	*ConfigPtr	Gpt_ConfigType
		Pointer to a selected configuration structure	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Initializes the timer module.		

Function Name:	Gpt_DisableNotification		
Arguments:	Input	Channel	Gpt_ChannelType
		Numeric identifier of the GPT channel.	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Enable the Interrupt of the ID of Timer Channel		

Function Name:	Gpt_EnableNotification		
Arguments:	Input	Channel	Gpt_ChannelType
		Numeric identifier of the GPT channel.	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Disable the Interrupt of the ID of Timer Channel		

Function Name:	Gpt_StartTimer		
Arguments:	Input	Channel	(Gpt_ChannelType
		Numeric identifier of the GPT channel.	
		Value	Gpt_ValueType
		Target time in number of ticks.	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Start the Channel of the timer		

Function name:	Gpt_StopTimer		
Arguments:	Input	Channel	Gpt_ChannelType
		Numeric identifier of the GPT channel.	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Stop the Channel of the timer		

Function name:	Gpt_GetTimerElapsed		
Arguments:	Input	Channel	Gpt_ChannelType
		Numeric identifier of the GPT channel.	
	Output	None	
	Input/Output	None	
Return:	Gpt_ValueType	0 -> <number of ticks that can be counted in the selected timer>	
Description:	Returns the time already elapsed.		

Function name:	Gpt_TimerRemaining		
Arguments:	Input	Channel	Gpt_ChannelType
		Numeric identifier of the GPT channel.	
	Output	None	
	Input/Output	None	
Return:	Gpt_ValueType	0 -> <number of ticks that can be counted in the selected timer>	
Description:	Returns the time remaining until the target time is reached.		

Interrupt Driver

Interrupt Typedefs

Name:	InterruptPeripheralGates
Type:	uint
Range:	0 --> <number of Exception Types >
Description:	Numeric ID of an Interrupt Peripheral Gates.

Name:	InterruptGroupPriority
Type:	uint8
Range:	0 --> 7
Description:	Set Group priority of the interrupt

Name:	InterruptSub_GroupPriority
Type:	uint8
Range:	0 --> 7
Description:	Set the Subgroup of the interrupt

Name:	IntCtrl_InterruptType		
Type:	Enumeration		
Range:	Interrupt Peripheral Gates	0 --> <138>	Interrupt of all Peripherals
Description:	Enable the interrupt of the peripheral		

Interrupt Structure:

Name:	IntCtrl_ConfigChannel	
Type:	Structure	
Elements:	IntCtrl_Interrupt_Number	Numeric ID of an Interrupt Peripheral
	Group Priority	Set Group priority of the interrupt
	subgroup Priority	Set the Subgroup of the interrupt
Description:	Type for the definition of a Configuration of the Channels, that contain all required data to initializing the Interrupt Driver	

Name:	IntCtrl_ConfigType
Type:	Structure
Elements:	0 --> <Number of Interrupt Configure Channel>
Description:	This structure contains Array of all parameters of IntCtrl_ConfigChannel Structure in Interrupt driver.

Interrupt Function:

Function name:	IntCtrl_init		
Arguments:	Input	*ConfigPtr	IntCtrl_ConfigType
		Pointer to a selected configuration structure	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Initializes the Interrupt module.		

CAN Driver

CAN Typedefs

Name:	Can_IdType	
Type:	uint	
Range:	0 --> <0x7FF>	Set 11 bits (Standard)
	0 --> <0x1FFFFFFF>	Set 29 bits (Extended)
Description:	Represents the Identifier of an L-PDU. For extended IDs the most significant bit is set.	

Name:	Can_StateTransitionType		
Type:	Enumeration		
Range:	CAN_T_START	0	CAN controller request state be STARTED.
	CAN_T_STOP	1	CAN controller request state be STOPPED.
	CAN_T_SLEEP	2	CAN controller request state be STLEEP.
	CAN_T_WAKEUP	3	CAN controller request state be WAKEUP.
Description:	State of the Can controller		

Name:	Can_ReturnType		
Type:	Enumeration		
Range:	CAN_OK	0	Return success
	CAN_NOT_OK	1	Return not success cause of error occurred
	CAN_BUSY	2	transmitter or receiver wasn't available
Description:	Return values of CAN driver API.		

CAN Structure:

Name:	Can_ControllerBaudrateConfigType	
Type:	Structure	
Elements:	CanControllerBaudRate	Specifies the baud rate of the controller in kbps from 0 to 2000
	CanControllerSeg1	Specifies phase segment 1 in time
	CanControllerSeg2	Specifies phase segment 2 in time
	CanControllerSeg3	Specifies phase segment 3 in time
Description:	This is the type of the external data structure containing the bit timing related initialization data for one CAN controller. The contents of the initialization data structure are CAN hardware specific.	

Name:	Can_PduType	
Type:	Structure	
Elements:	swPduHandle	-
	length	-
	id	-
	sdu	-
Description:	This type is used to provide ID, DLC and SDU from CAN interface to CAN driver.	

Name:	can_ConfigType1
Type:	Structure
Elements:	0 --> <Number of Baud rate Configure Channel>
Description:	This structure contains Array of all parameters of Can_ControllerBaudrateConfigType Structure in Timer driver.

Name:	can_ConfigType2
Type:	Structure
Elements:	0 --> <Number of PduType Configure Channel>
Description:	This structure contains Array of all parameters of Can_PduType Structure in Timer driver.

CAN Functions:

Function name:	CanBaudRate_init		
Arguments:	Input	*ConfigPtr1	can_ConfigType1
		Pointer to a selected Baud rate configuration structure	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	brief This function initializes the module.		

Function name:	CanPduType_init		
Arguments:	Input	*ConfigPtr2	can_ConfigType2
		Pointer to a selected Pdu Type configuration structure	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	brief This function initializes the module.		

Function name:	Can_SetBaudrate		
Arguments:	Input	Controller	uint8
		ID controller (CAN0 ,CAN1 ,…)	
		CanControllerBaudRate	uint16
		sets Baudrate	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	brief This function sets Baudrate the module.		

Function name:	CAN_SendData		
Arguments:	Input	Data	uint16
		Data required to be sent	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Send Data from the CAN controller.		

Function name:	CAN_ReceiveData	
Arguments:	Input	None
	Output	None
	Input/Output	None
Return:	None	
Description:	Receive Data from the CAN controller.	

ADC Driver

ADC typedefs

Name:	ADC_ChannelType
Type:	uint
Range:	0 --> <number of ADC channel Types >
Description:	This is the type of the data structure including the configuration set required for initializing the ADC.

Name:	Adc_ResolutionType
Type:	uint8
Range:	The range of this type is µC specific and must be described by the supplier.
Description:	Type of channel resolution in number of bits.

Name:	Adc_StatusType		
Type	Enumeration		
Range:	ADC_IDLE	0	The conversion of the specified group has not been started.
	ADC_BUSY	1	The conversion of the specified group has been started and is still going on.
	ADC_COMPLETED	2	A conversion round (which is not the final one) of the specified group has been finished.
	ADC_STREAM_COMPLETED	3	For each channel of the selected group the number of samples to be acquired is available
Description:	Current status of the conversion of the requested ADC Channel group.		

ADC Structure

Name:	Adc_ConfigChannel	
Type:	Structure	
Elements:	ADC_channel	number of ADC channel Types
	Adc_Resolution	channel resolution in number of bits
	Adc_Status	Current status of ADC requested
Description:	Type for the definition of a Configuration of the Channels, that contain all required data to initializing the Adc Driver	

Name:	Adc_ConfigType
Type:	Structure
Elements:	0 --> <Number of Adc Configure Channel>
Description:	This structure contains Array of all parameters of Adc_ConfigChannel Structure in Adc driver.

Adc Functions

Function name:	Adc_init		
Arguments:	Input	* ConfigPtr	ADC_ConfigType
		Pointer to a selected configuration structure	
	Output	None	
	Input/Output	None	
Return:	None		
Description:	Initializes the ADC module.		

Function name:	Adc_readChannel		
Arguments:	Input	Channel	ADC_ChannelType
		Numeric ID of an Adc Channels	
	Output	None	
	Input/Output	None	
Return:	Returns the value of the specified ADC Channel		
Description:	Get the value of ADC Channel.		

ECU1 Components:

1- Door Sensor.
2-Speed Sensor.
3-Light Switch.

Door Sensor

Door Functions:

Function name:	Door_init	
Arguments:	Input	None
	Output	None
	Input/Output	None
Return:	None	
Description:	Initializes the Door Module.	

Function name:	Door_State		
Arguments:	Input	PinId	Dio_PinIdType
		ID of DIO PIN	
	Output	None	
	Input/Output	None	
Return:	The Level Value of the Dio Pin ID		
Description:	State of a Door sensor on DIO_Pin		

Speed Sensor

Speed Function:

Function name:	Speed_init	
Arguments:	Input	None
	Output	None
	Input/Output	None
Return:	None	
Description:	Initializes the Speed Module	

Function name:	Speed_State		
Arguments:	Input	Channel	ADC_ChannelType
		ID of ADC Channel	
	Output	None	
	Input/Output	None	
Return:	The Value of the ADC channel		
Description:	State of a Speed Sensor on ADC Channel		

Light Switch Sensor

Light Functions:

Function name:	Light_init	
Arguments:	Input	None
	Output	None
	Input/Output	None
Return:	None	
Description:	Initializes the Light Module	

Function name:	Light_State		
Arguments:	Input	PinId	Dio_PinIdType
		ID of DIO PIN	
	Output	None	
	Input/Output	None	
Return:	The Level Value of the Dio Pin ID		
Description:	State of a Light sensor on DIO_Pin		