MASTERING EMBEDDED SYSTEM ONLINE DIPLOMA

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First Term (Final Project 1)

Eng.Abdelrahman Ahmed Emam

My profile:

https://www.learn-in-depth-store.com/certificate/abdo.emam2002912%40gmail.com

High Pressure Detection System

CASE STUDY

A client wants the specific requirements:

- ***A pressure detection system that alerts crew by an alarm if pressure exceeds 20 bar in the cabin.***
- ***The alarm duration is 60 seconds***
- ***Client wants optional feature (in newer version) to keep record of pressure values and save it in a flash memory.***

Assumptions

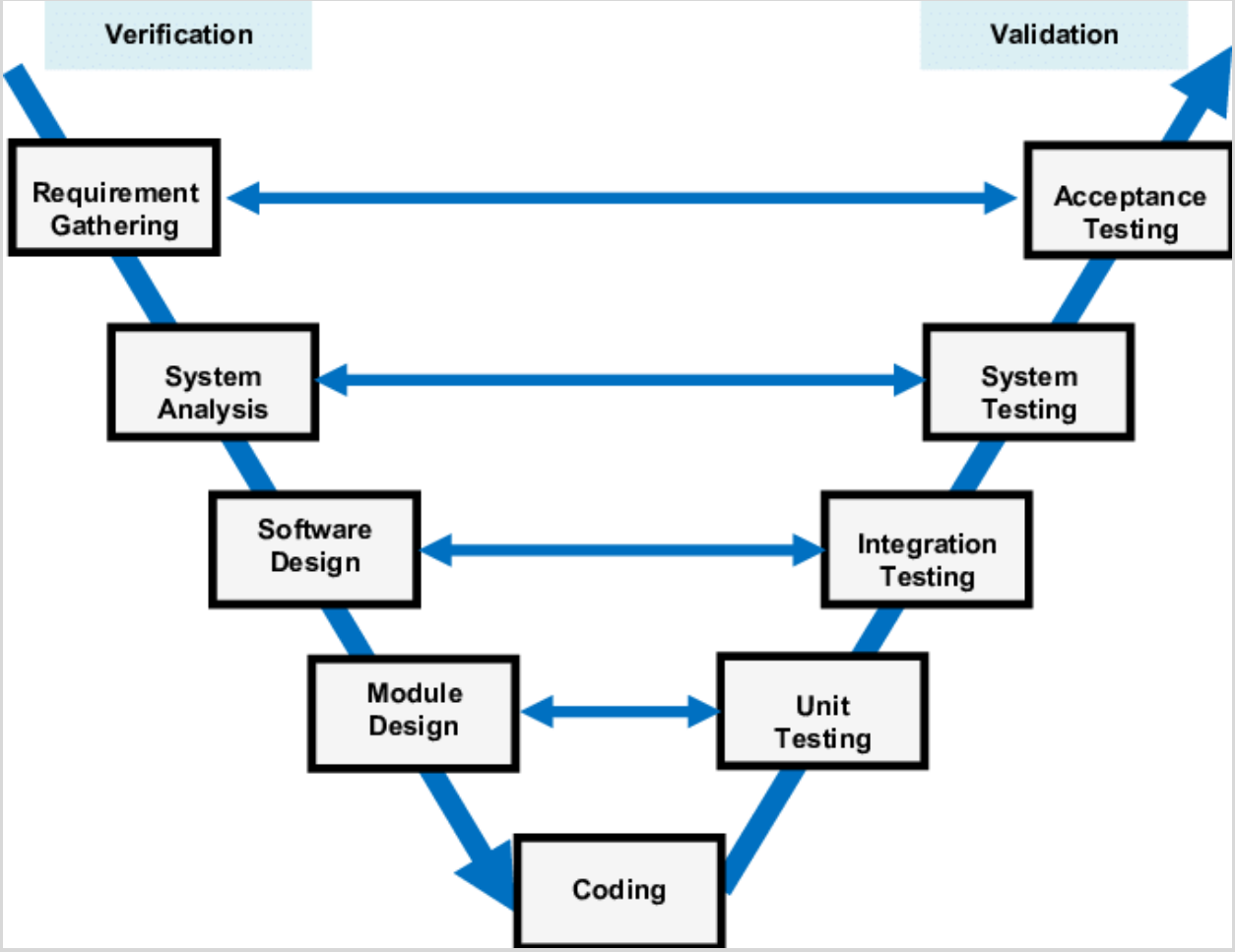
- ***The pressure sensor maintenance is not in consideration.***
- ***The power of the pressure sensor and alarm is not in consideration.***
- ***The failure of alarm or pressure sensor is not in consideration.***
- ***There are no sudden power cuts.***

Note

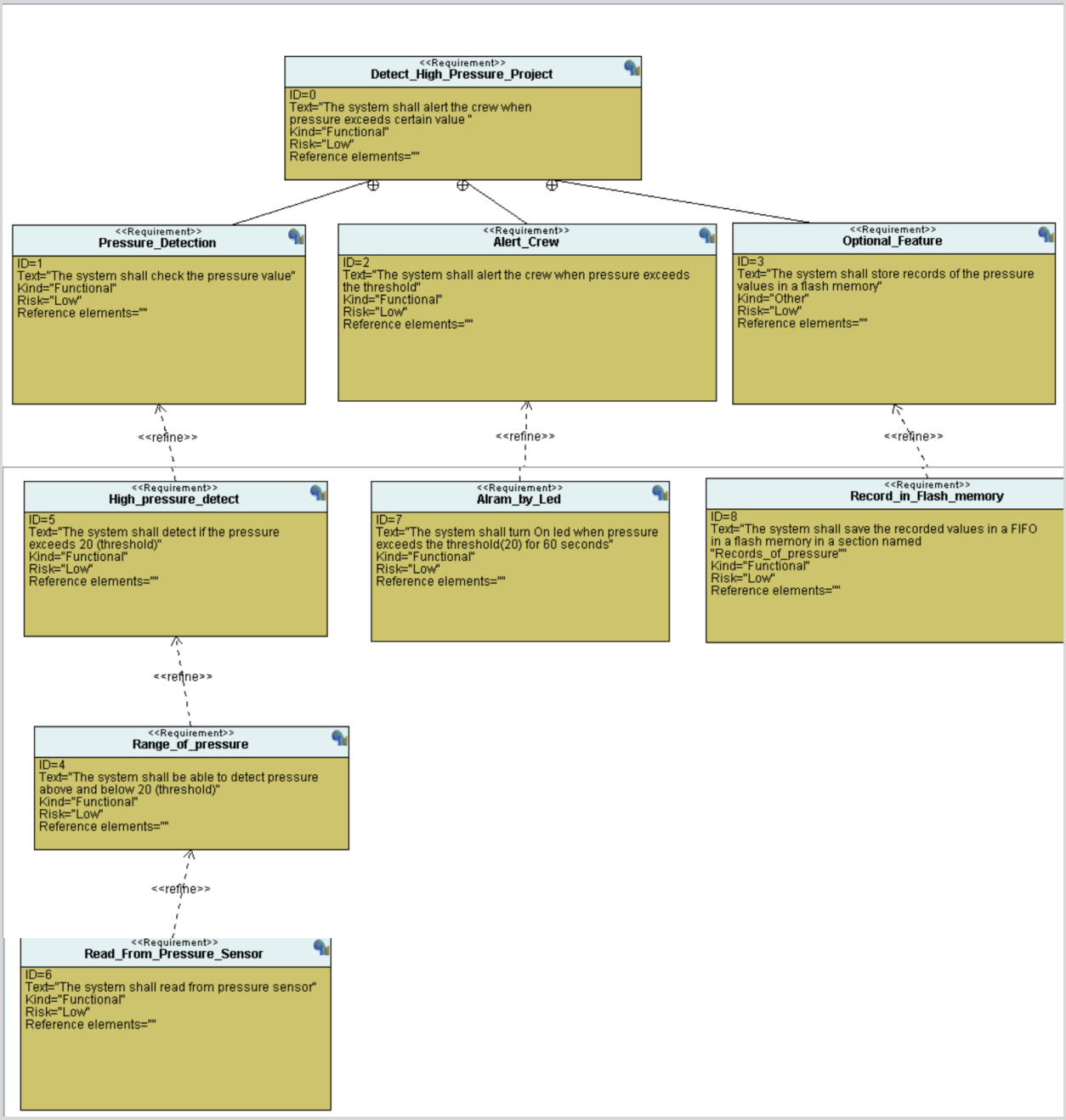
This version does not have the optional feature of recording pressure values in a flash memory.

Method

V Cycle Methodology



Requirements

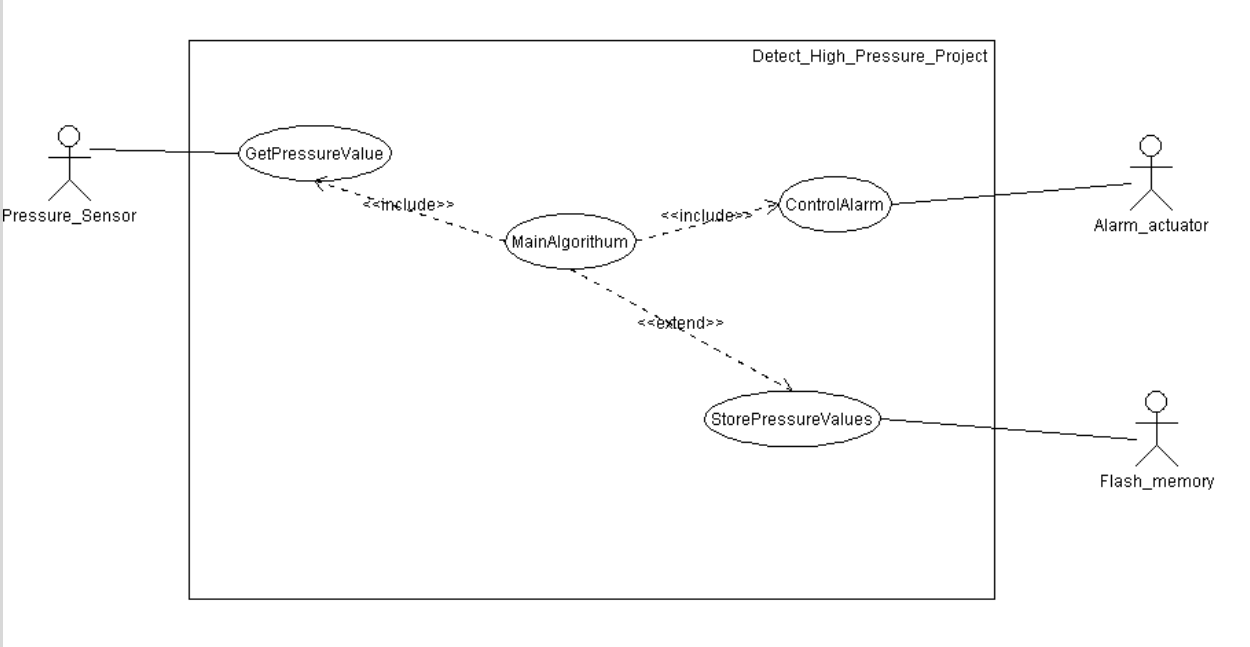


Hardware /Software Partitioning

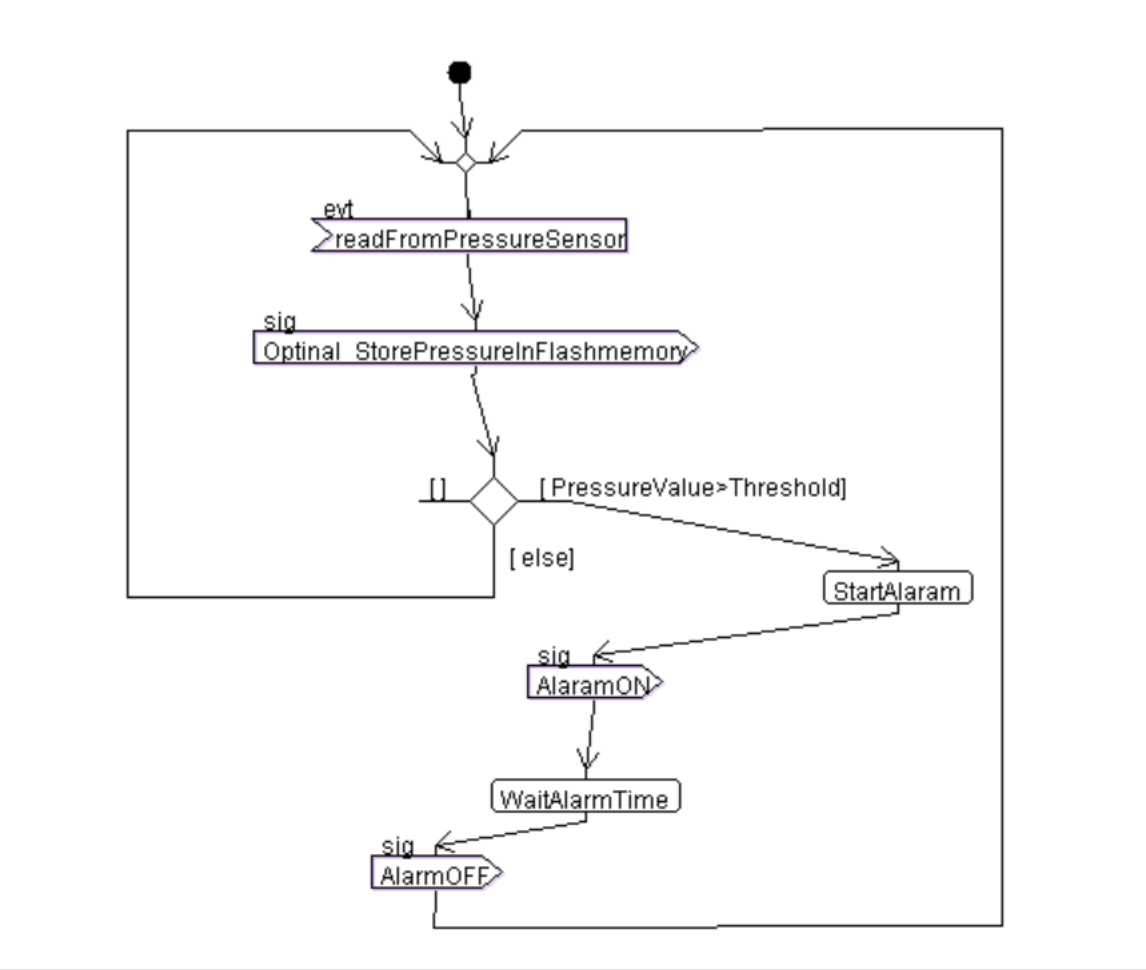
We will use 1 microcontroller for our implementation (STM32) whuch has cortex -M3 .

System Analysis

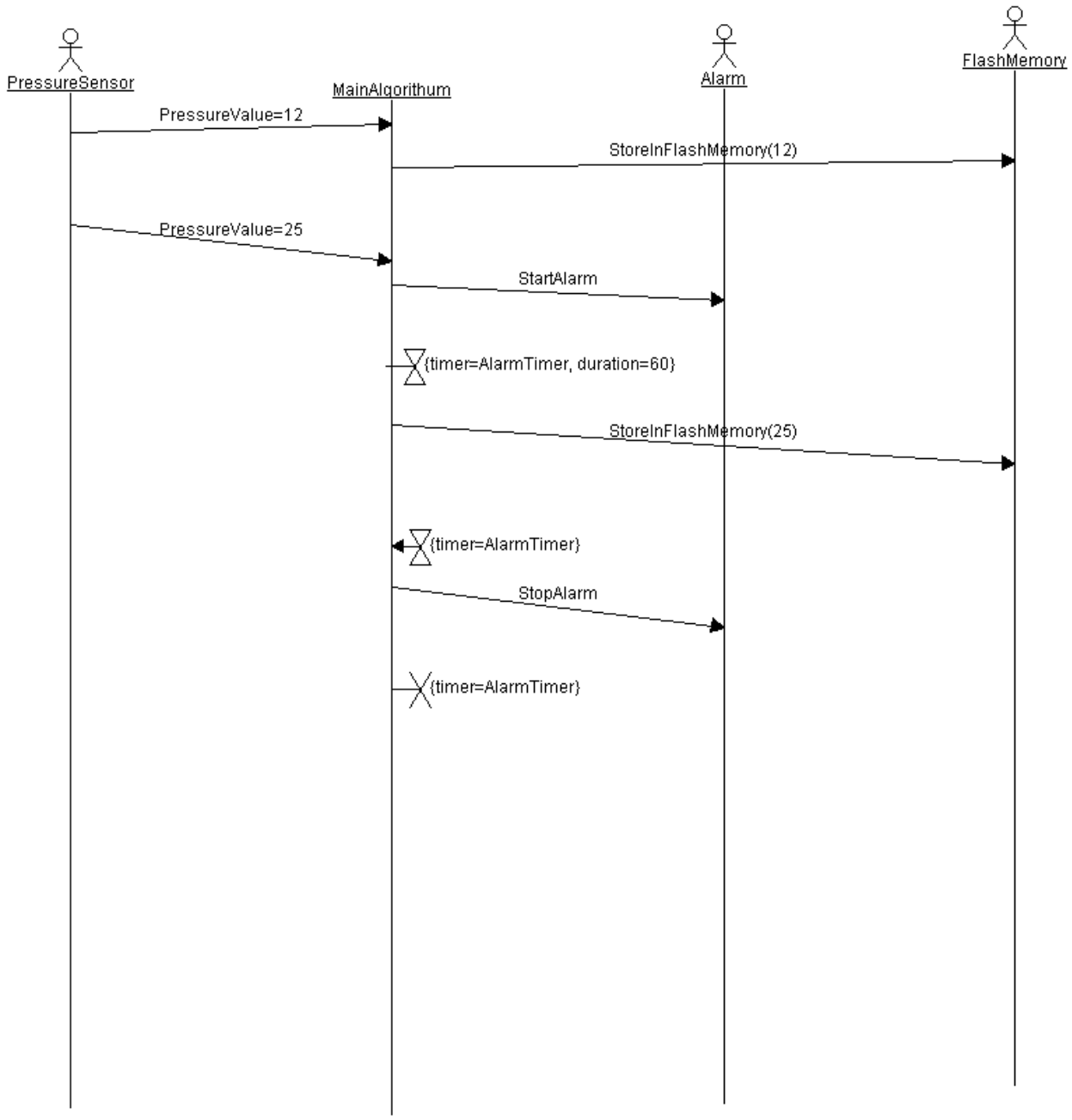
Use Case Diagram



Activity Diagram

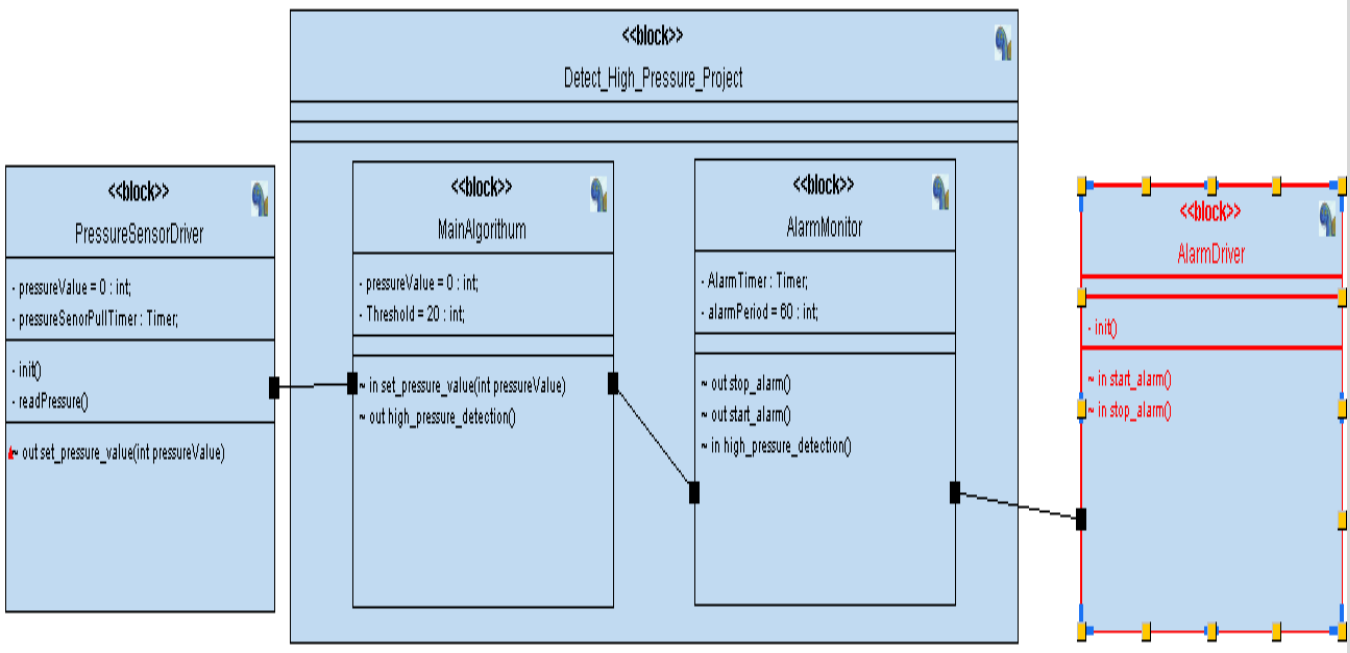


Sequence Diagram



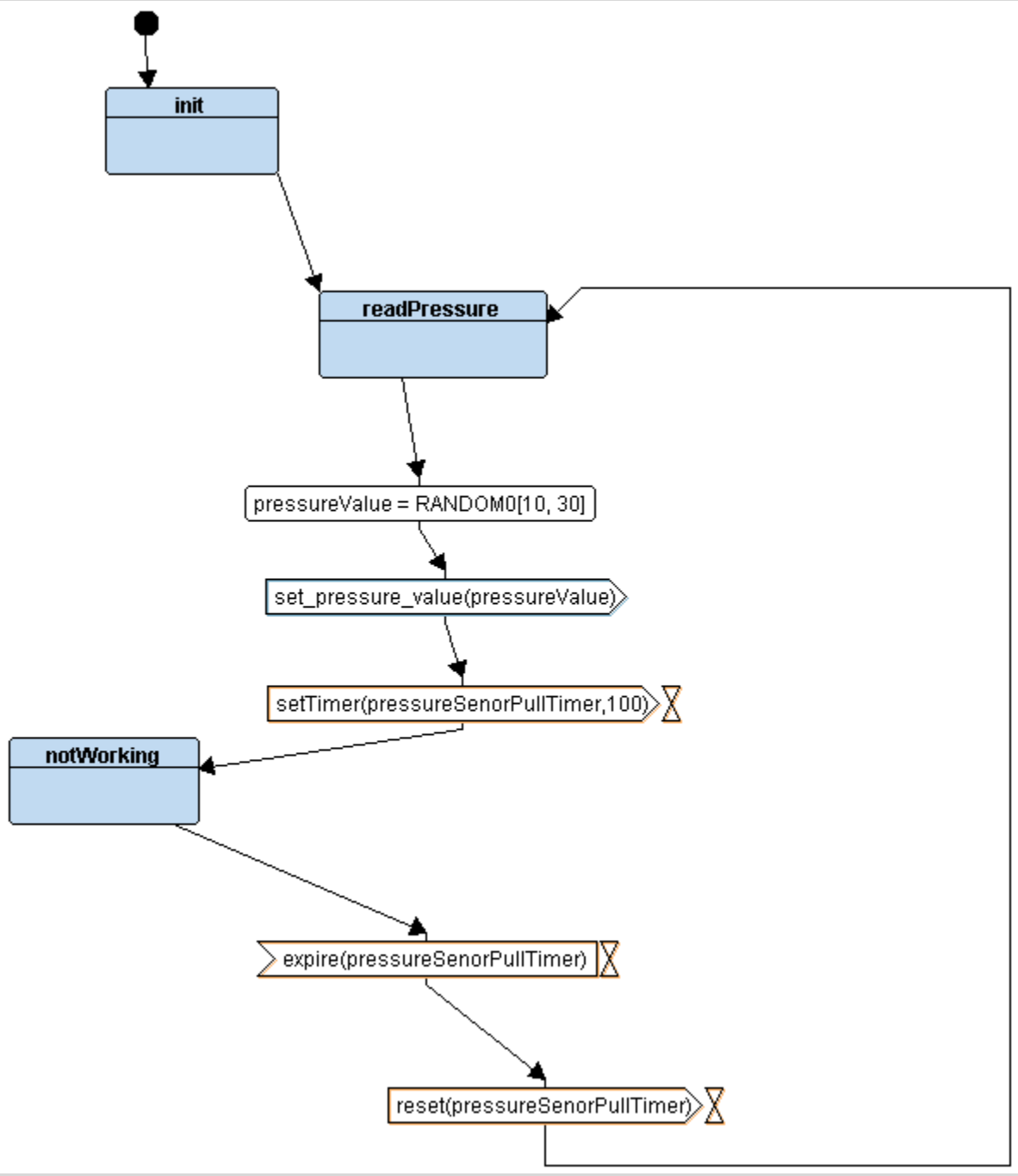
System Desigen

Block diagram

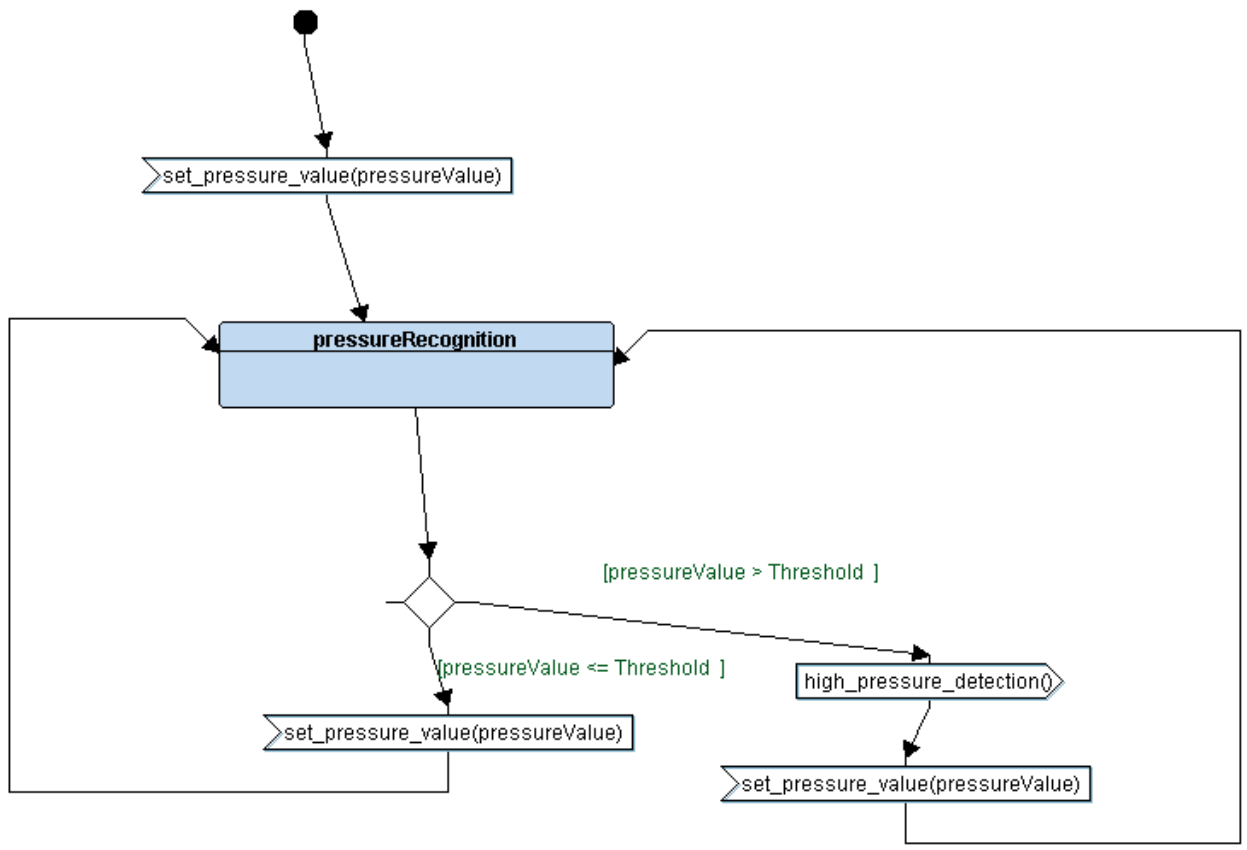


State Machines:

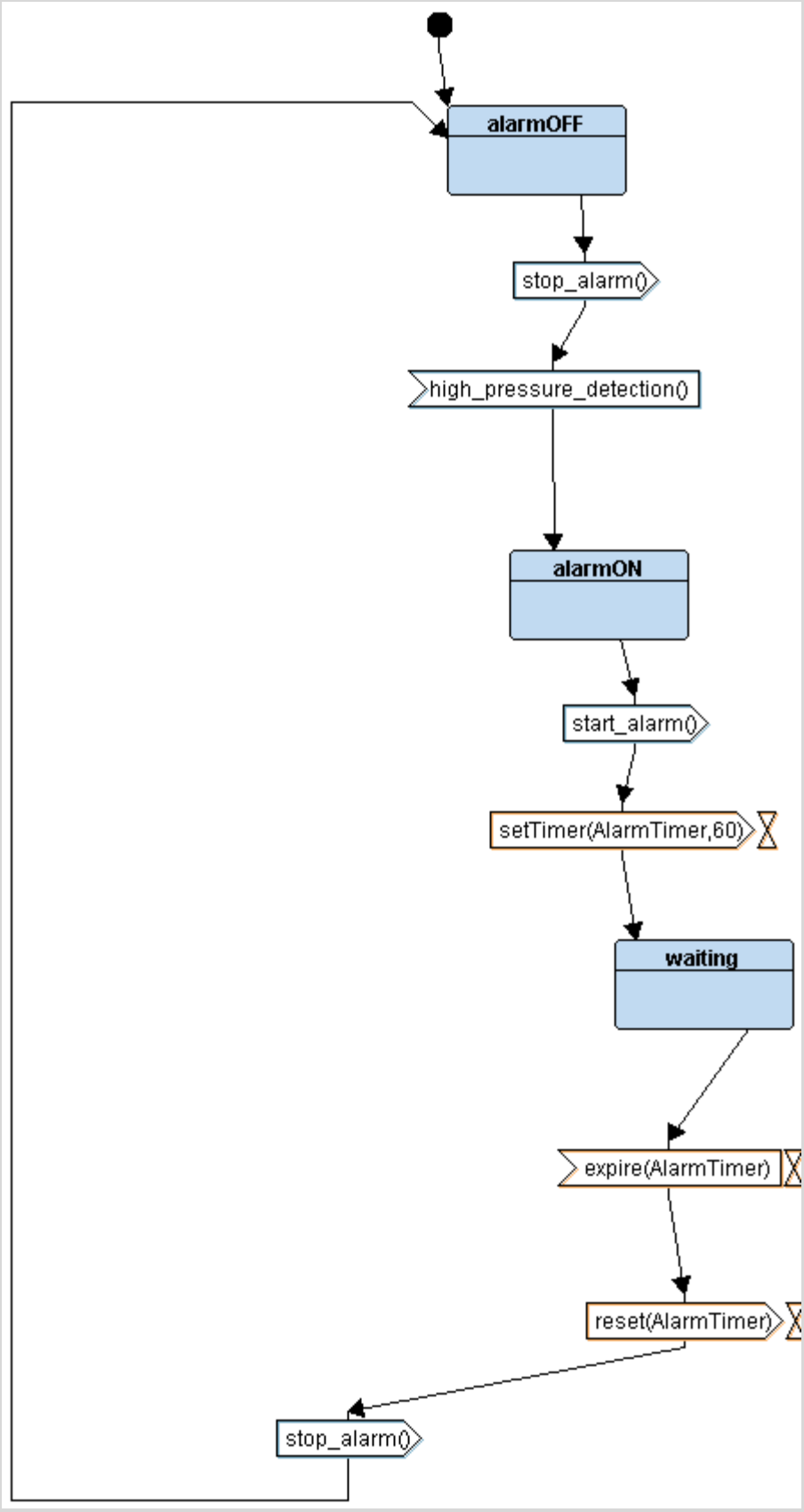
Pressure Sensor Driver:



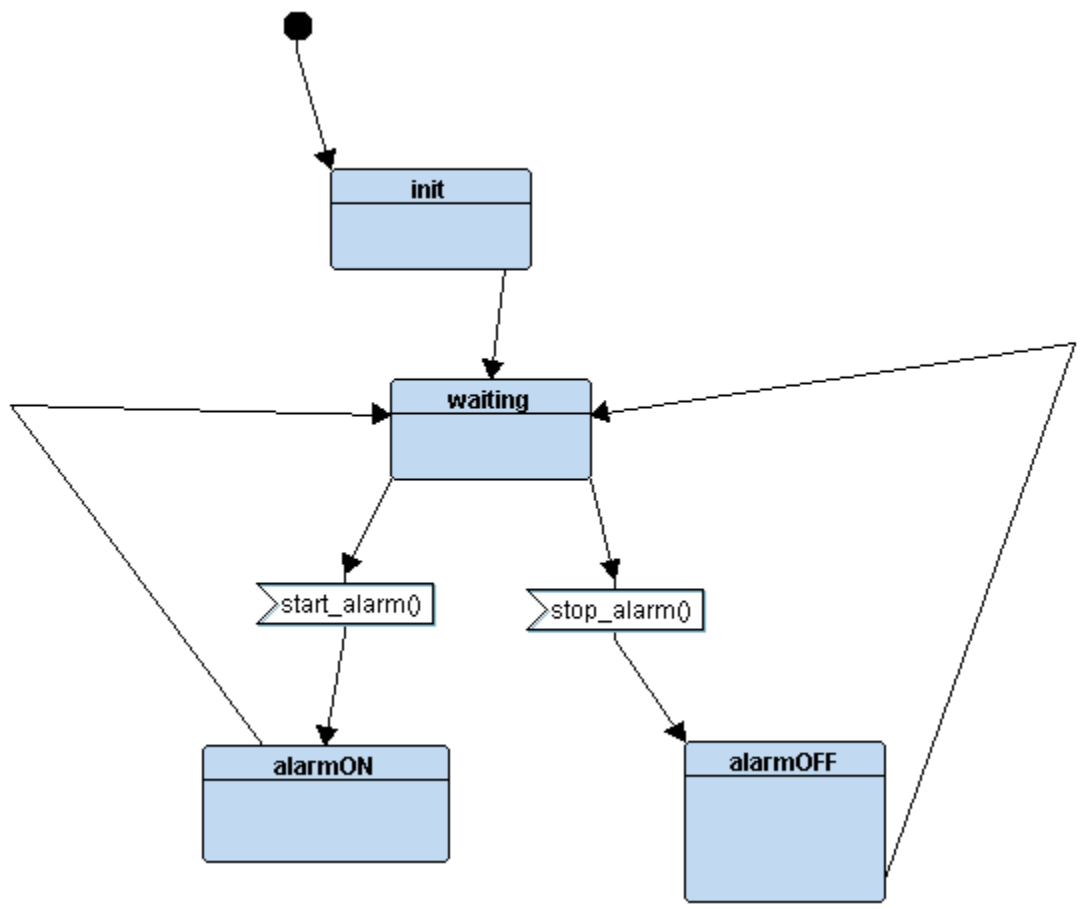
Main Algorithm:



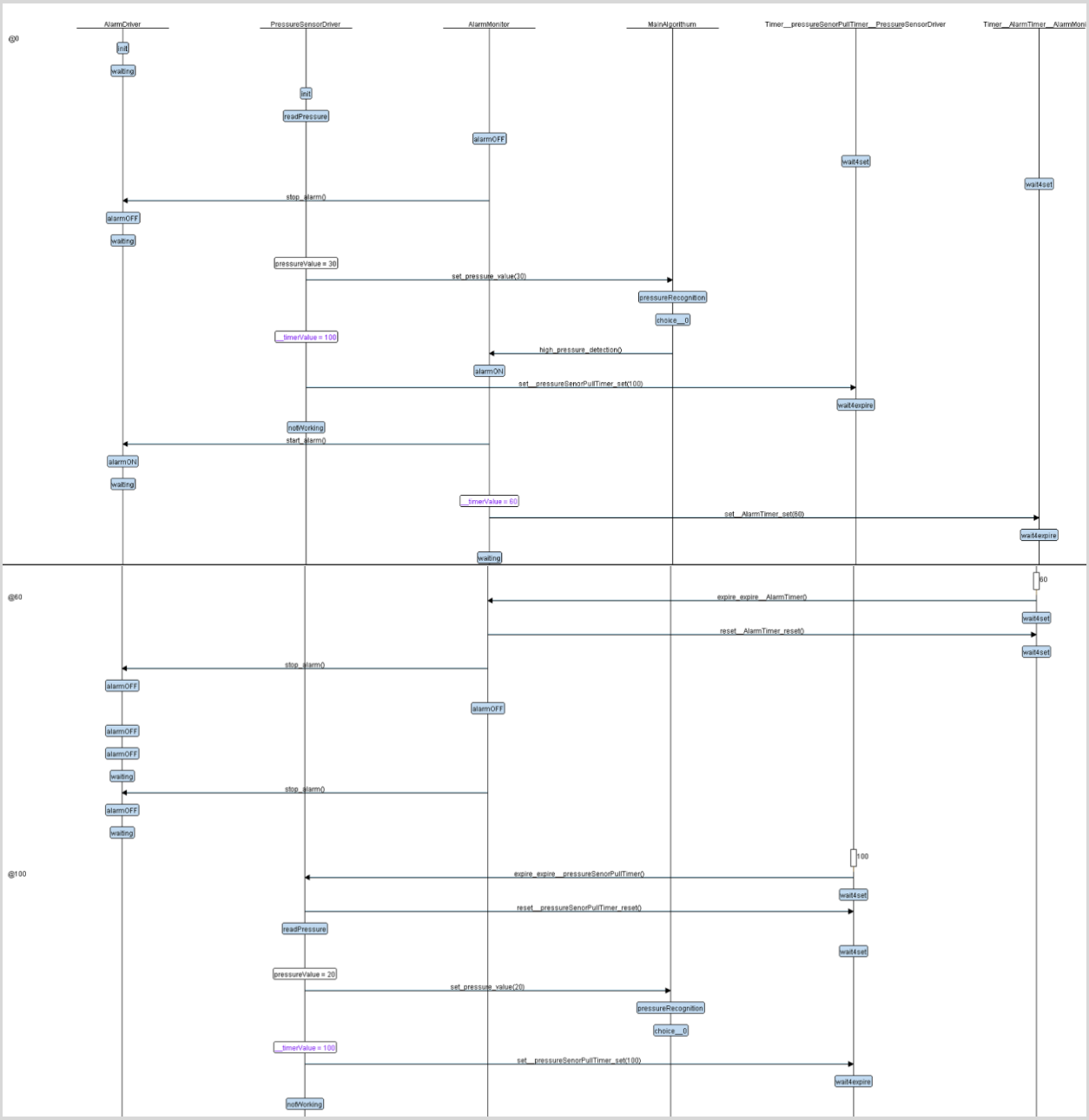
Alarm Monitor:



Alarm Driver:



Simulation


AlarmDriver
PressureSensorDriver
AlarmMonitor
MainAlgorithum
Timer__pressureSenorPullTimer__PressureSensorDriver
Timer__AlarmTimer__AlarmMonitor
@0
init
waiting
init
readPressure
alarmOFF
wait4set
wait4set
stop_alarm()
alarmOFF
waiting
pressureValue = 30
set_pressure_value(30)
pressureRecognition
choice__0
__timerValue = 100
high_pressure_detection()
alarmON
set__pressureSenorPullTimer_set(100)
wait4expire
notWorking
start_alarm()
alarmON
waiting
__timerValue = 60
set__AlarmTimer_set(60)
wait4expire
waiting
60
@60
expire_expire__AlarmTimer()
wait4set
reset__AlarmTimer_reset()
wait4set
stop_alarm()
alarmOFF
alarmOFF
alarmOFF
alarmOFF
waiting
stop_alarm()
alarmOFF
waiting
100
@100
expire_expire__pressureSenorPullTimer()
wait4set
reset__pressureSenorPullTimer_reset()
readPressure
wait4set
pressureValue = 20
set_pressure_value(20)
pressureRecognition
choice__0
__timerValue = 100
set__pressureSenorPullTimer_set(100)
wait4expire
notWorking

Sections:

Alarm Driver header section

```
$ arm-none-eabi-objdump.exe -h AlarmDriver.O

AlarmDriver.O:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         0000009c  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000d0  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000d0  2**0
                  ALLOC
  3 .debug_info   00000a4b  00000000  00000000  000000d0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001e1  00000000  00000000  00000b1b  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    000000f4  00000000  00000000  00000cfc  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000df0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000200  00000000  00000000  00000e10  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    000005b6  00000000  00000000  00001010  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  000015c6  2**0
                  CONTENTS, READONLY
 10 .debug_frame  000000a0  00000000  00000000  00001644  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000016e4  2**0
                  CONTENTS, READONLY
```

Alarm Monitor header section

```
$ arm-none-eabi-objdump.exe -h AlarmMonitor.o

AlarmMonitor.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000070  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000a4  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000a4  2**0
                  ALLOC
  3 .debug_info   00000a1b  00000000  00000000  000000a4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001e1  00000000  00000000  00000abf  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    0000009c  00000000  00000000  00000ca0  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000d3c  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   000001fc  00000000  00000000  00000d5c  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    000005b2  00000000  00000000  00000f58  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  0000150a  2**0
                  CONTENTS, READONLY
 10 .debug_frame  00000068  00000000  00000000  00001588  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000015f0  2**0
                  CONTENTS, READONLY
```

Main header section

```
$ arm-none-eabi-objdump.exe -h main.o

main.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000040  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  00000074  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  00000074  2**0
                  ALLOC
  3 .debug_info   00000a92  00000000  00000000  00000074  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001c0  00000000  00000000  00000b06  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    0000002c  00000000  00000000  00000cc6  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000cf2  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000237  00000000  00000000  00000d12  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    00000645  00000000  00000000  00000f49  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  0000158e  2**0
                  CONTENTS, READONLY
 10 .debug_frame  0000002c  00000000  00000000  0000160c  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  00001638  2**0
                  CONTENTS, READONLY
```

High Pressure Detection header section

```
$ arm-none-eabi-objdump.exe -h HighPressureDetection.elf

HighPressureDetection.elf:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000340  08000000  08000000  00010000  2**2
                  CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .data         00000000  20000000  08000340  00020000  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          0000001c  20000000  08000340  00020000  2**2
                  ALLOC
  3 .debug_info   00003eab  00000000  00000000  00020000  2**0
                  CONTENTS, READONLY, DEBUGGING
  4 .debug_abbrev 00000bbf  00000000  00000000  00023eab  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000438  00000000  00000000  00024a6a  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 000000e0  00000000  00000000  00024ea2  2**0
                  CONTENTS, READONLY, DEBUGGING
  7 .debug_line   00000d9f  00000000  00000000  00024f82  2**0
                  CONTENTS, READONLY, DEBUGGING
  8 .debug_str    000007bf  00000000  00000000  00025d21  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007b  00000000  00000000  000264e0  2**0
                  CONTENTS, READONLY
 10 .ARM.attributes 00000033  00000000  00000000  0002655b  2**0
                  CONTENTS, READONLY
 11 .debug_frame  000002a4  00000000  00000000  00026590  2**2
                  CONTENTS, READONLY, DEBUGGING
```

Pressure Sensor header section

```
$ arm-none-eabi-objdump.exe -h PressureSensorDriver.o

PressureSensorDriver.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000060  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  00000094  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000004  00000000  00000000  00000094  2**2
                  ALLOC
  3 .debug_info   00000a23  00000000  00000000  00000094  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001e1  00000000  00000000  00000ab7  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000070  00000000  00000000  00000c98  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000d08  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   0000021b  00000000  00000000  00000d28  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    000005d1  00000000  00000000  00000f43  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  00001514  2**0
                  CONTENTS, READONLY
 10 .debug_frame  0000004c  00000000  00000000  00001590  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000015dc  2**0
                  CONTENTS, READONLY
```

Main Algorithm header section

```
$ arm-none-eabi-objdump.exe -h MainAlgorithum.o

MainAlgorithum.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000024  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  00000058  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  00000058  2**0
                  ALLOC
  3 .debug_info   000009f8  00000000  00000000  00000058  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001be  00000000  00000000  00000a50  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000050  00000000  00000000  00000c0e  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000c5e  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000209  00000000  00000000  00000c7e  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    000005a8  00000000  00000000  00000e87  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  0000142f  2**0
                  CONTENTS, READONLY
 10 .debug_frame  00000034  00000000  00000000  000014ac  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000014e0  2**0
                  CONTENTS, READONLY
```

Symbols table

Symbol of Pressure Sensor Driver file

```
$ arm-none-eabi-nm.exe PressureSensorDriver.o
         U Delay
         U getPressureVal
0000003c T pressure_sensor_init
00000004 C Pressure_Sensor_State
00000001 C PressureSensorStateID
00000000 B pressureValue
00000000 T read_pressure
         U set_pressure_value
```

Symbol of main file

```
$ arm-none-eabi-nm.exe main.o
         U Alarm_Driver_State
         U alarm_init
         U Alarm_Monitor_State
         U alarm_OFF
00000001 C AlarmDriverStateID
00000001 C AlarmMonitorStateID
         U GPIO_INITIALIZATION
00000000 T main
00000001 C MainAlgorithumStateID
         U pressure_sensor_init
         U Pressure_Sensor_State
00000001 C PressureSensorStateID
```

Symbol of Main Algorithum file

```
$ arm-none-eabi-nm.exe MainAlgorithum.o
         U high_pressure_detection
00000004 C Main_Algorithum_State
00000001 C MainAlgorithumStateID
00000000 T set_pressure_value
```

Symbol of Alarm Monitor file

```
$ arm-none-eabi-nm.exe AlarmMonitor.o
00000004 C Alarm_Monitor_State
00000038 T alarm_OFF
00000000 T alarm_ON
00000001 C AlarmMonitorStateID
         U Delay
00000054 T high_pressure_detection
         U start_alarm
         U stop_alarm
```

Symbol of Alarm Driver file

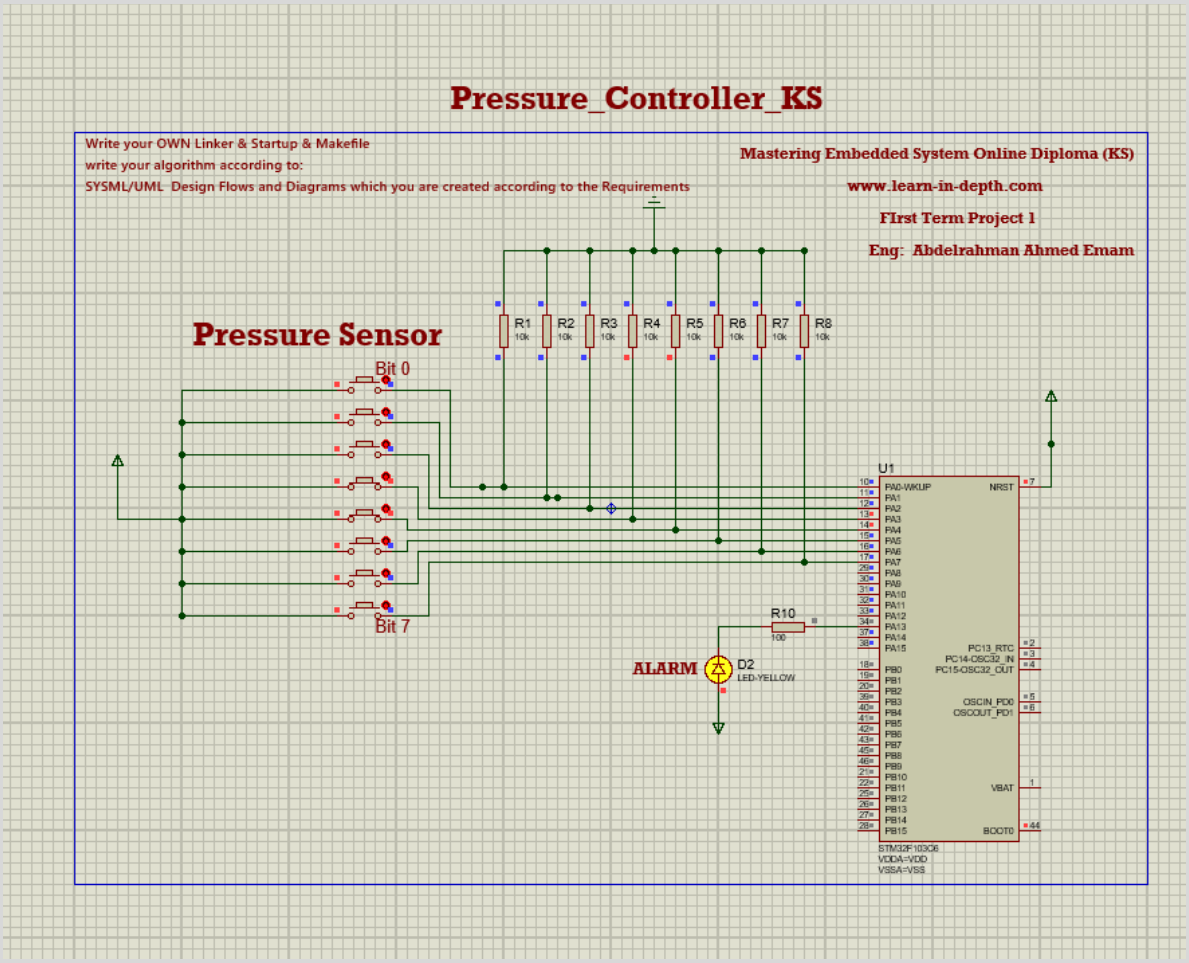
```
$ arm-none-eabi-nm.exe AlarmDriver.o
00000004 C Alarm_Driver_State
00000000 T alarm_init
00000044 T alarm_off
00000024 T alarm_on
00000001 C AlarmDriverStateID
         U Set_Alarm_actuator
00000080 T start_alarm
00000064 T stop_alarm
```

Symbol High Pressure Detection file

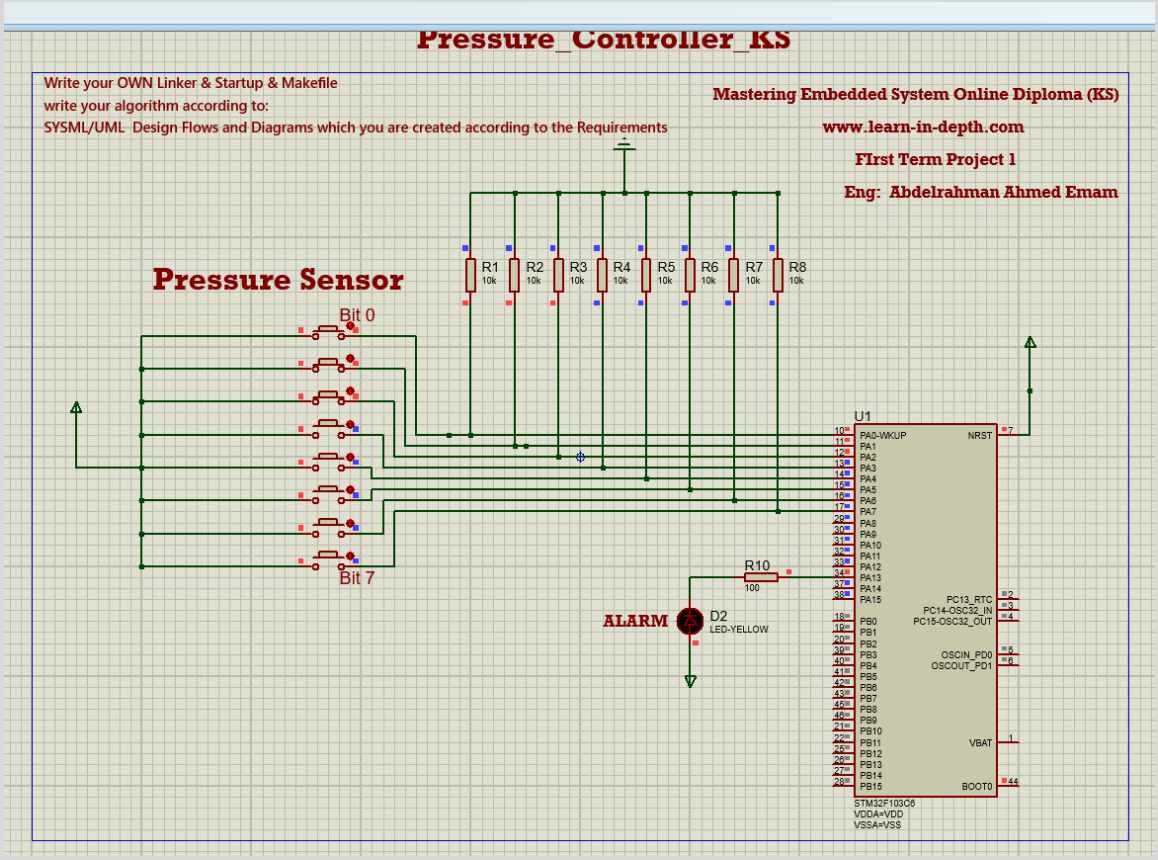
```
$ arm-none-eabi-nm.exe HighPressureDetection.elf
20000000 D _D_Size
20000004 B _E_bss
20000000 D _E_Data
08000340 T _E_Text
20000000 B _S_bss
20000000 D _S_Data
08000000 T _S_Text
2000000c B Alarm_Driver_State
080000d0 T alarm_init
20000014 B Alarm_Monitor_State
08000114 T alarm_off
080002a8 T alarm_OFF
080000f4 T alarm_on
08000270 T alarm_ON
20000010 B AlarmDriverStateID
20000012 B AlarmMonitorStateID
0800001c W Bus_Fault_Handler
0800001c T Default_Handler
080001ac T Delay
080001cc T getPressureVal
08000220 T GPIO_INITIALIZATION
0800001c W Hard_fault_Handler
080002c4 T high_pressure_detection
0800016c T main
20000004 B Main_Algorithum_State
20000008 B MainAlgorithumStateID
0800001c W MM_Fault_Handler
0800001c W NMI_Handler
0800031c T pressure_sensor_init
20000018 B Pressure_Sensor_State
20000011 B PressureSensorStateID
20000000 B pressureValue
080002e0 T read_pressure
08000028 T Reset_Handler
080001e4 T Set_Alarm_actuator
080000ac T set_pressure_value
2000101c B stack_top
08000150 T start_alarm
08000134 T stop_alarm
0800001c W Usage_Fault_Handler
08000000 T vectors
```

Proteus

Pressure equal 24 so alarm is on for 60 seconds



Pressure equal 7 so alarm does not work



For code and all files follow the link:

https://github.com/Abdelrahman-Ahmed-Emam/Embedded_System_Online_Diploma/tree/5abd4a41d098d14a9973389cdac60bea53664541/High%20Pressure%20Detection%20Project