Mastering Embedded Systems Diploma

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First Term (Final Project 2)

Pressure Controller

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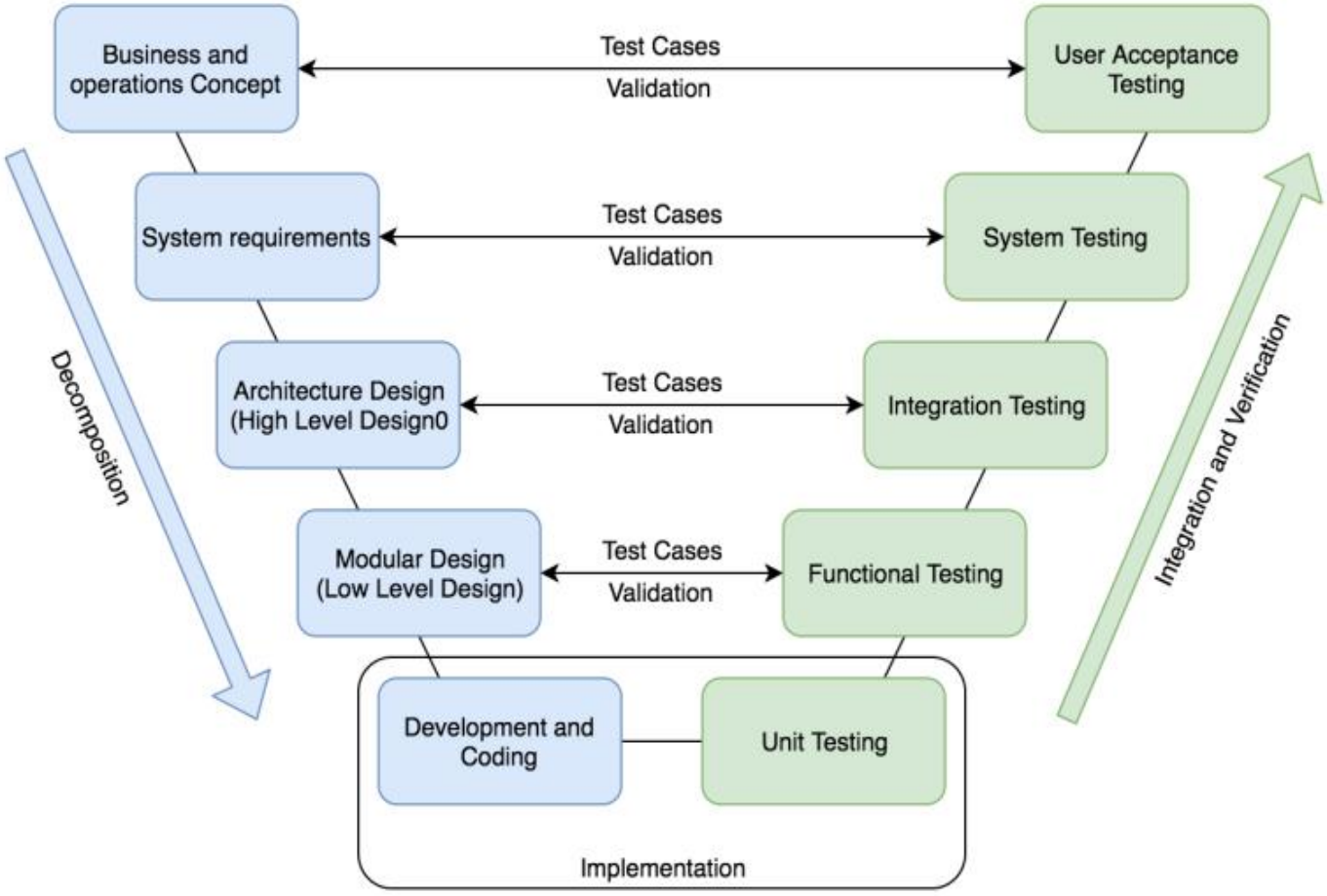
- **Case study**

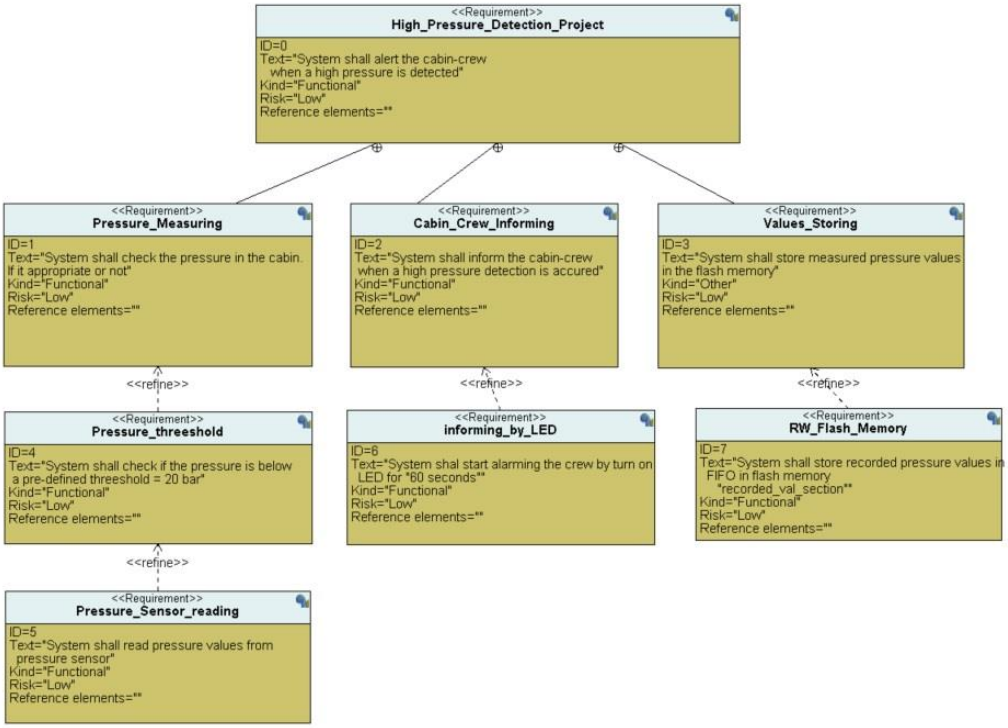
  A pressure detection system is required to monitor pressure levels in a plane's kokbit to inform the crew when a high pressure detected (above 20bar) by turning on an alarm for 60 seconds.
  Optional: Measured values could be tracked and stored

  Assumptions:
  - The controller startup and shutdown procedures aren't moduled.
  - The controller maintenance isn't modueled.
  - Pressusre sensor never fails.
  - Alarm never fails.
  - The controller never faces a power cut.

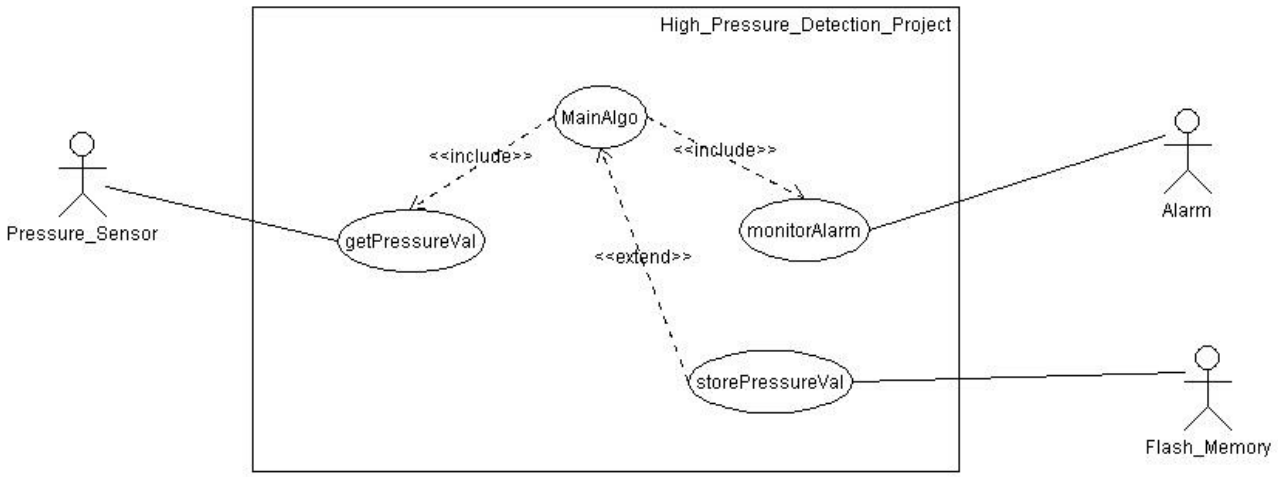
- **Methodolgy**



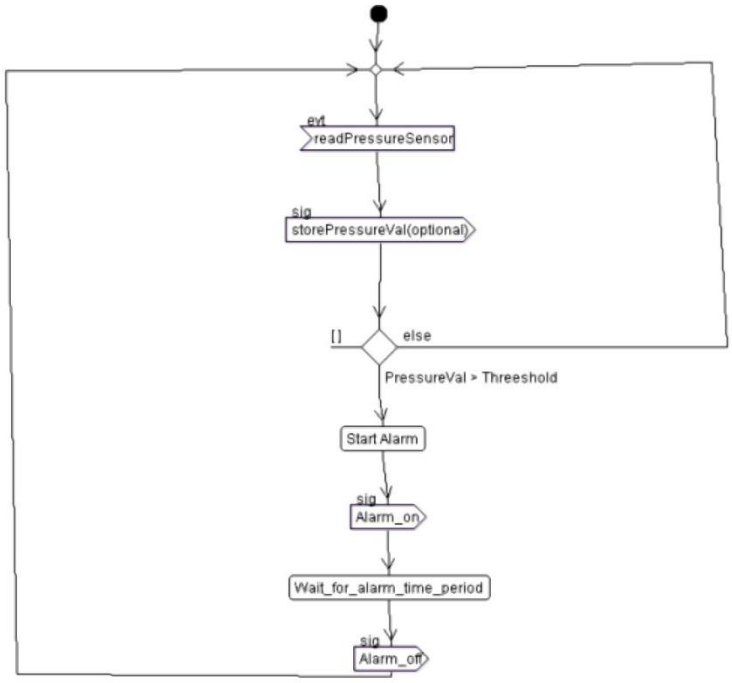
- **System Requirment**
  - UML Requirment Diagram



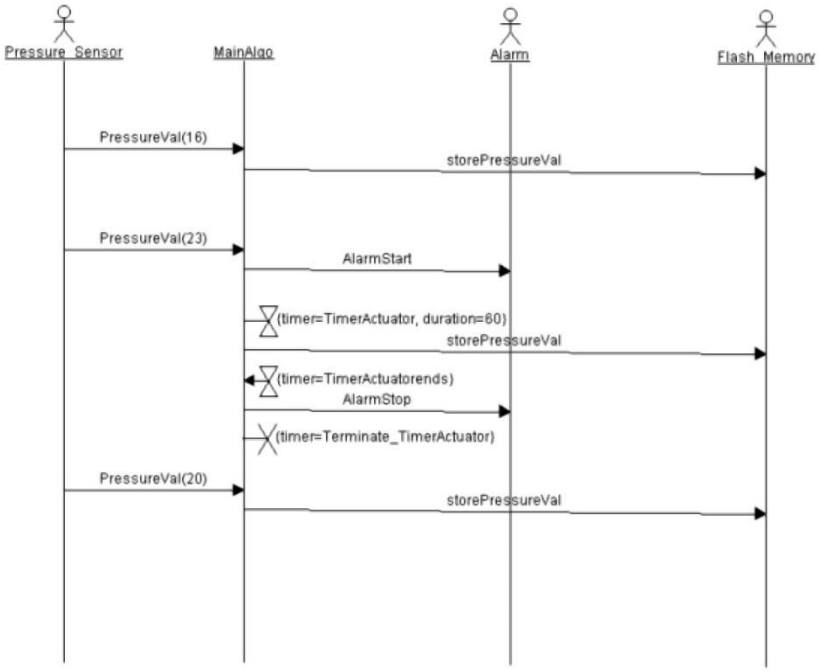
- **System Analysis**
  - UML Use Case Diagram



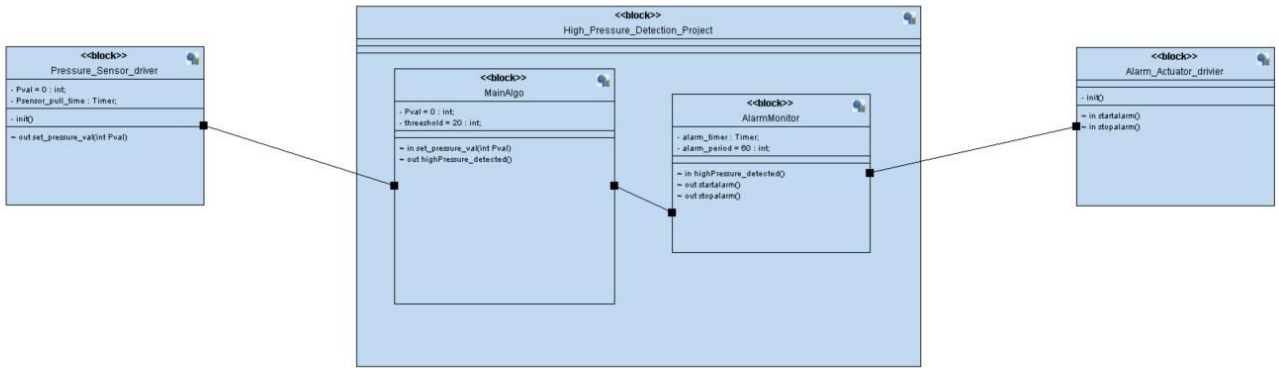
- UML Activity Diagram



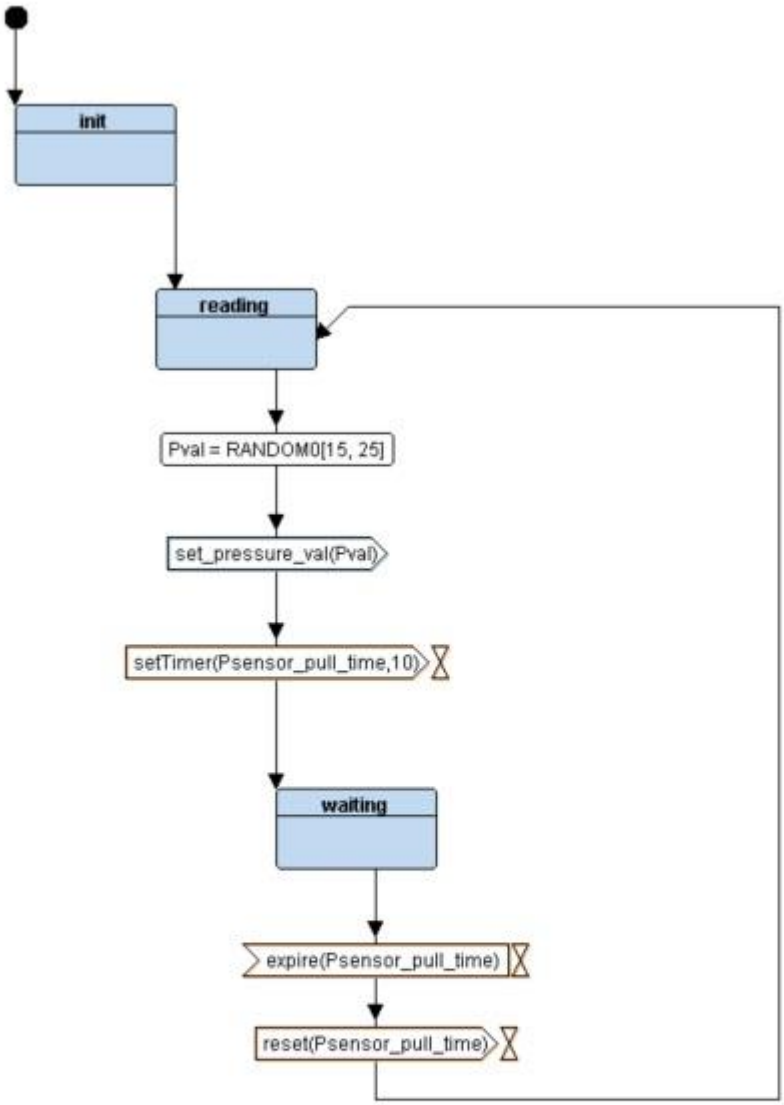
- UML Sequence Diagram



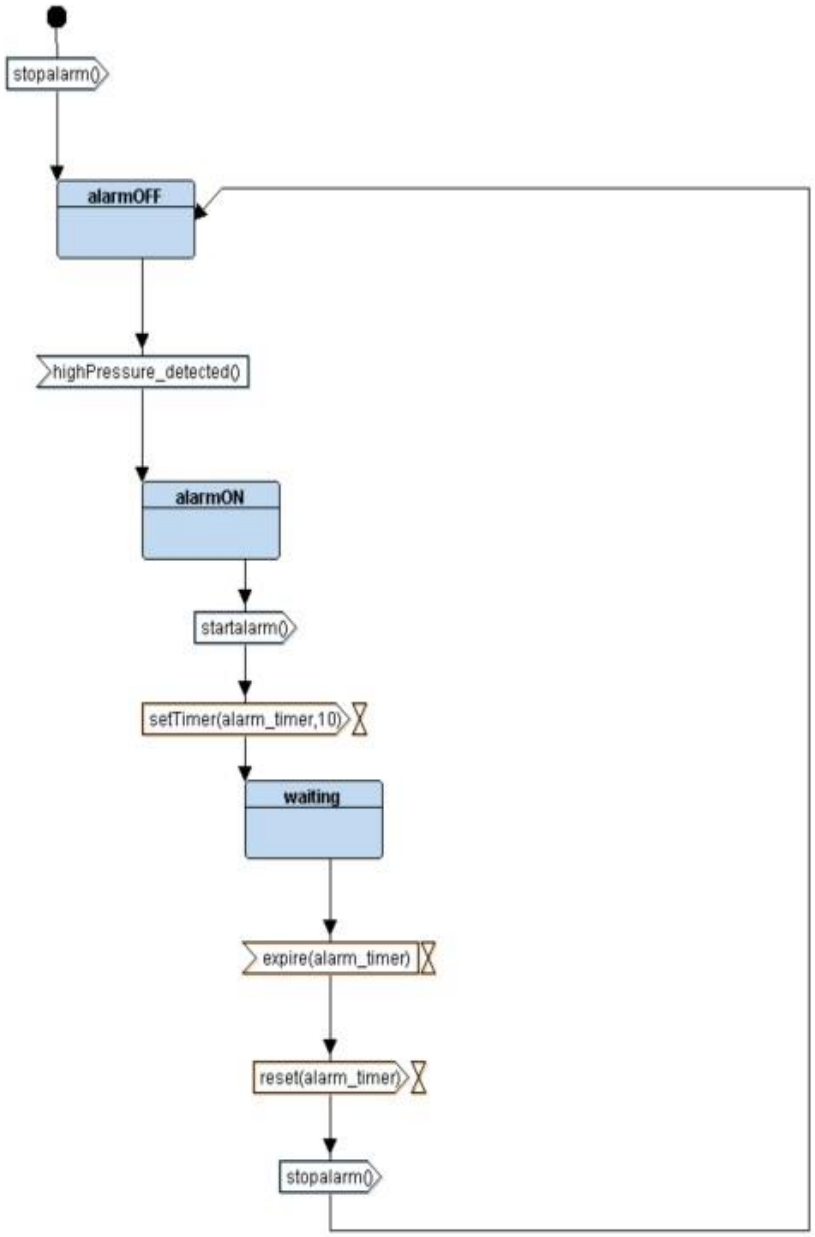
- **System Disegn**
  - UML Class Diagram



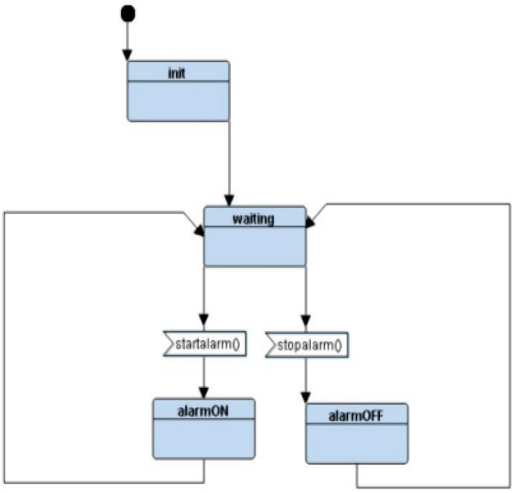
- UML State Diagrams
    1. Pressure Sensor



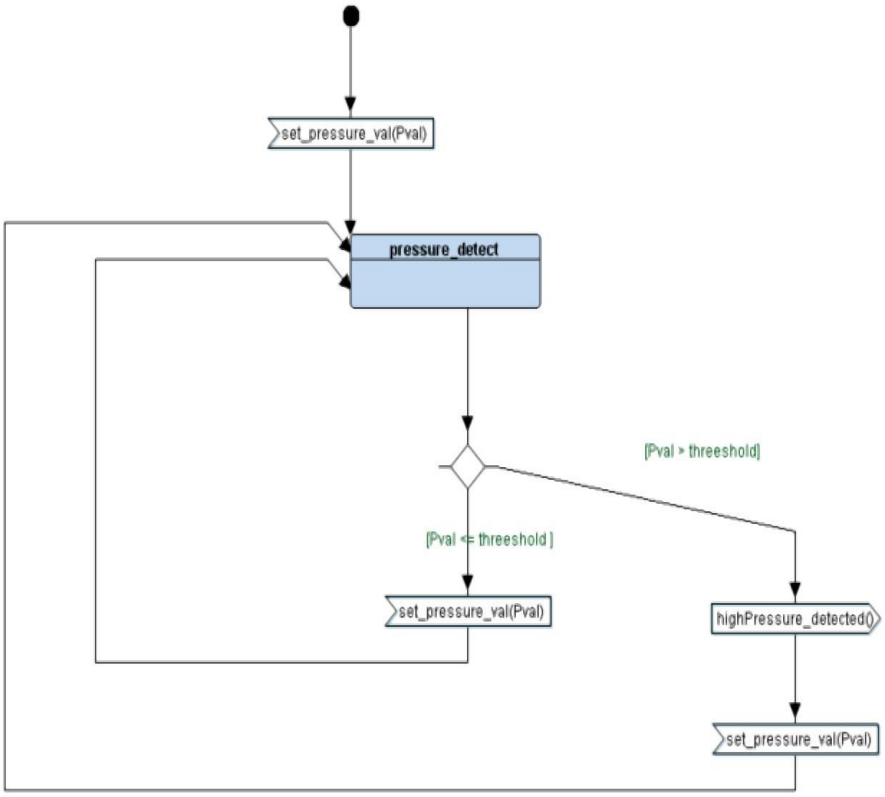
2. Alarm Monitor



3. Alarm Sensor

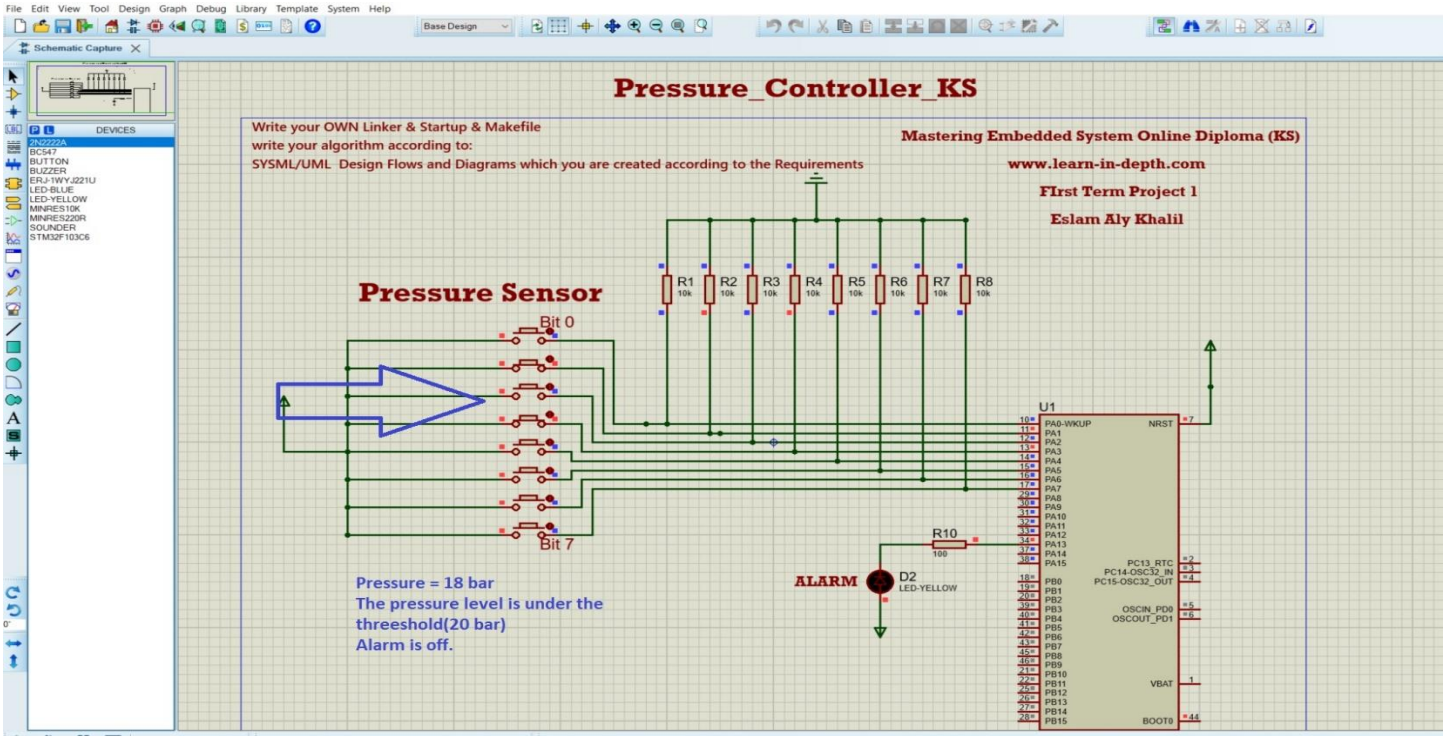


4.Main

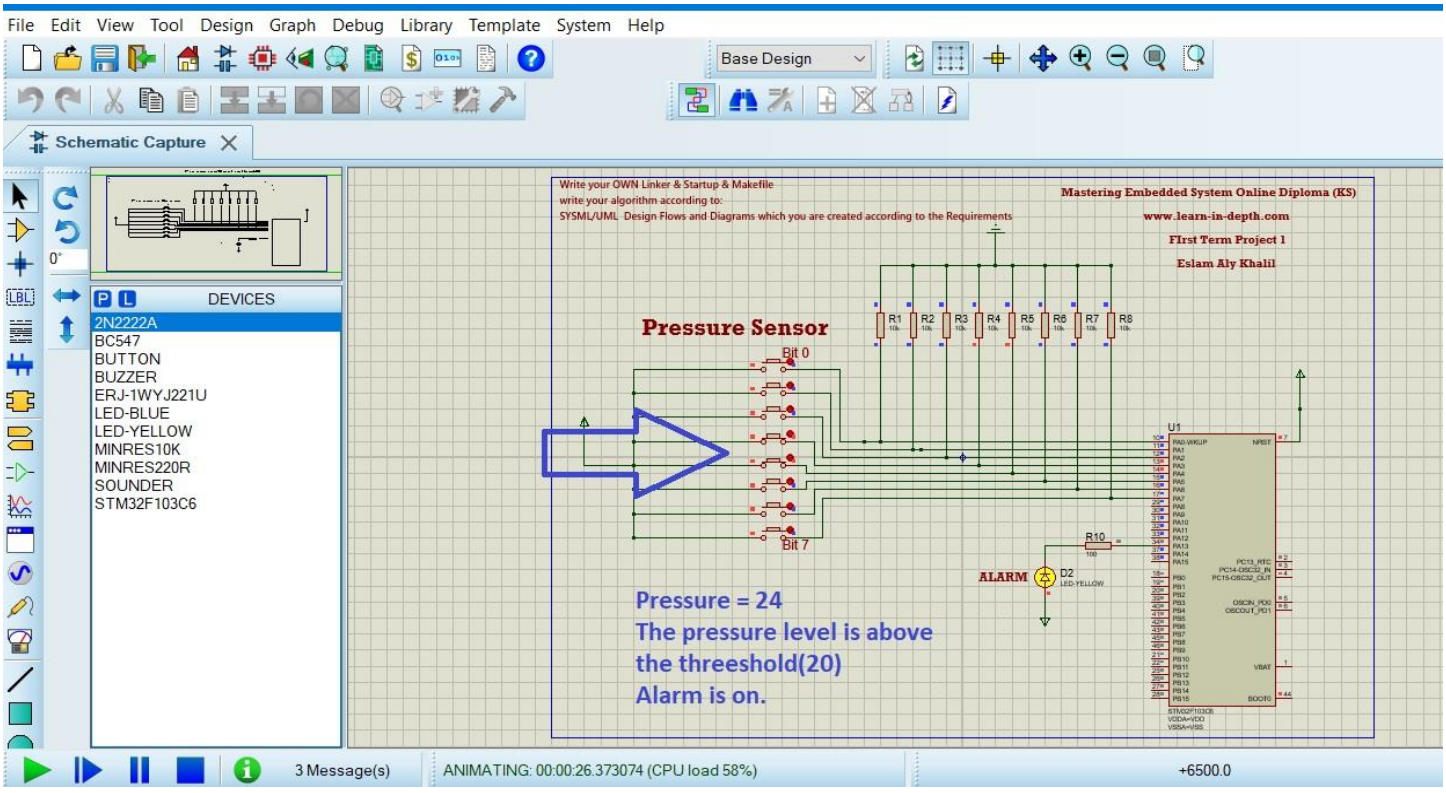


- **Project Simulation on Proteus**

  When a pressure level is under the threeshold(20 bar), alarm is off.

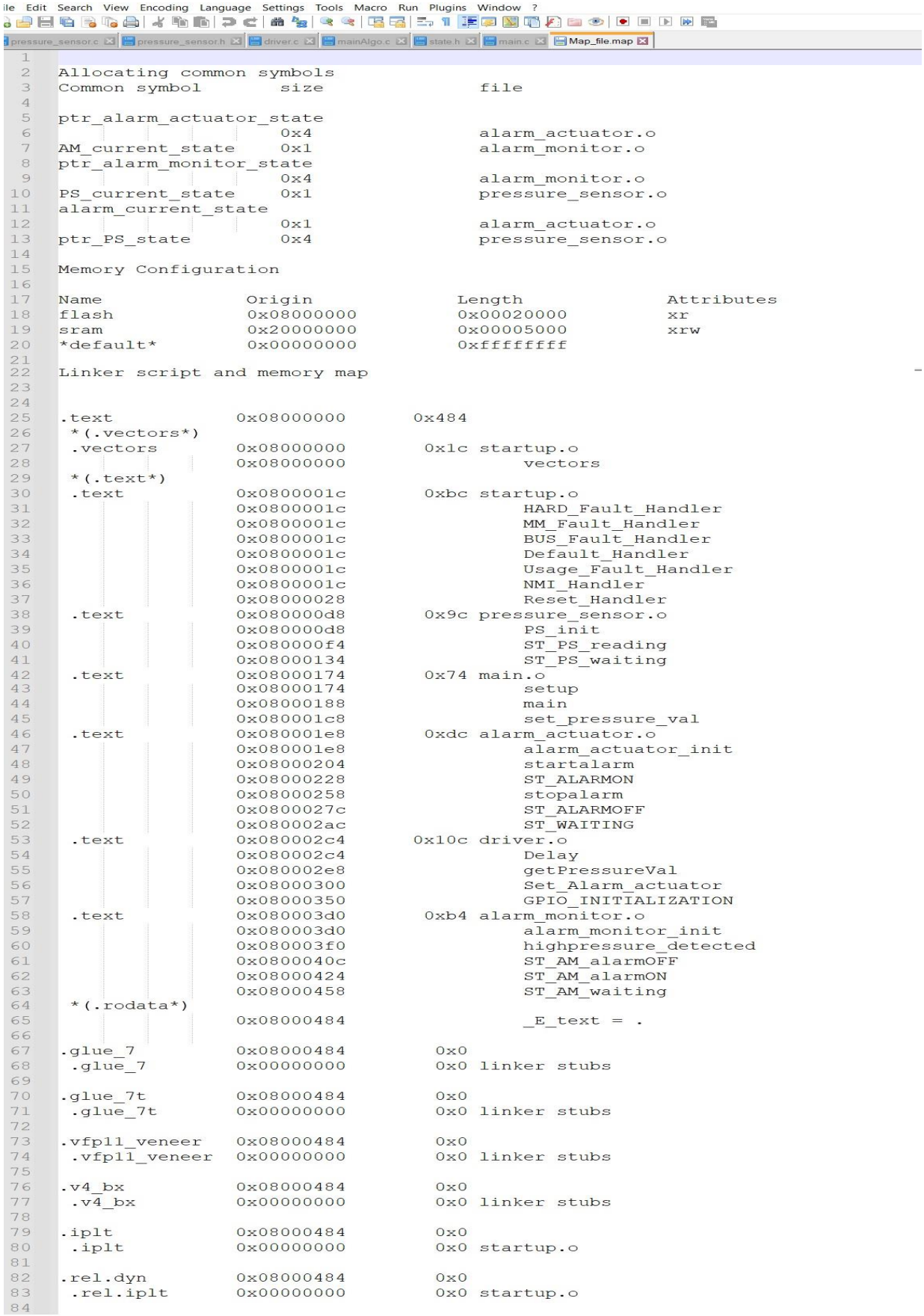


When the pressure level raised in the cockpit, an indicator (alarm) is turned on to inform the crew.



- **Software and Memory Analysis**

  Mapfile of the project



```
Allocating common symbols
Common symbol        size              file

ptr_alarm_actuator_state
                     0x4               alarm_actuator.o
AM_current_state     0x1               alarm_monitor.o
ptr_alarm_monitor_state
                     0x4               alarm_monitor.o
PS_current_state     0x1               pressure_sensor.o
alarm_current_state
                     0x1               alarm_actuator.o
ptr_PS_state         0x4               pressure_sensor.o

Memory Configuration

Name             Origin             Length             Attributes
flash            0x08000000         0x00020000         xr
sram             0x20000000         0x00005000         xrw
*default*        0x00000000         0xffffffff

Linker script and memory map


.text           0x08000000      0x484
 *(.vectors*)
 .vectors       0x08000000       0x1c startup.o
                0x08000000                vectors
 *(.text*)
 .text          0x0800001c       0xbc startup.o
                0x0800001c                HARD_Fault_Handler
                0x0800001c                MM_Fault_Handler
                0x0800001c                BUS_Fault_Handler
                0x0800001c                Default_Handler
                0x0800001c                Usage_Fault_Handler
                0x0800001c                NMI_Handler
                0x08000028                Reset_Handler
 .text          0x080000d8       0x9c pressure_sensor.o
                0x080000d8                PS_init
                0x080000f4                ST_PS_reading
                0x08000134                ST_PS_waiting
 .text          0x08000174       0x74 main.o
                0x08000174                setup
                0x08000188                main
                0x080001c8                set_pressure_val
 .text          0x080001e8       0xdc alarm_actuator.o
                0x080001e8                alarm_actuator_init
                0x08000204                startalarm
                0x08000228                ST_ALARMON
                0x08000258                stopalarm
                0x0800027c                ST_ALARMOFF
                0x080002ac                ST_WAITING
 .text          0x080002c4      0x10c driver.o
                0x080002c4                Delay
                0x080002e8                getPressureVal
                0x08000300                Set_Alarm_actuator
                0x08000350                GPIO_INITIALIZATION
 .text          0x080003d0       0xb4 alarm_monitor.o
                0x080003d0                alarm_monitor_init
                0x080003f0                highpressure_detected
                0x0800040c                ST_AM_alarmOFF
                0x08000424                ST_AM_alarmON
                0x08000458                ST_AM_waiting
 *(.rodata*)
                0x08000484                _E_text = .

.glue_7         0x08000484        0x0
 .glue_7        0x00000000        0x0 linker stubs

.glue_7t        0x08000484        0x0
 .glue_7t       0x00000000        0x0 linker stubs

.vfp11_veneer   0x08000484        0x0
 .vfp11_veneer  0x00000000        0x0 linker stubs

.v4_bx          0x08000484        0x0
 .v4_bx         0x00000000        0x0 linker stubs

.iplt           0x08000484        0x0
 .iplt          0x00000000        0x0 startup.o

.rel.dyn        0x08000484        0x0
 .rel.iplt      0x00000000        0x0 startup.o
```

Memory Sections

```
pressure_controller.elf:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000484  08000000  08000000  00008000  2**2
                  CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .bss          00001020  20000000  08000484  00010000  2**2
                  ALLOC
  2 .debug_info   00000783  00000000  00000000  00008484  2**0
                  CONTENTS, READONLY, DEBUGGING
  3 .debug_abbrev 0000043b  00000000  00000000  00008c07  2**0
                  CONTENTS, READONLY, DEBUGGING
  4 .debug_loc    00000424  00000000  00000000  00009042  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_aranges 000000c0  00000000  00000000  00009466  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_line   000002fe  00000000  00000000  00009526  2**0
                  CONTENTS, READONLY, DEBUGGING
  7 .debug_str    0000034a  00000000  00000000  00009824  2**0
                  CONTENTS, READONLY, DEBUGGING
  8 .comment      00000011  00000000  00000000  00009b6e  2**0
                  CONTENTS, READONLY
  9 .ARM.attributes 00000033  00000000  00000000  00009b7f  2**0
                  CONTENTS, READONLY
 10 .debug_frame  000002d4  00000000  00000000  00009bb4  2**2
                  CONTENTS, READONLY, DEBUGGING
```

Symbol Table:

```
20000008 B _E_bss
20000000 T _E_data
08000484 T _E_text
20000000 B _S_bss
20000000 T _S_data
20001008 B _stack_top
080001e8 T alarm_actuator_init
20001014 B alarm_current_state
080003d0 T alarm_monitor_init
20001018 B AM_current_state
0800001c W BUS_Fault_Handler
0800001c T Default_Handler
080002c4 T Delay
080002e8 T getPressureVal
08000350 T GPIO_INITIALIZATION
0800001c W HARD_Fault_Handler
080003f0 T highpressure_detected
20000004 b local_pVal
08000188 T main
0800001c W MM_Fault_Handler
0800001c W NMI_Handler
20001008 B PS_current_state
080000d8 T PS_init
20001010 B ptr_alarm_actuator_state
2000101c B ptr_alarm_monitor_state
2000100c B ptr_PS_state
20000000 b pVal
08000028 T Reset_Handler
08000300 T Set_Alarm_actuator
080001c8 T set_pressure_val
08000174 T setup
0800027c T ST_ALARMOFF
08000228 T ST_ALARMON
0800040c T ST_AM_alarmOFF
08000424 T ST_AM_alarmON
08000458 T ST_AM_waiting
080000f4 T ST_PS_reading
08000134 T ST_PS_waiting
080002ac T ST_WAITING
08000204 T startalarm
08000258 T stopalarm
0800001c W Usage_Fault_Handler
08000000 T vectors
```