

2023

High Pressure Detection system

**AHMED OSAMA AHMED SOLIMAN
FIRST TERM PROJECT 1**

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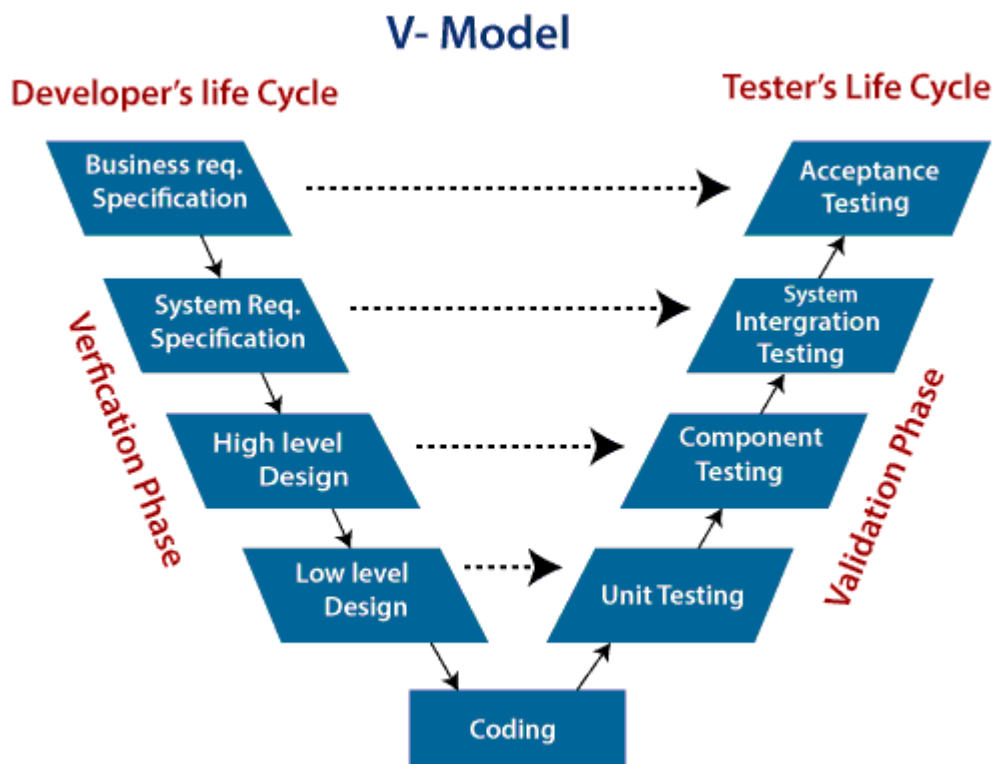
1st Term Project 1

Case study:

- A pressure controller informs the crew of a cabin with an alarm when the pressure exceeds 20 bars in the cabin
- The alarm duration equals 60 seconds.
- keeps track of the measured values.

Method:

I'll work with v-model method.



Building file by using my makefile

```
MINGW64/c/Users/sam20/OneDrive/المكتب/سطح المكتب/Project_1
AHMED OSAMAHMSI MINGW64 ~/OneDrive/المكتب/سطح المكتب/Project_1
$ make
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c Alarm_Actuator.c -o Alarm_Actuator.o
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c Alarm_monitor.c -o Alarm_monitor.o
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c driver.c -o driver.o
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c main.c -o main.o
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c main_Algorithm.c -o main_Algorithm.o
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c Pressure_Sensor.c -o Pressure_Sensor.o
arm-none-eabi-gcc.exe -g -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . -c startup.c -o startup.o
arm-none-eabi-ld.exe -T linker_script.ld Alarm_Actuator.o Alarm_monitor.o driver.o main.o main_Algorithm.o Pressure_Sensor.o startup.o -o 1st_term_project_1.elf -Map=Map_file.map
arm-none-eabi-objcopy.exe -O binary 1st_term_project_1.elf 1st_term_project_1.bin
===== Build is Done =====
```

Readelf

```
MINGW64/c/Users/sam20/OneDrive/المكتب/سطح المكتب/Project_1
AHMED OSAMAHMSI MINGW64 ~/OneDrive/المكتب/سطح المكتب/Project_1
$ arm-none-eabi-readelf.exe -a 1st_term_project_1.elf
ELF Header:
  Magic:   7f 45 4c 46 01 01 00 00 00 00 00 00 00 00 00 00
  Class:       ELF32
  Data:        2's complement, little endian
  Version:     1 (current)
  OS/ABI:      UNIX - System V
  ABI Version: 0
  Type:        EXEC (Executable file)
  Machine:     0x1
  Version:     0x1
  Entry point address: 0x80000000
  Start of program headers: 52 (bytes into file)
  Start of section headers: 73184 (bytes into file)
  Flags:       0x5000002, has entry point, Version5 EABI
  Size of this header: 52 (bytes)
  Size of program headers: 32 (bytes)
  Number of program headers: 2
  Size of section headers: 40 (bytes)
  Number of section headers: 16
  Section header string table index: 13

Section Headers:
 [Nr] Name                Type              Addr      Off      Size    ES Flg Lk Inf Al
 [ 0]                     NULL              00000000  000000  000000  00  0  0  0  0
 [ 1] .text                 PROGBITS          80000000  008000  0004e4  00  AX  0  0  4
 [ 2] .data                 PROGBITS          20000000  010000  00000c  00  WA  0  0  4
 [ 3] .bss                  NOBITS            2000000c  01000c  001024  00  WA  0  0  4
 [ 4] .debug_info           PROGBITS           00000000  01000c  00091f  00  0  0  1
 [ 5] .debug_abbrev         PROGBITS           00000000  01092b  00045d  00  0  0  1
 [ 6] .debug_loc            PROGBITS           00000000  010d88  000424  00  0  0  1
 [ 7] .debug_aranges        PROGBITS           00000000  0111ac  0000e0  00  0  0  1
 [ 8] .debug_line           PROGBITS           00000000  01128c  0003bb  00  0  0  1
 [ 9] .debug_str            PROGBITS           00000000  011647  0003d8  01  MS  0  0  1
[10] .comment              PROGBITS           00000000  011a1f  000011  01  MS  0  0  1
[11] .ARM.attributes        ARM_ATTRIBUTES     00000000  011a30  000033  00  0  0  1
[12] .debug_frame           PROGBITS           00000000  011a64  0002dc  00  0  0  4
[13] .shstrtab              STRTAB             00000000  011d40  00009d  00  0  0  1
[14] .symtab                SYMTAB             00000000  012060  000590  10  15 41 4
[15] .strtab                STRTAB             00000000  0125f0  00035a  00  0  0  1

Key to Flags:
  W (write), A (alloc), X (execute), M (merge), S (strings)
  I (info), L (link order), G (group), T (TLS), E (exclude), x (unknown)
  O (extra OS processing required) o (OS specific), p (processor specific)

There are no section groups in this file.

Program Headers:
  Type   Offset  VirtAddr  PhysAddr  FileSiz MemSiz  Flg Align
  LOAD   0x008000 0x80000000 0x80000000 0x004e4 0x004e4  R E 0x8000
  LOAD   0x010000 0x20000000 0x800004e4 0x0000c 0x01030  RW 0x8000

Section to Segment mapping:
Segment Sections...
```

```
MINGW64/c/Users/sam20/OneDrive/المكتب/Project_1
Segment Sections...
00 .text
01 .data .bss

There is no dynamic section in this file.
There are no relocations in this file.
There are no unwind sections in this file.
Symbol table '.symtab' contains 89 entries:
Num:  Value      Size  Type  Bind  Vis  Ndx  Name
0:  00000000      0 NOTYPE LOCAL DEFAULT UND
1:  80000000      0 SECTION LOCAL DEFAULT 1
2:  20000000      0 SECTION LOCAL DEFAULT 2
3:  2000000c      0 SECTION LOCAL DEFAULT 3
4:  00000000      0 SECTION LOCAL DEFAULT 4
5:  00000000      0 SECTION LOCAL DEFAULT 5
6:  00000000      0 SECTION LOCAL DEFAULT 6
7:  00000000      0 SECTION LOCAL DEFAULT 7
8:  00000000      0 SECTION LOCAL DEFAULT 8
9:  00000000      0 SECTION LOCAL DEFAULT 9
10: 00000000      0 SECTION LOCAL DEFAULT 10
11: 00000000      0 SECTION LOCAL DEFAULT 11
12: 00000000      0 SECTION LOCAL DEFAULT 12
13: 00000000      0 FILE   LOCAL DEFAULT ABS startup.c
14: 80000428      0 NOTYPE LOCAL DEFAULT 1 $t
15: 80000000      0 NOTYPE LOCAL DEFAULT 1 $d
16: 000002a0      0 NOTYPE LOCAL DEFAULT 12 $d
17: 00000000      0 FILE   LOCAL DEFAULT ABS Alarm_Actuator.c
18: 8000001c      0 NOTYPE LOCAL DEFAULT 1 $t
19: 00000010      0 NOTYPE LOCAL DEFAULT 12 $d
20: 00000000      0 FILE   LOCAL DEFAULT ABS Alarm_monitor.c
21: 20000000      0 NOTYPE LOCAL DEFAULT 2 $d
22: 80000098      0 NOTYPE LOCAL DEFAULT 1 $t
23: 000000a0      0 NOTYPE LOCAL DEFAULT 12 $d
24: 00000000      0 FILE   LOCAL DEFAULT ABS driver.c
25: 80000144      0 NOTYPE LOCAL DEFAULT 1 $t
26: 0000011c      0 NOTYPE LOCAL DEFAULT 12 $d
27: 00000000      0 FILE   LOCAL DEFAULT ABS main.c
28: 80000250      0 NOTYPE LOCAL DEFAULT 1 $t
29: 00000194      0 NOTYPE LOCAL DEFAULT 12 $d
30: 00000000      0 FILE   LOCAL DEFAULT ABS main_Algorithm.c
31: 2000000c      0 NOTYPE LOCAL DEFAULT 3 $d
32: 20000004      0 NOTYPE LOCAL DEFAULT 2 $d
33: 800002e8      0 NOTYPE LOCAL DEFAULT 1 $t
34: 000001dc      0 NOTYPE LOCAL DEFAULT 12 $d
35: 00000000      0 FILE   LOCAL DEFAULT ABS Pressure_Sensor.c
36: 20000010      0 NOTYPE LOCAL DEFAULT 3 $d
37: 20000008      0 NOTYPE LOCAL DEFAULT 2 $d
38: 8000039c      0 NOTYPE LOCAL DEFAULT 1 $t
39: 00000240      0 NOTYPE LOCAL DEFAULT 12 $d
40: 00000000      0 FILE   LOCAL DEFAULT ABS
41: 800002e9      72 FUNC  GLOBAL DEFAULT 1 Set_Pressure_Value
42: 80000061      28 FUNC  GLOBAL DEFAULT 1 ST_alarm_ON
```

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MINGW64/c/Users/sam20/OneDrive/المكتب/Project_1
42: 80000061      28 FUNC  GLOBAL DEFAULT 1 ST_alarm_ON
43: 800000b5      42 FUNC  GLOBAL DEFAULT 1 ST_alarm_monitor_ON
44: 20000004      4 OBJECT GLOBAL DEFAULT 2 threshold
45: 80000161     126 FUNC  GLOBAL DEFAULT 1 GPIO_INITIALIZATION
46: 80000429      10 FUNC  WEAK  DEFAULT 1 NWI_Handler
47: 800003f1      54 FUNC  GLOBAL DEFAULT 1 ST_Pressure_Sensor_waitin
48: 2000102c      4 OBJECT GLOBAL DEFAULT 3 Pressure_Sensor_State
49: 20000014      0 NOTYPE GLOBAL DEFAULT 3 _E_bss
50: 800003a9      70 FUNC  GLOBAL DEFAULT 1 ST_Pressure_Sensor_Readin
51: 20001024      1 OBJECT GLOBAL DEFAULT 3 Pressure_Sensor_State_ID
52: 80000099      28 FUNC  GLOBAL DEFAULT 1 High_Pressure_Detected
53: 80000429      10 FUNC  WEAK  DEFAULT 1 MW_Fault_Handler
54: 80000435     176 FUNC  GLOBAL DEFAULT 1 Reset_Handler
55: 20001014      4 OBJECT GLOBAL DEFAULT 3 Alarm_Actuator_State
56: 20000000      4 OBJECT GLOBAL DEFAULT 2 Timer
57: 2000000c      4 OBJECT GLOBAL DEFAULT 3 pressure
58: 20001014      0 NOTYPE GLOBAL DEFAULT 3 _stack_top
59: 20001025      1 OBJECT GLOBAL DEFAULT 3 main_algorithm_state_ID
60: 20000010      4 OBJECT GLOBAL DEFAULT 3 Pressure_val
61: 2000000c      0 NOTYPE GLOBAL DEFAULT 2 _E_DATA
62: 80000429      10 FUNC  WEAK  DEFAULT 1 Bus_Fault
63: 80000169      24 FUNC  GLOBAL DEFAULT 1 getPressureVal
64: 2000000c      0 NOTYPE GLOBAL DEFAULT 3 _S_bss
65: 80000365      56 FUNC  GLOBAL DEFAULT 1 ST_High_Pressure
66: 80000429      10 FUNC  WEAK  DEFAULT 1 H_Fault_Handler
67: 80000181      80 FUNC  GLOBAL DEFAULT 1 Set_Alarm_actuator
68: 800002a1      70 FUNC  GLOBAL DEFAULT 1 main
69: 800000a5      28 FUNC  GLOBAL DEFAULT 1 Alarm_Actuator_OFF
70: 800000e1      42 FUNC  GLOBAL DEFAULT 1 ST_alarm_monitor_OFF
71: 80000429      10 FUNC  WEAK  DEFAULT 1 Usage_Fault_Handler
72: 80000029      28 FUNC  GLOBAL DEFAULT 1 Alarm_Actuator_ON
73: 8000001d      10 FUNC  GLOBAL DEFAULT 1 Alarm_Actuator_init
74: 80000429      10 FUNC  GLOBAL DEFAULT 1 Default_Handler
75: 20000000      0 NOTYPE GLOBAL DEFAULT 2 _S_DATA
76: 80000251      78 FUNC  GLOBAL DEFAULT 1 setup
77: 80000145      34 FUNC  GLOBAL DEFAULT 1 Delay
78: 8000039d      10 FUNC  GLOBAL DEFAULT 1 Pressure_Sensor_init
79: 2000101c      1 OBJECT GLOBAL DEFAULT 3 alarm_monitor_state_ID
80: 8000007d      28 FUNC  GLOBAL DEFAULT 1 ST_alarm_OFF
81: 20001020      4 OBJECT GLOBAL DEFAULT 3 Alarm_monitor_State
82: 8000010d      54 FUNC  GLOBAL DEFAULT 1 ST_alarm_monitor_waiting
83: 20001018      1 OBJECT GLOBAL DEFAULT 3 alarm_state_ID
84: 800004e4      0 NOTYPE GLOBAL DEFAULT 1 _E_text
85: 80000000      28 OBJECT GLOBAL DEFAULT 1 vectors
86: 20001028      4 OBJECT GLOBAL DEFAULT 3 main_Algorithm_State
87: 20000008      4 OBJECT GLOBAL DEFAULT 2 sensor_PullTime
88: 80000331      52 FUNC  GLOBAL DEFAULT 1 ST_Low_Pressure

No version information found in this file.
Attribute Section: aeabi
File Attributes
Tag_CPU_name: "Cortex-M3"
Tag_CPU_arch: v7
Tag_CPU_arch_profile: Microcontroller
Tag_THUMB_ISA_use: Thumb-2
```

```
No version information found in this file.
Attribute Section: aeabi
File Attributes
  Tag_CPU_name: "Cortex-M3"
  Tag_CPU_arch: v7
  Tag_CPU_arch_profile: Microcontroller
  Tag_THUMB_ISA_use: Thumb-2
  Tag_ABI_PCS_wchar_t: 4
  Tag_ABI_FP_denormal: Needed
  Tag_ABI_FP_exceptions: Needed
  Tag_ABI_FP_number_model: IEEE 754
  Tag_ABI_align_needed: 8-byte
  Tag_ABI_align_preserved: 8-byte, except leaf SP
  Tag_ABI_enum_size: small
  Tag_ABI_optimization_goals: Aggressive Debug
  Tag_CPU_unaligned_access: v6
```

Sections

```
MINGW64/c/Users/sam20/OneDrive/المكتب/Project_1
AHMED OSAMA@MSI MINGW64 ~/OneDrive/المكتب/Project_1
$ arm-none-eabi-objdump.exe -h 1st_term_project_1.elf

1st_term_project_1.elf:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA           LMA           File off  Algn
 0 .text          000004e4  80000000  80000000  00008000  2**2
CONTENTS, ALLOC, LOAD, READONLY, CODE
 1 .data          0000000c  20000000  800004e4  00010000  2**2
CONTENTS, ALLOC, LOAD, DATA
 2 .bss           00001024  2000000c  800004f0  0001000c  2**2
ALLOC
 3 .debug_info    0000091f  00000000  00000000  0001000c  2**0
CONTENTS, READONLY, DEBUGGING
 4 .debug_abbrev  0000045d  00000000  00000000  0001092b  2**0
CONTENTS, READONLY, DEBUGGING
 5 .debug_loc     00000424  00000000  00000000  00010d88  2**0
CONTENTS, READONLY, DEBUGGING
 6 .debug_ranges  000000e0  00000000  00000000  000111ac  2**0
CONTENTS, READONLY, DEBUGGING
 7 .debug_line    000003bb  00000000  00000000  0001128c  2**0
CONTENTS, READONLY, DEBUGGING
 8 .debug_str     000003d8  00000000  00000000  00011647  2**0
CONTENTS, READONLY, DEBUGGING
 9 .comment       00000011  00000000  00000000  00011a1f  2**0
CONTENTS, READONLY
10 .ARM.attributes 00000033  00000000  00000000  00011a30  2**0
CONTENTS, READONLY
11 .debug_frame   000002dc  00000000  00000000  00011a64  2**2
CONTENTS, READONLY, DEBUGGING
```

Symbol Table

```
MINGW64/C:/Users/sam20/OneDrive/المكتب/Project_1
AHMED OSAMA@MSTI MINGW64 ~/OneDrive/المكتب/Project_1
$ arm-none-eabi-nm.exe 1st_term_project_1.elf
20000014 B _E_bss
20000000c D _E_DATA
800004e4 T _E_text
20000000c B _S_bss
200000000 D _S_DATA
20001014 B __stack_top
8000001c T Alarm_Actuator_init
80000044 T Alarm_Actuator_OFF
80000028 T Alarm_Actuator_ON
20001014 B Alarm_Actuator_State
20001020 B Alarm_monitor_State
2000101c B alarm_monitor_state_ID
20001018 B alarm_state_ID
80000428 W Bus_Fault
80000428 T Default_Handler
80000144 T Delay
80000168 T getPressureVal
800001d0 T GPIO_INITIALIZATION
80000428 W H_fault_Handler
80000098 T High_Pressure_Detected
800002a0 T main
20001028 B main_Algorithm_State
20001025 B main_algorithm_state_ID
80000428 W MM_Fault_Handler
80000428 W NMI_Handler
20000000c B pressure
8000039c T Pressure_Sensor_init
2000102c B Pressure_Sensor_State
20001024 B Pressure_Sensor_state_ID
20000010 B Pressure_val
80000434 T Reset_Handler
20000008 D sensor_Pull_time
80000180 T Set_Alarm_actuator
800002e4 T Set_Pressure_Value
80000250 T setup
800000e0 T ST_alarm_monitor_OFF
800000b4 T ST_alarm_monitor_ON
8000010c T ST_alarm_monitor_waiting
8000007c T ST_alarm_OFF
80000060 T ST_alarm_ON
800003e4 T ST_High_Pressure
80000330 T ST_Low_Pressure
800003a8 T ST_Pressure_Sensor_Reading
800003f0 T ST_Pressure_Sensor_waiting
20000004 D threshold
20000000 D Timer
80000428 W Usage_Fault_Handler
80000000 T vectors
AHMED OSAMA@MSTI MINGW64 ~/OneDrive/المكتب/Project_1
$ |
```

MAP File

```
C:\Users\sam20\OneDrive\المكتب\Project_1\Map_file.map - Sublime Text (UNREGISTERED)
File Edit Selection Find View Goto Tools Project Preferences Help
Map_file.map x
1
2 Allocating common symbols
3 Common symbol size file
4
5 Pressure_Sensor_State
6 0x4 Pressure_Sensor.o
7 Pressure_Sensor_state_ID
8 0x1 main.o
9 Alarm_Actuator_State
10 0x4 Alarm_Actuator.o
11 main_algorithm_state_ID
12 0x1 main.o
13 alarm_monitor_state_ID
14 0x1 Alarm_monitor.o
15 Alarm_monitor_State
16 0x4 Alarm_monitor.o
17 alarm_state_ID 0x1 Alarm_Actuator.o
18 main_Algorithm_State
19 0x4 main_Algorithm.o
20
21 Memory Configuration
22
23 Name Origin Length Attributes
24 flash 0x80000000 0x00020000 xr
25 sram 0x20000000 0x00005000 xrw
26 *default* 0x00000000 0xffffffff
27
28 Linker script and memory map
29
30
31 .text 0x80000000 0x4e4
32 *(.vectors*)
33 .vectors 0x80000000 0x1c startup.o
34 0x80000000 vectors
35 *(.text*)
36 .text 0x8000001c 0x7c Alarm_Actuator.o
37 0x8000001c Alarm_Actuator_init
38 0x80000028 Alarm_Actuator_ON
39 0x80000044 Alarm_Actuator_OFF
40 0x80000060 ST_alarm_ON
41 0x8000007c ST_alarm_OFF
42 .text 0x80000098 0xac Alarm_monitor.o
43 0x80000098 High_Pressure_Detected
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C:\Users\sam20\OneDrive\المكتبة\Project_1\Map_file.map - Sublime Text (UNREGISTERED)
File Edit Selection Find View Goto Tools Project Preferences Help

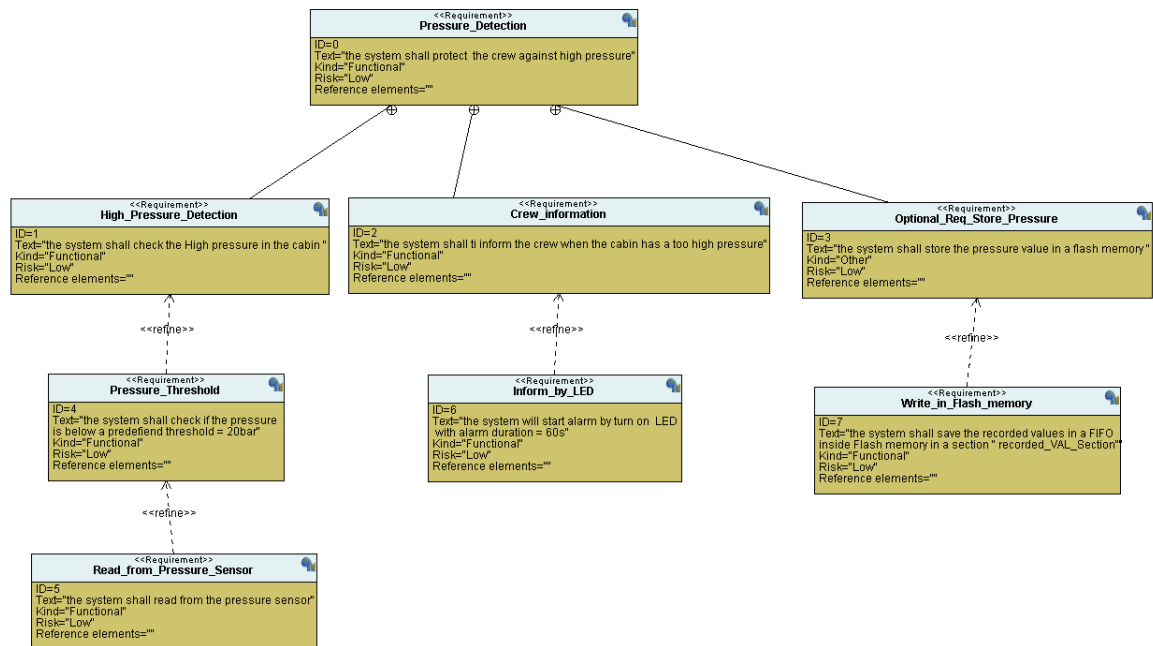
Map_file.map
42 .text 0x80000098 @xac Alarm_monitor.o
43 0x80000098 High_Pressure_Detected
44 0x800000b4 SI_alarm_monitor_ON
45 0x800000e3 SI_alarm_monitor_OFF
46 0x8000010c SI_alarm_monitor_waiting
47 .text 0x80000144 @x10c driver.o
48 0x80000144 Delay
49 0x80000168 getPressureVal
50 0x80000180 Set_Alarm_actuator
51 0x800001d0 GPIO_INITIALIZATION
52 .text 0x80000250 @x98 main.o
53 0x80000250 setup
54 0x800002a0 main
55 .text 0x800002e8 @xb4 main_Algorithm.o
56 0x800002e8 Set_Pressure_Value
57 0x80000330 SI_Low_Pressure
58 0x80000364 SI_High_Pressure
59 .text 0x8000039c @x8c Pressure_Sensor.o
60 0x8000039c Pressure_Sensor_init
61 0x800003a8 SI_Pressure_Sensor_Reading
62 0x800003f0 SI_Pressure_Sensor_waiting
63 .text 0x80000428 @x8c startup.o
64 0x80000428 MM_Fault_Handler
65 0x80000428 Default_Handler
66 0x80000428 Bus_Fault
67 0x80000428 H_fault_Handler
68 0x80000428 Usage_Fault_Handler
69 0x80000428 NMI_Handler
70 0x80000434 Reset_Handler
71 *(.rodata*)
72 0x800004e4 _E_text = .
73
74 .glue_7 0x800004e4 0x0
75 .glue_7 0x00000000 0x0 linker stubs
76
77 .glue_7t 0x800004e4 0x0
78 .glue_7t 0x00000000 0x0 linker stubs
79
80 .vfp11_veneer 0x800004e4 0x0
81 .vfp11_veneer 0x00000000 0x0 linker stubs
82
83 .v4_bx 0x800004e4 0x0
84 .v4_bx 0x00000000 0x0 linker stubs
85
Line 64, Column 59 Spaces: 4 Plain Text
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C:\Users\sam20\OneDrive\المكتبة\Project_1\Map_file.map - Sublime Text (UNREGISTERED)
File Edit Selection Find View Goto Tools Project Preferences Help

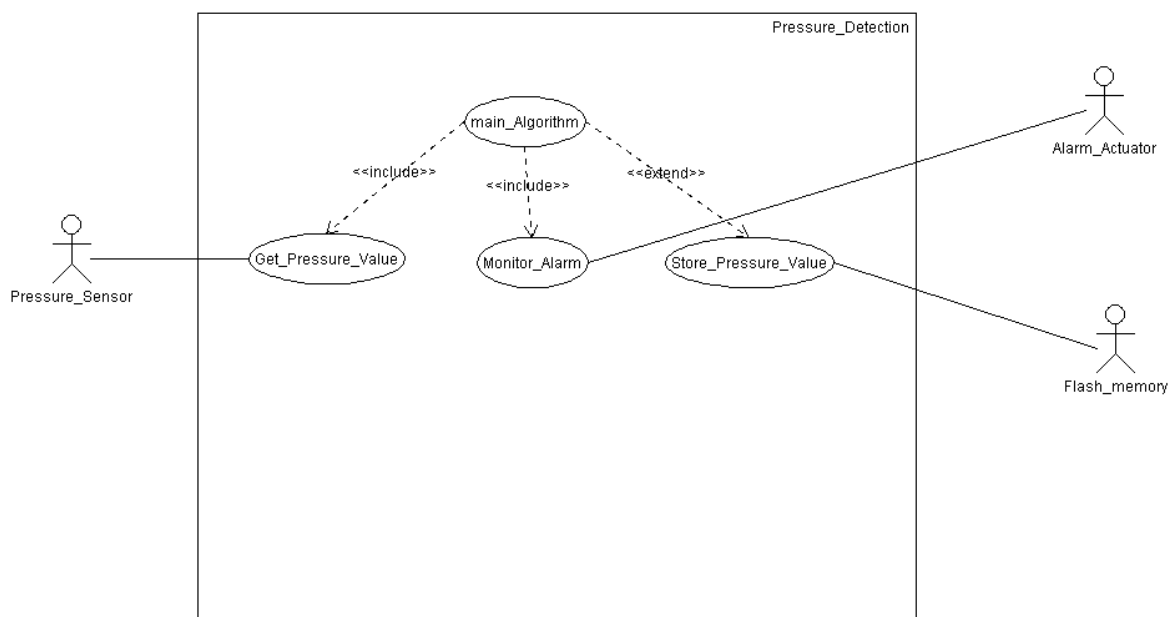
Map_file.map
83 .v4_bx 0x800004e4 0x0
84 .v4_bx 0x00000000 0x0 linker stubs
85
86 .iplt 0x800004e4 0x0
87 .iplt 0x00000000 0x0 Alarm_Actuator.o
88
89 .rel.dyn 0x800004e4 0x0
90 .rel.iplt 0x00000000 0x0 Alarm_Actuator.o
91
92 .data 0x20000000 0xc load address 0x800004e4
93 0x20000000 _S_DATA = .
94 *(.data*)
95 .data 0x20000000 0x0 Alarm_Actuator.o
96 .data 0x20000000 0x4 Alarm_monitor.o
97 0x20000000 Timer
98 .data 0x20000004 0x0 driver.o
99 .data 0x20000004 0x0 main.o
100 .data 0x20000004 0x4 main_Algorithm.o
101 0x20000004 threshold
102 .data 0x20000008 0x4 Pressure_Sensor.o
103 0x20000008 sensor_Pull_time
104 .data 0x2000000c 0x0 startup.o
105 0x2000000c . = ALIGN (0x4)
106 0x2000000c _E_DATA = .
107
108 .igot.plt 0x2000000c 0x0 load address 0x800004f0
109 .igot.plt 0x00000000 0x0 Alarm_Actuator.o
110
111 .bss 0x2000000c 0x1024 load address 0x800004f0
112 0x2000000c _S_bss = .
113 *(.bss*)
114 .bss 0x2000000c 0x0 Alarm_Actuator.o
115 .bss 0x2000000c 0x0 Alarm_monitor.o
116 .bss 0x2000000c 0x0 driver.o
117 .bss 0x2000000c 0x0 main.o
118 .bss 0x2000000c 0x4 main_Algorithm.o
119 0x2000000c pressure
120 .bss 0x20000010 0x4 Pressure_Sensor.o
121 0x20000010 Pressure_val
122 .bss 0x20000014 0x0 startup.o
123 0x20000014 _E_bss = .
124 0x20000014 . = ALIGN (0x4)

Line 82, Column 1 Spaces: 4 Plain Text
```

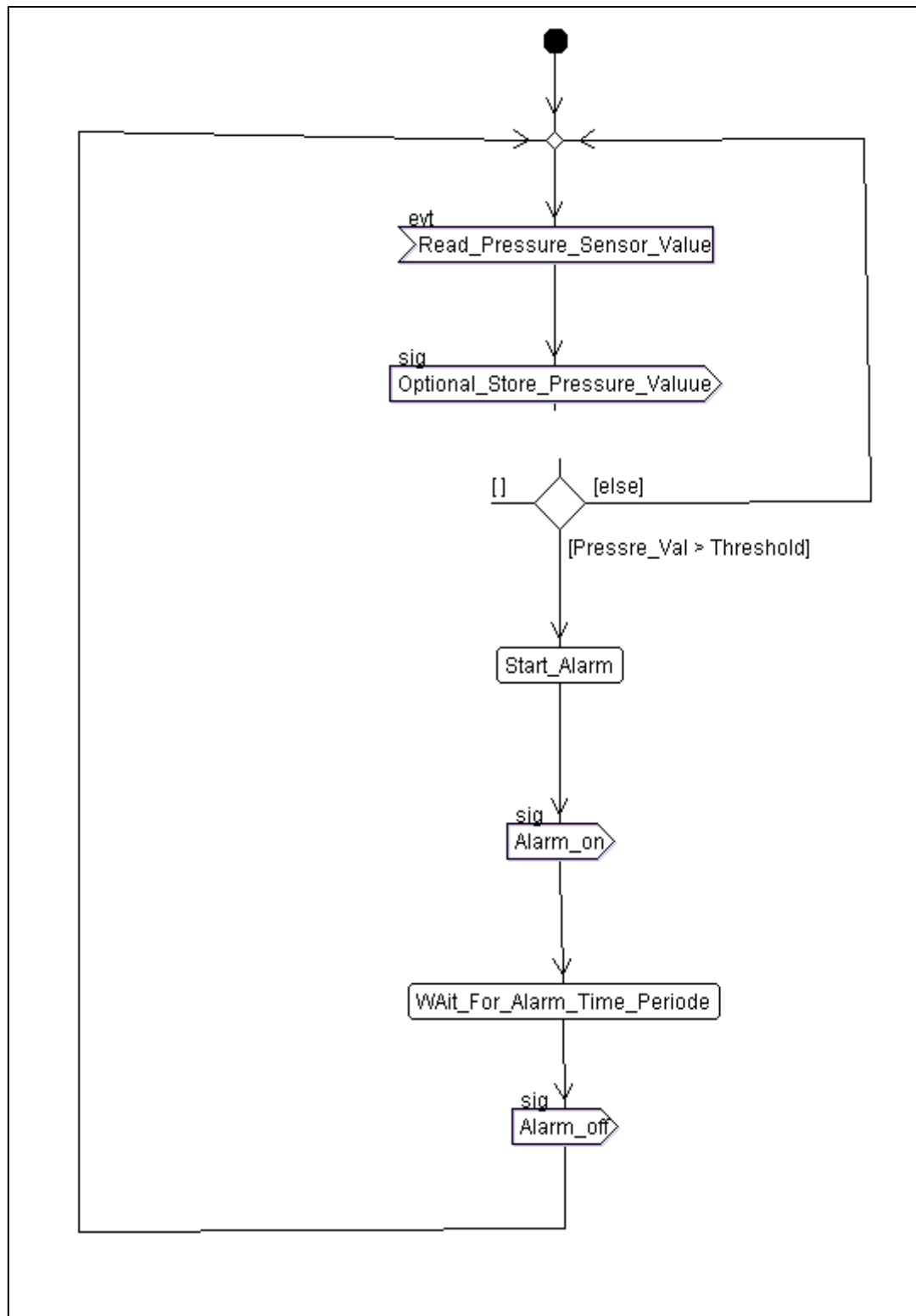

Requirements Diagram



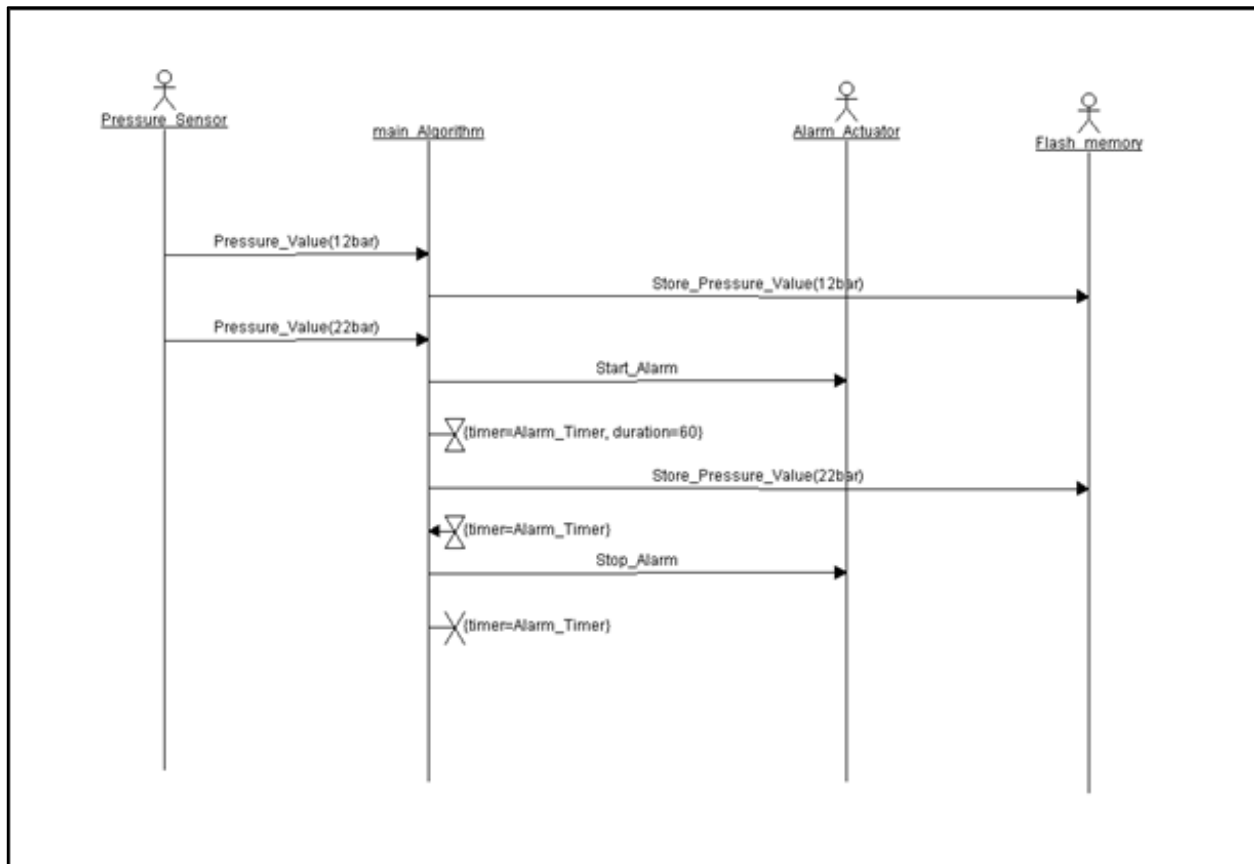
System Analysis: Use case diagram



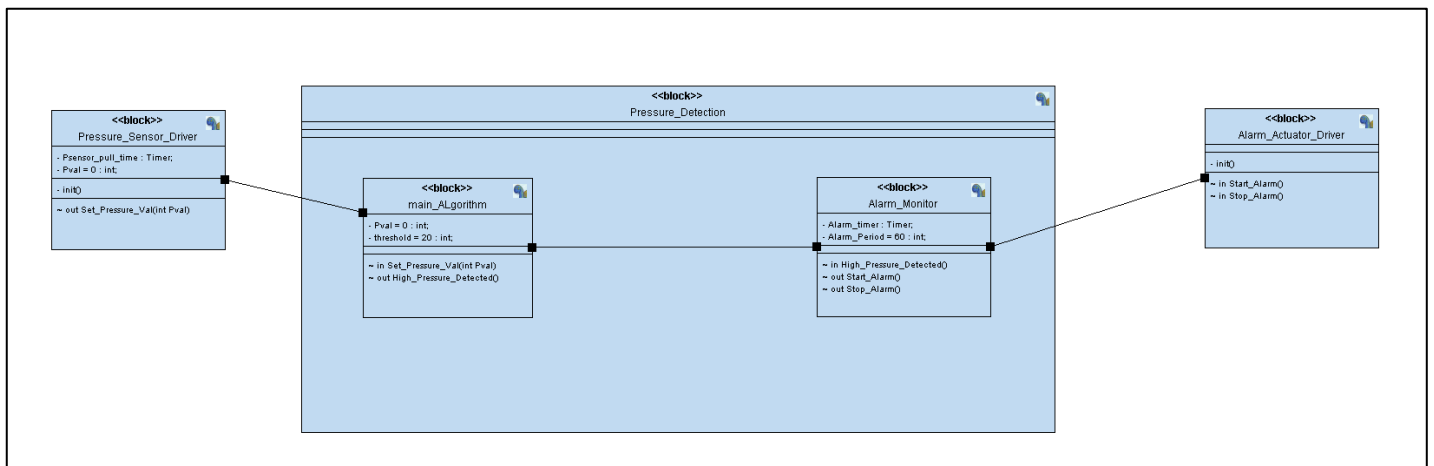
System Analysis: **Activity diagram**



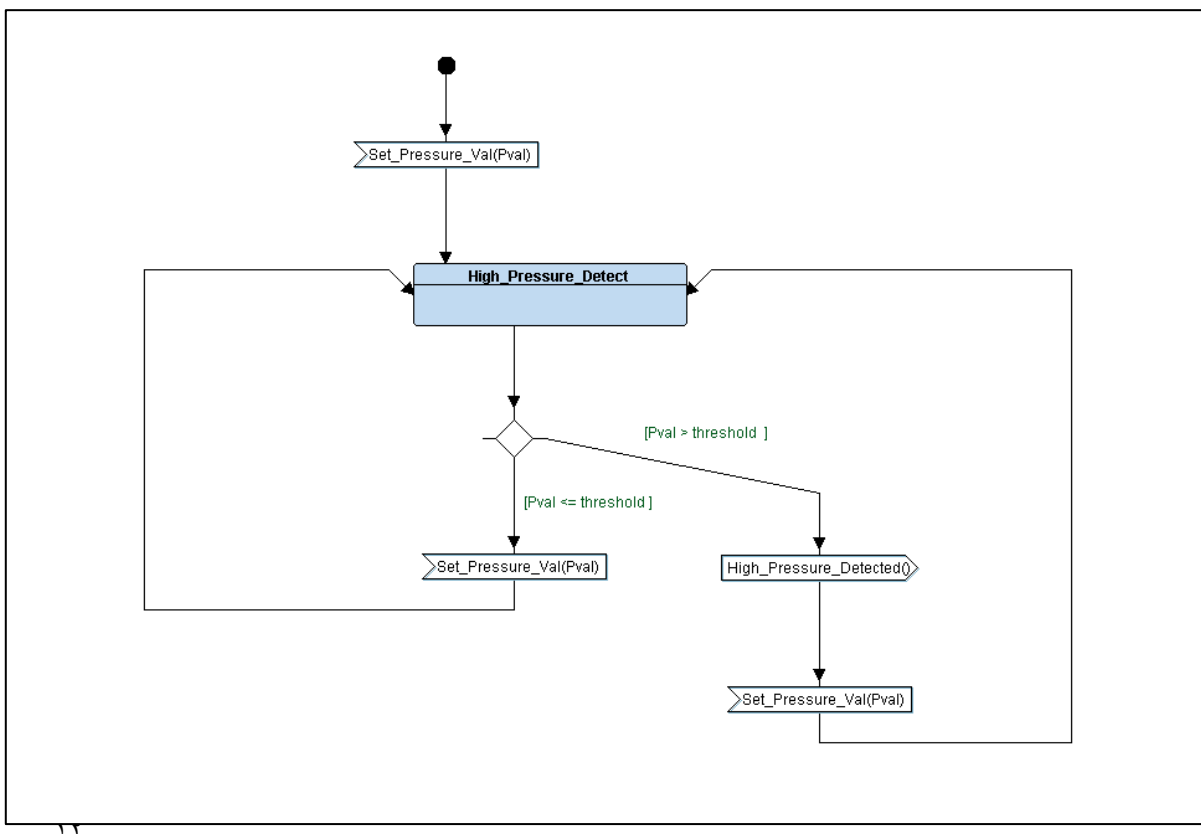
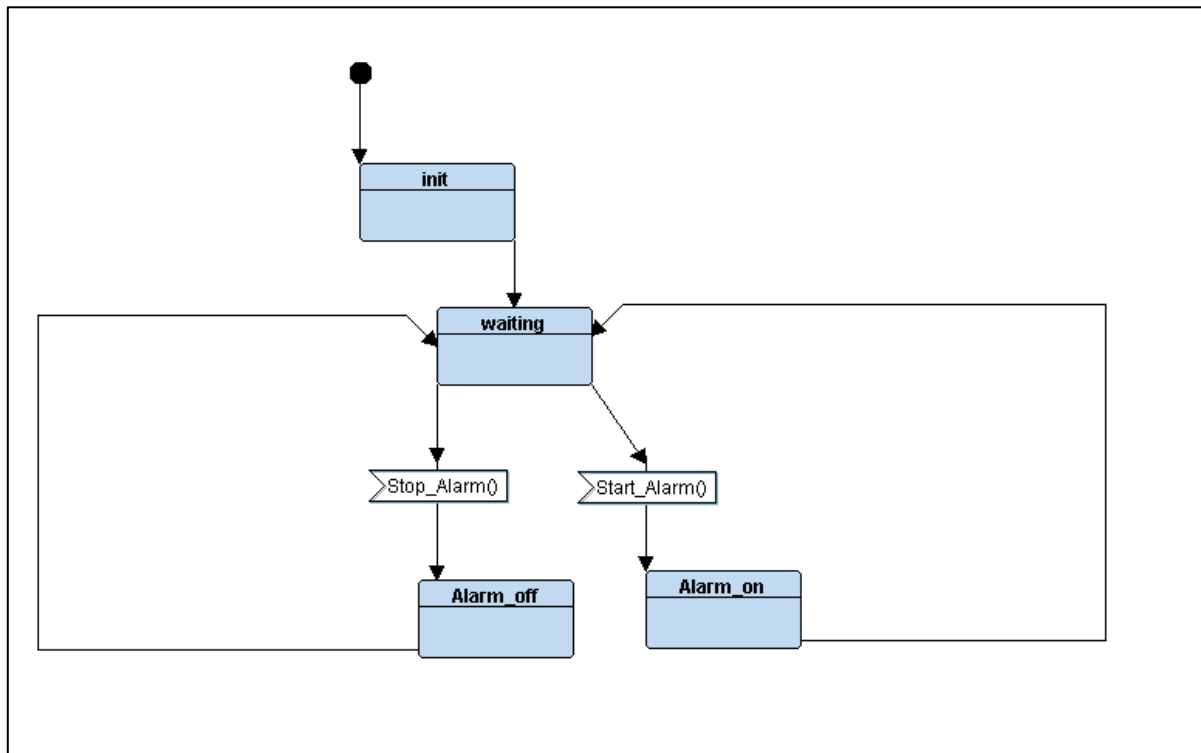
System Analysis: Sequence diagram

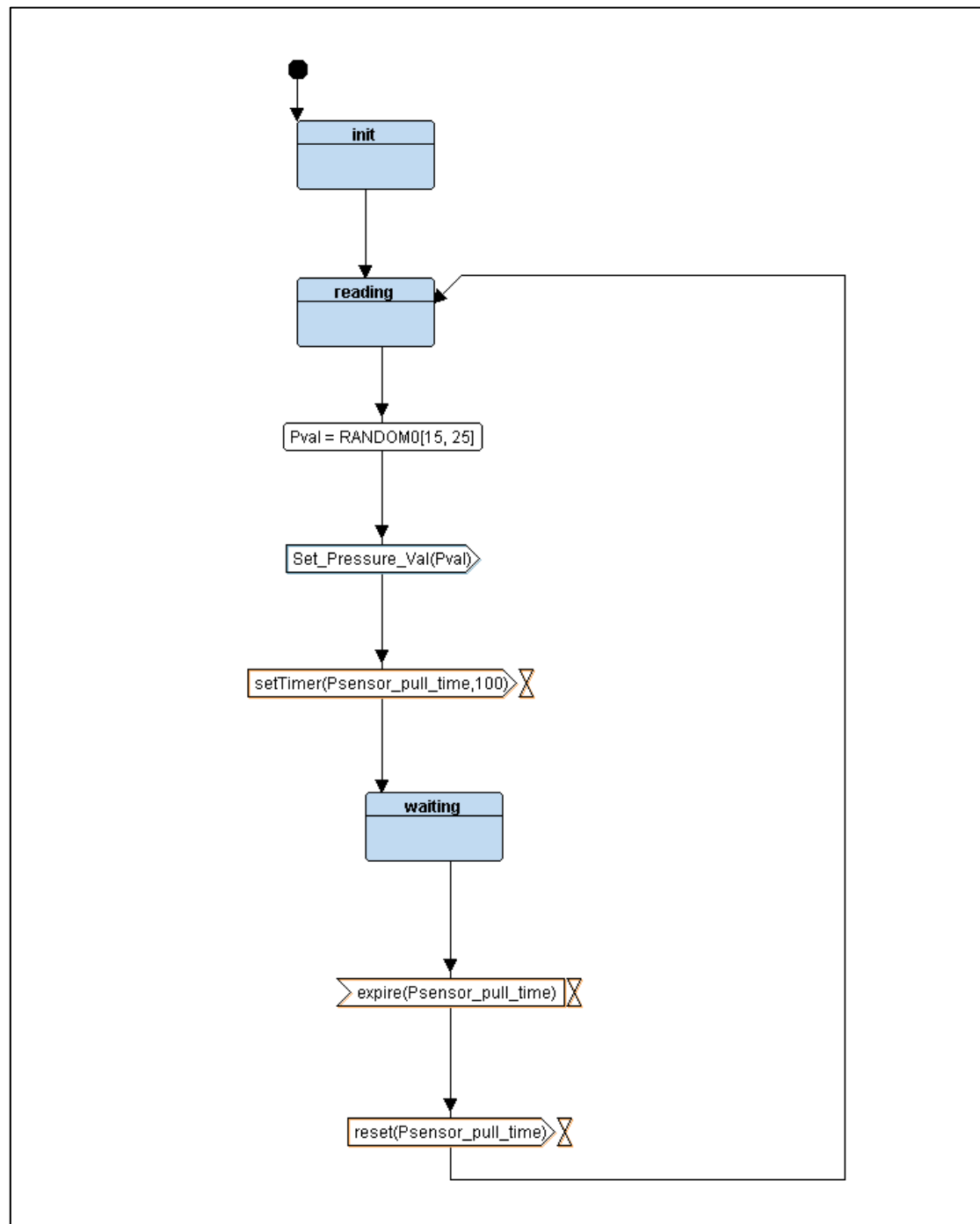


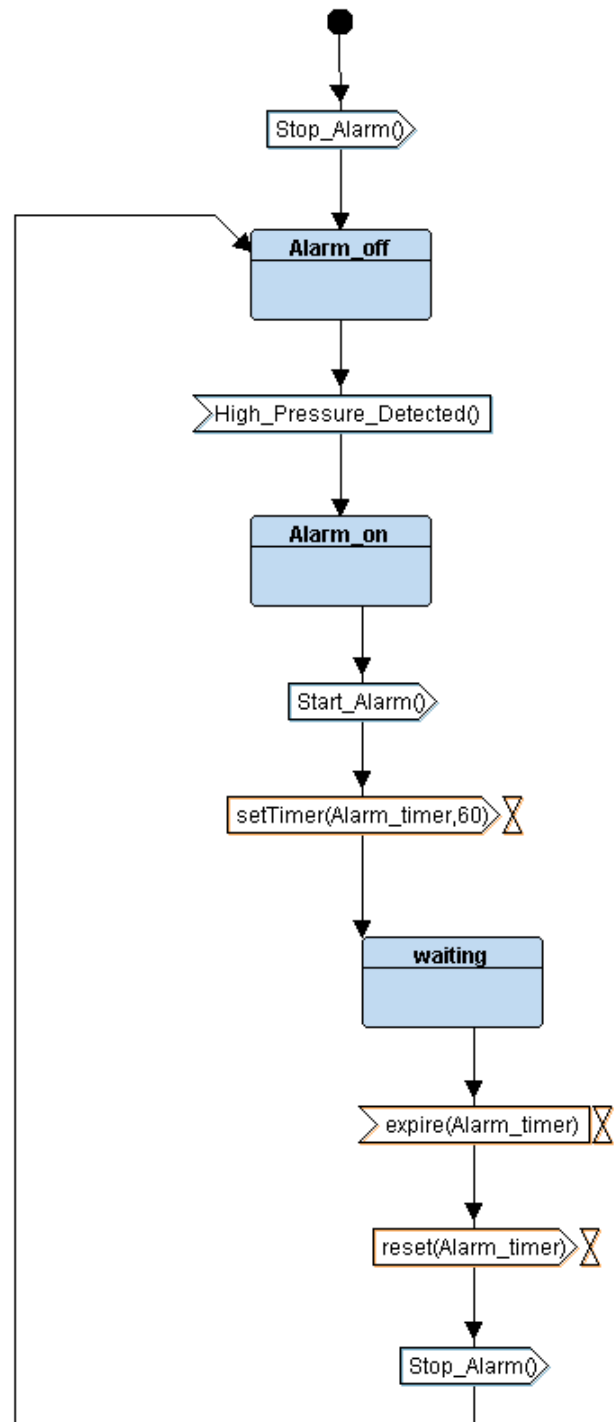
System Design



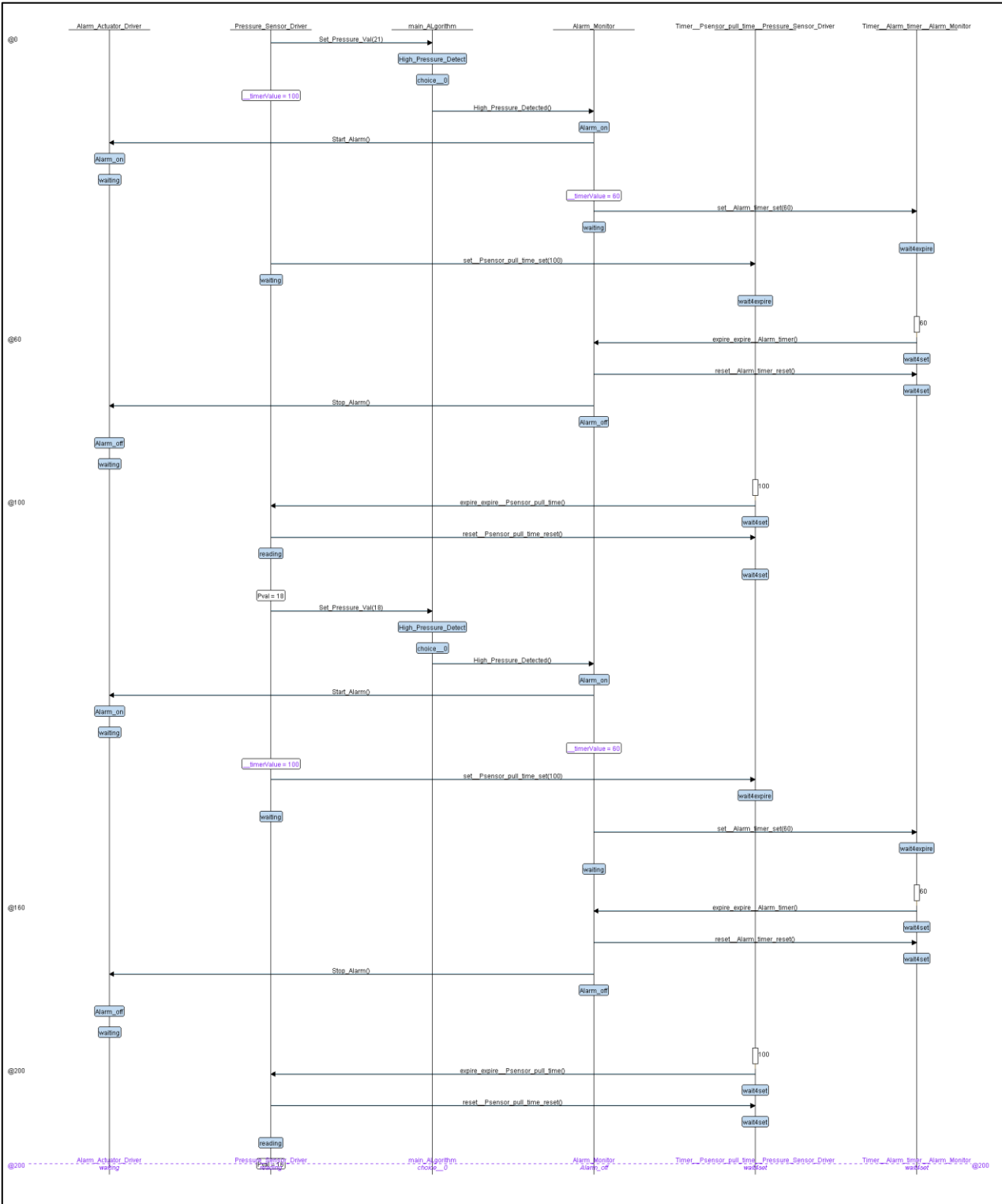
Blocks diagrams





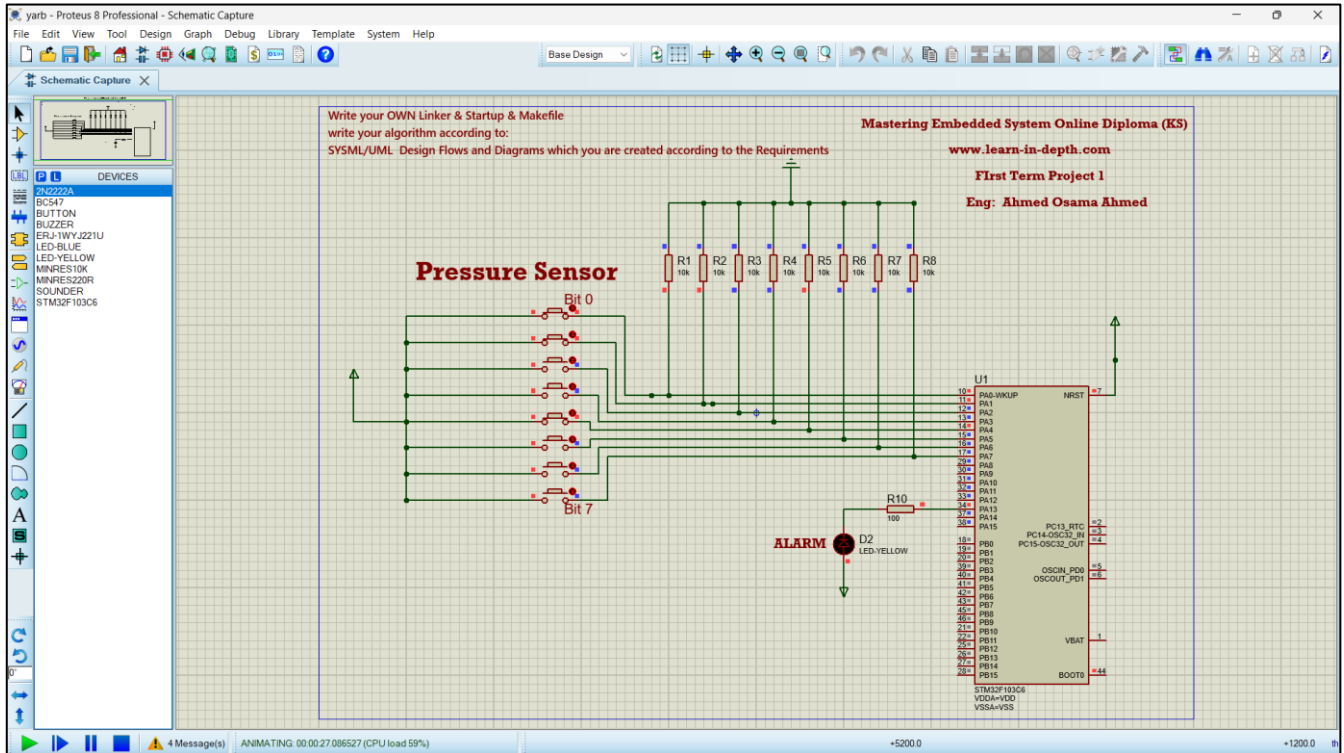


Blocks simulation



Proteus simulation

at 19bar



at 36bar

