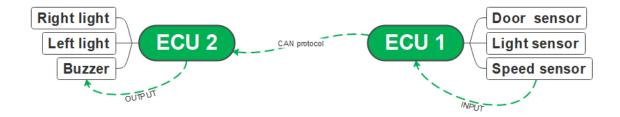
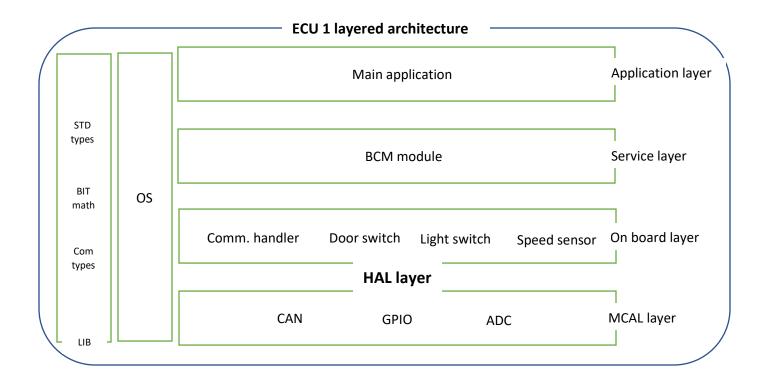
# **Embedded system design project**

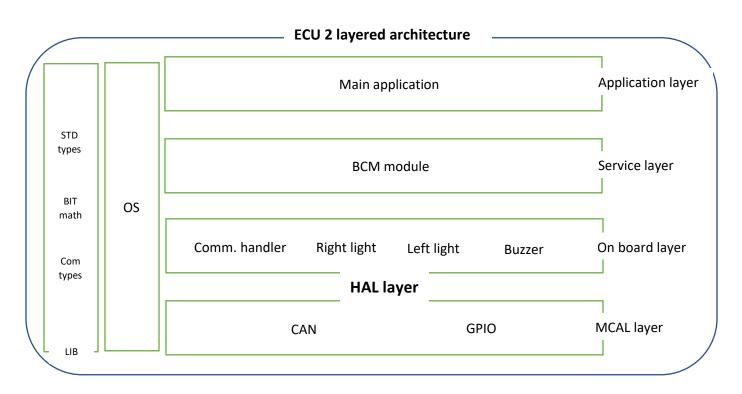
## **Content:**

- Static design
  - System block diagram design
  - Layered architecture
  - ECUs modules and components used
  - Detailed APIs
- Dynamic design
  - State machine diagram of each component
  - State machine diagram of the ECU operation
  - Sequence diagram

# System block diagram design







# ECU 1 components and modules:

- GPIO
- ADC
- CAN
- RTOS
- LIB
- BCM module
- Communication handler
- Door switch
- Light switch
- Speed sensor

# ECU 2 components and modules:

- GPIO
- CAN
- RTOS
- LIB
- BCM module
- Communication handler
- Right light
- Left light
- Buzzer

# ECU 1 APIs and data types:

Function name		GPIO_	GetPinDirection(portID port, PinNo pin)				
				p	ort		portID
				Description: Port number			
Arguments			Inputs		in		PinNo
				Description: Pin number			
			GPIO_INPUT	Description. Fill humber	0		
Return							
Description			GPIO_OUTPUT	<u> </u>	1		
Description			This function is used to get a pin's direction				
			/				
Function name	GPIO	)_SetPin	Value(portID port, PinNo pin, PinValue value)				
					ort		portID
				Description: Port number			
Arguments			Inputs		in		PinNo
_				Description: Pin number			
				va	lue		PinValue
				Description: Pin value (H/L)			
Return			void		N/A		
Description			This function is used to set a pin's value to high o	rlow			
Function name			GPIO_INIT(void)	İ			1
Arguments			Inputs		N/A		
Return			void		N/A		
Description			This function is responsible for initializing GPIO	driver	,14		
2 2 2 2 1 peron			Steaponstor for microlling drift				
Function name	GPIO	SetDinD	irection(portID port, PinNo pin, PinDir direction)				
Tunedon nume	di 10_0	ocu iiib	nection(portion port, r into pin, r into in direction)	n	ort		portID
				Description: Port number	011		portio
					in		PinNo
Arguments			Inputs		"""		FIIINO
				Description: Pin number	ction		PinDir
					CUOII		PIIIDII
Return			void	Description: Pin direction	N/A		
$\overline{}$			This function is used to set a pin's direction to outpu	t or innut	N/A		
Description			This function is used to set a pin's direction to outpu	t or input			
Function name		GPIC	_GetPinValue(portID port, PinNo pin)				
				p	ort		portID
				Description: Port number			
Arguments			Inputs	р	in		PinNo
				Description: Pin number			
Datama			GPIO_LOW		0		
Return			GPIO_HIGH		1		
Description			This function is used to get a pin's value				
Name			portID				
Туре			Enumeration				
	PORTA		0	Description: choose PortA			
Range	PORTB		1	Description: choose PortB			
	PORTC		2	Description: choose PortC			
Description			This enumeration is used to help with choosing the port in code				
Name			PinNo				
Type			Enumeration				
	PIN0		0		Description: 0	hoose pin 0	
1	PIN1		1		Description: 0	hoose pin 1	
	PIN2		2		Description: 0		
Range	PIN3	$\overline{}$	3		Description: 0	hoose pin 3.	
	PIN4 PIN5		4		Description: 0	ion: Choose pin 4	
			5			hoose pin 5	oin 5
1	PIN6	6	Description: Choose pin 6				
	PIN7		7		Description: 0		
n	FIIV				Description. C	noose pin 7	
Description			This enumeration is used to help with choosing t	ne pins in code			
Name			PinDir				
Туре			Enumeration				
77-	GPIO INPUT		0		Description: S	at the nin -	inout
Range							
	GPIO_OUTPUT		1		Description: S	et the pin as	output
Description			This enumeration is used to help with choosing the dire	ection of a pin in cod	e		

				•		
Name		PinValue				
Туре		Enumeration				
Range	GPIO_LOW	0		Description: set the pin to low		
	GPIO_HIGH	1		Description: set the pin to high	1	
Description		This enumeration is used to help with cho	osing the value of a pin in code	T. T		
Francisco a const		ADC INIT(:-1)				
Function name		ADC_INIT(void)			21/2	
Arguments		Inputs void			N/A N/A	
Return Description			esponsible for initializing ADC o	rivor	N/A	
Description		This function is re	esponsible for initializing ADC t	ilivei		
Function name		ADC_StartContinuous(void)				
Arguments		Inputs			N/A	
Return		void			N/A	
Description			d to start ADC conversion conti	nuously		
				1	-	1
						-
Function name		ADC_StopContinuous(void)				
Arguments		Inputs			N/A	
Return		void			N/A	
Description		This function is use	ed to stop continuous ADC conv	ersion		
Eunction =====	ADC Boodycline	(ADC Channel SEL ADC Channel ADC Resolution	+ ADC Posulution)			
Function name	AUC_Keadvalue	(ADC_Channel_SEL_ADC_Channel, ADC_Resulution	_t ADC_Resulution)	ADC_C	hannol	ADC_Channel_S
	Inputs			Description: select ADC chann		ADC_Channel_s
Arguments				ADC Re		ADC_Resulution
				Description: select ADC resolu		ADC_RESUITED
Return		u int16		Description: data to be read		
Description		<u>-</u>	to get the data read on a specifi			
Description		This failetier is a sea t	to Bet the data read on a specifi	o ditamine.		
Function name		CAN_INIT(void)				
Arguments		Inputs			N/A	
		E OK		Descriptio	n: The operation do	one successffully
Return		E_NOK		Descriptio	n: The operation wa	asn't successfful
Description		This function	n is used to initialize CAN drive	r		
Function name		CAN_SendByte(u_int8 Byte)				
Arguments		Inputs		Ву		u_int8
		E OK		Description: the byte to be sen		
Return		E_NOK		1	n: The operation do n: The operation wa	
Description		<del>-</del>	n is used to send a byte of data	Descriptio	n. The operation wa	isii t successiiui
Bescription		mistanea	in is asea to sena a byte or data			
Name		OutputState				
Туре		Enumeration				
	E OK	0		Description: The operation do	ne successffully	
Range	E NOK	1		Description: The operation wa	sn't successfful	
Description	_	This enumeration is used to check if a	function succeeded to run			
	· .	,				
Name		ADC_Channel_SEL				
Туре		Enumeration				
	A0		0		Description: Sele	ect channel AO
	A1			Description: Select channel A1		ect channel A1
	A2 2		Description: Select channel A2			
Range						
			Description: Select channel A3			
	A4 4			Description: Select channel A4		
	A5		5		Description: Sele	ect channel A5
Description						
Name		ADC Resulution t	:			
Туре		Enumeration				
.10c	olaht bit-	Enumeration	0		December: 5:	O bis
Range	eight_bits					ect 8 bits resolution
	ten_bits		1		Description: Sel	ect 10 bits resolution
Description		This Enumeratio	on is used to set the ADC re	solution		

Name	Byte				
Туре	u_int8				
Range	0:255				
Description	The data we want to send or receive over CAN				
Function name	SpeedSensorRead()				
Arguments	Inputs	N/A			
Return	u_int16	Description: speed sensor reading			
Description	This function is used to get the dat	a out of the speed sensor			
Function name	LightSwitchRead()				
Arguments	Inputs	N/A	N/A		
Datum	LOW	Description: The light switch st	Description: The light switch state is low		
Return	HIGH	Description: The light switch st	ite is high		
Description	This function is used to get the s	tatus of the light switch			
Function name	DoorSwitchRead()	İ	· · · · · · · · · · · · · · · · · · ·		
Arguments	Inputs	N/A			
	LOW	Description: The door state	slow		
Return	HIGH	Description: The door state	s hgih		
Description	This function is used to get the s	tatus of the door switch			
Function name	BCM_SendByte(u_int8 Byte)				
Arguments	Inputs	Byte	u_int8		
Algumento	трио	Description: byte to be sent	Description: byte to be sent		
Return	E_OK	Description: The operation done s	Description: The operation done successffully		
neturi	E_NOK Description: The operation wasn't succ				
Description	This function is used to send a byte o	f data through BCM module			
Function name	BCM_HandlerSendByteThroughCAN(u_int8 Byte)				
Arguments	Inputs	Byte	u_int8		
		Description: byte to be sent			
Return	E_OK	Description: The operation done s	Description: The operation done successffully		
	E_NOK	Description: The operation wasn't	successfful		
Description	This function is used to send a byte of data th	arough BCM handler to CAN module			

# ECU 2 APIs and data types:

Function name	GPIC	D_INIT(void)				
Arguments		Inputs	N/A	Desc: N/A		
Return		void	N/A			
Description		This function is responsible for ini	tializing GPIO driver			
Function name	GPIO_SetPinDirection(port	ID port, PinNo pin, PinDir direction)	)			
			port	portID		
Arguments			Description: Port number			
		Inputs	pin	PinNo		
		•	Description: Pin number			
			direction	PinDir		
			Description: Pin direction			
Return		void	N/A			
Description	Th	is function is used to set a pin's dire	ction to output or input	:		
Function name	GPIO_GetPinDirect	ion(portID port, PinNo pin)				
			port	portID		
Arguments		Inputs	Description: Port number			
Aiguments		inputs	pin	PinNo		
			Description: Pin number			
Return	GI	PIO_INPUT	0			
	GPI	о_оитрит	1			
Description		This function is used to get a	pin's direction			
Function name	GPIO_SetPinValue(portID	port, PinNo pin, PinValue value)				
			port	portID		
			Description: Port number			
Arguments	Inputs		pin	PinNo		
			Description: Pin number	p!-v-l		
			value	PinValue		
Datama		!4	Description: Pin value (H/L)			
Return		void  This function is used to set a pin's	N/A			
Description	:	1	value to high or low	1,		
Function name	GPIO_GetPinValu	ıe(portID port, PinNo pin)				
			port	portID		
Arguments		Inputs	Description: Port number	<del></del>		
_			pin	PinNo		
			Description: Pin number			
Return		PIO_LOW	0			
	G	PIO_HIGH	1			
Description		This function is used to get	apin's value			
Name		nortID				
Name	En	portID		_		
Туре	PORTA	umeration 0	Description: channel Banks			
Range	PORTA	1	Description: choose PortA	_		
nange	PORTC	2	Description: choose PortB			
Description		meration is used to help with choos	Description: choose PortC			
• Description	• IIIIS EIIUI	menation is asea to help with thous	mg me port in code			

Name		nNo .			
Туре	Enume	eration			
L	PIN0	0		Description: Choose pin 0	
	PIN1	1		Description: Choose pin 1	
	PIN2	2		Description: Choose pin 2	
Dango	PIN3	3		Description: Choose pin 3	
Range	PIN4	4		Description: Choose pin 4	
	PIN5	5		Description: Choose pin 5	
Г	PIN6	6		Description: Choose pin 6	
	PIN7	7		Description: Choose pin 7	
Description	This enumera	ation is used to help with	h choosin	g the pins in code	
Name	Pir	nDir			
Туре	Enume	eration			
D	GPIO_INPUT 0		Description: Set the pin as input		
Range	GPIO_OUTPUT	1		Description: Set the pin as output	
Description	This enumeration is	used to help with choos	sing the d	irection of a pin in code	
Function name	BuzzerOFF	0			
			_	N/A	
Return	E_OK	_	on: The operation done successffully		
December 1	E_NOK	Lin f		on: The operation wasn't successfful	
Description	II	his function is used to turn	the buzze	erott	
Function name	RightLightO	N()			
distroit fiding	Мъливио	1/		N/A	
	E OK			Description: The operation done successffully	
Return	E_NOK	Description: The operation wasn't successfful			
Description	Thi	is function is used to turn t	he right li	ght on	
Function name	RightLightOI	FF()			
Arguments	Inputs			N/A	
Return	E_OK		Description: The operation done successffully		
	E_NOK			on: The operation wasn't successfful	
Description	This function is used to turn the right l			1	

		<u> </u>
Function name	LeftLightON()	
Arguments	Inputs	N/A
Return	E_OK	Description: The operation done successffully
Ketuiii	E_NOK	Description: The operation wasn't successfful
Description	This function is used to tu	urn the left light on
Function name	LeftLightOFF()	
Arguments	Inputs	N/A
Return	E_OK	Description: The operation done successffully
Return	E_NOK	Description: The operation wasn't successfful
Description	This function is used to tu	urn the left light off
Function name	BCM_ReadByte()	
Arguments	Inputs	N/A
Return	E_OK	Description: The operation done successffully
Retuin	E_NOK	Description: The operation wasn't successfful
Description	This function is used to read a byte	of data through BCM module
Function name	BCM_HandlerReadByteThroughCAN()	
Arguments	Inputs	N/A
Deturn	E_OK	Description: The operation done successffully
Return	E_NOK	Description: The operation wasn't successfful
Description	This function is used to read a byte of data	through BCM handler to CAN module

GPIO_LOW GPIO_HIGH  This enumeration  CAN_IN  Inp  E_  CAN_Re	eration  0  1  is used to help with choosin  NIT(void)  outs  OK  NOK  This function is used to in	N/A Description: N/A 0	N/A	
CAN_Re	1 I is used to help with choosin  IIT(void)  OK  NOK  This function is used to in	Description: set the pin to high  ng the value of a pin in code  N/A  Description: N/A  0	N/A	
This enumeration  CAN_IN  Inp  E_  CAN_Re	I is used to help with choosin  IIT(void)  OK  NOK  This function is used to in	N/A  Description: N/A  0	N/A	
CAN_IN Inp E_ E_I	NIT(void)  outs  OK  NOK  This function is used to in	N/A Description: N/A 0	N/A	
Inp E_ E_N CAN_Re	OK NOK This function is used to in	Description: N/A 0 1	N/A	
Inp E_ E_N CAN_Re	OK NOK This function is used to in	Description: N/A 0 1	N/A	
E_ E_N CAN_Re	OK NOK This function is used to in	Description: N/A 0 1	N/A	
E_ E_N CAN_Re	OK NOK This function is used to in	0		
E_N CAN_Re	NOK  This function is used to in	o 1 Nitialize CAN driver		
CAN_Re	This function is used to in	1 litialize CAN driver		
		nitialize CAN driver		
	eadByte()			
		N/A		
u_i	int8	Description: the byte to be read		
	This function is used to re	ead a byte of data		
Outpu	utState			
Enum	eration			
E_OK	0	Description: The operation done successffully		
E_NOK	1	Description: The operation wasn't successfful		
This function	on is used to check if a functi	ion succeeded to run		
·				
u_int8				
The data we want to se	end or receive over CAN			
Buzze	erON()			
		N/A		
E_	ОК	Description: The operation done successffully		
E_I	NOK	Description: The operation wasn't successfful		
	E_OK E_NOK  This functi  B:  U_ 0: The data we want to se	Byte u_int8 0:255 The data we want to send or receive over CAN  BuzzerON()  E_OK E_NOK	E_OK 0 Description: The operation done successffully  E_NOK 1 Description: The operation wasn't successfful  This function is used to check if a function succeeded to run   Byte  u_int8 0:255  The data we want to send or receive over CAN  BuzzerON()  N/A  E_OK Description: The operation done successffully	