By Alfred Fayez

Mastering Embedded Systems Online Diploma

www.learn-in-depth.com

First Term (Final Project 1)

Eng. Alfred Fayez

My Profile:

https://www.learn-in-depth-store.com/certificate/alfred.f.d646%40gmail.com

By Alfred Fayez

HIGH PRESSURE DETECTION REPORT

Creating Linker_Script, Startup.c For a Pressure Monitoring Program & Simulating On Proteus

Contents

By Alfred Fayez

Table of Figures

By Alfred Fayez

1. Case Study

The system is intended to be a component of a pressure control system designed to monitor pressure values in a cabin or closed environment, adhering to the following specifications:

- If the pressure exceeds a specific threshold (20 bar) in the cabin, it will notify the cabin crew.

- The alarm duration is set to 60 seconds.

- The system will consistently track the measured pressure values.

2. Assumptions about the System

1. The controller set up and shutdown procedures are not modeled/considered
2. The controller maintenance is not modeled
3. The pressure sensor never fails
4. The alarm never fails
5. The controller never faces a power cut

Kindly Note that: Any change in these assumptions will be considered as additional feature in the project.

3. Method

The method used to design and develop the system is the V-model

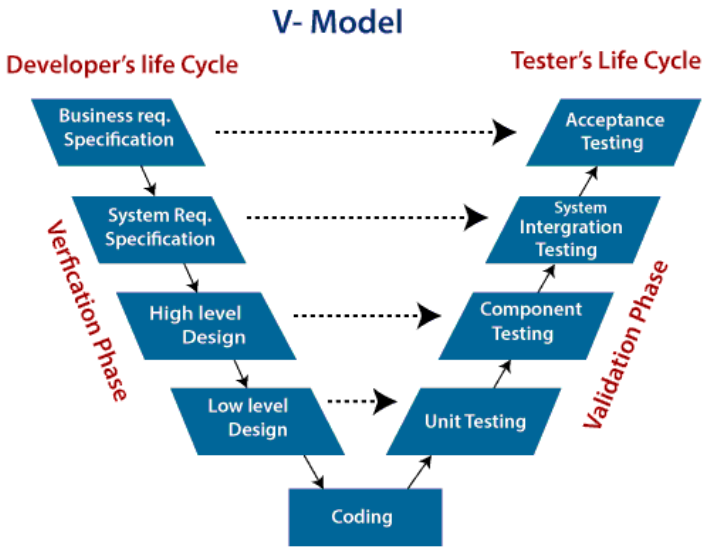

Figure 1 v model

4. Space Exploration

Will be using STM32F103C8T6 MCU (blue pill)

Manufacturer: ST-Microelectronics

Processor: ARM-Cortex-M3

Clock speed: 72MHz

Package: LQFP 48 pins

5. Requirements Diagram

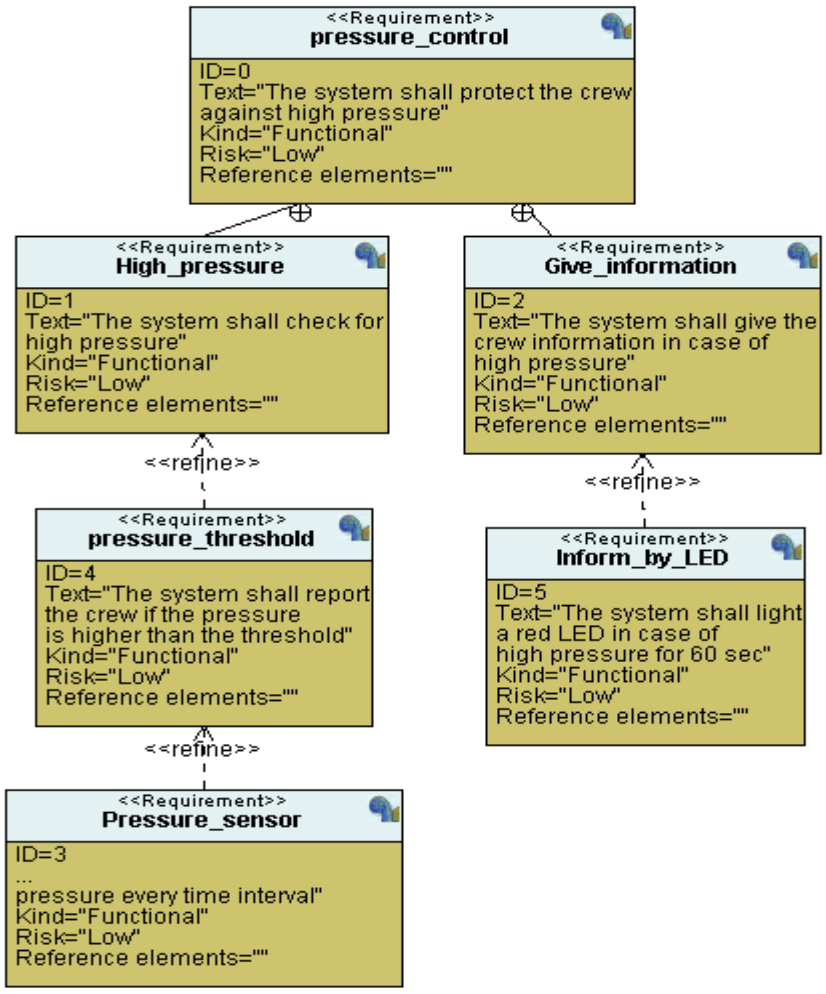

Figure 2 Requirements diagram

6. System Analysis

1. Case diagram

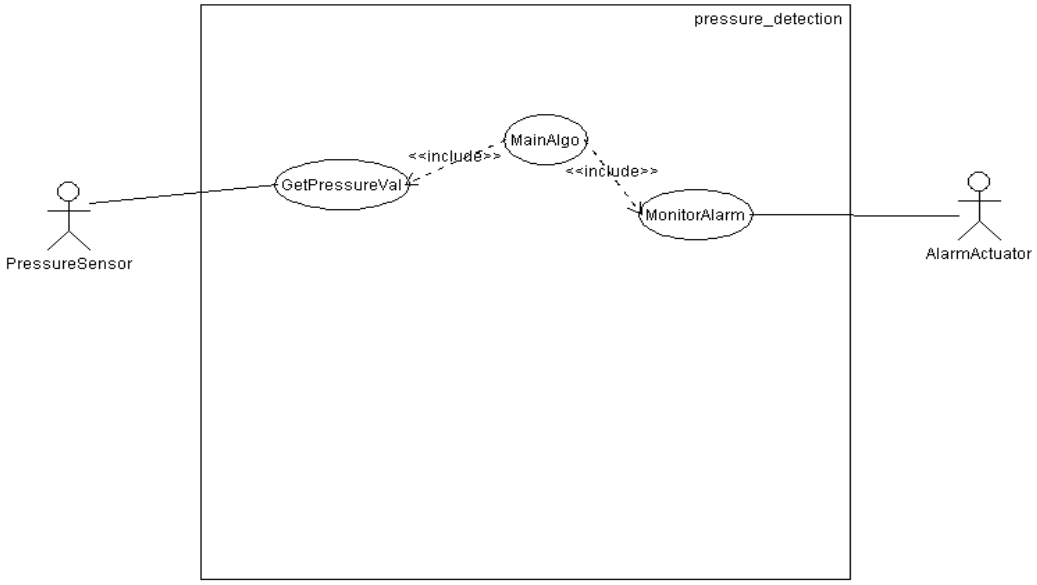

Figure 3 case diagram

2. Activity diagram

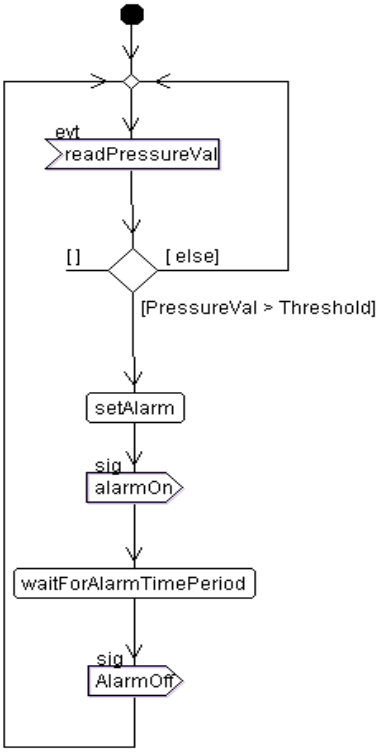

Figure 4 activity diagram

3. Sequence diagram

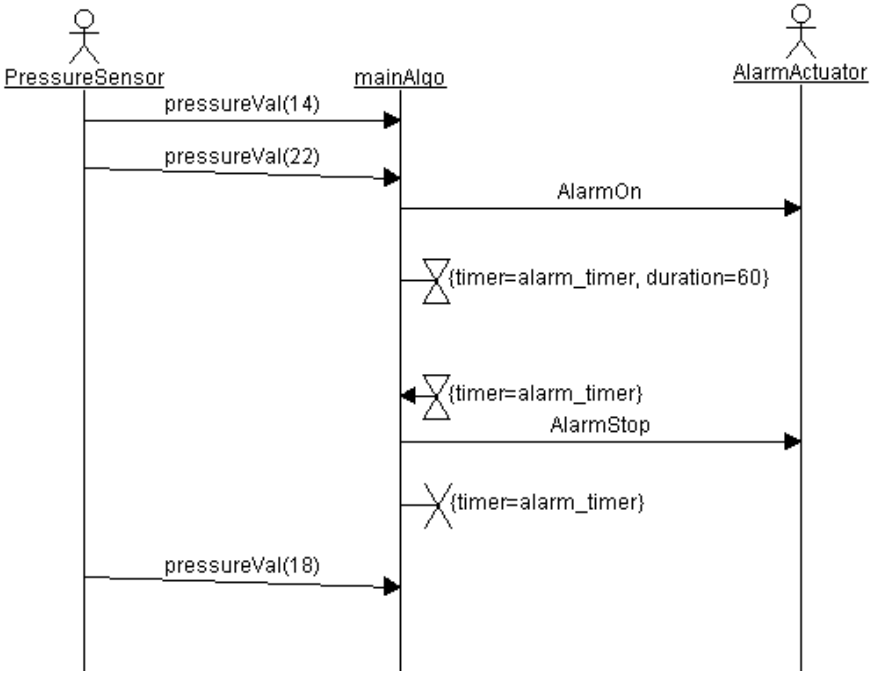

Figure 5 sequence diagram

7. System Design

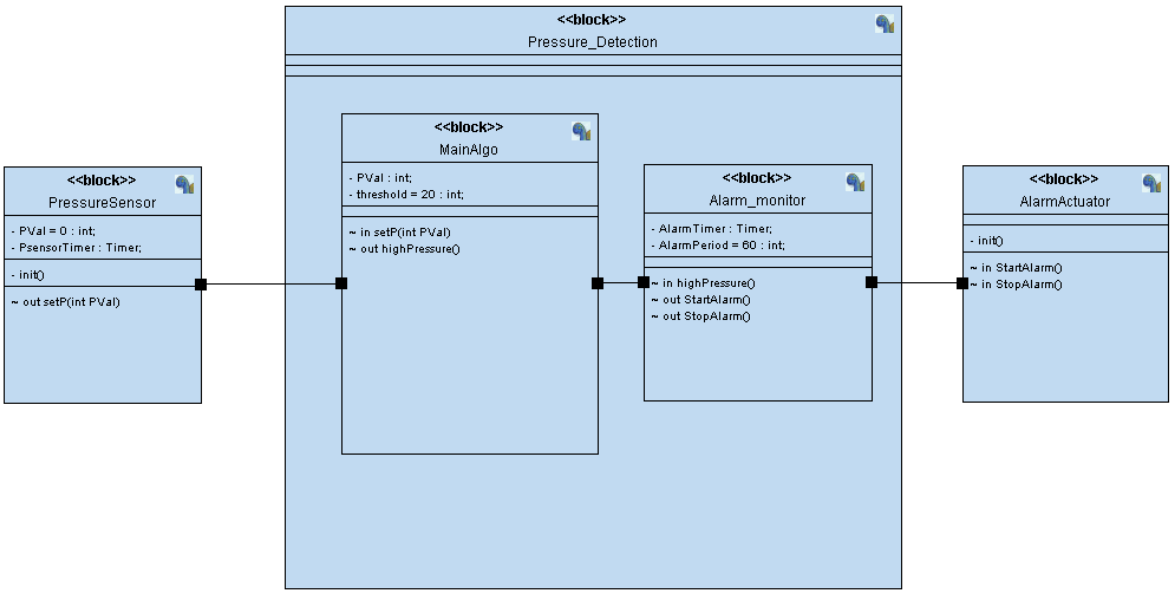

Figure 6 Sys. Design in TTool

8. State Machine of each block

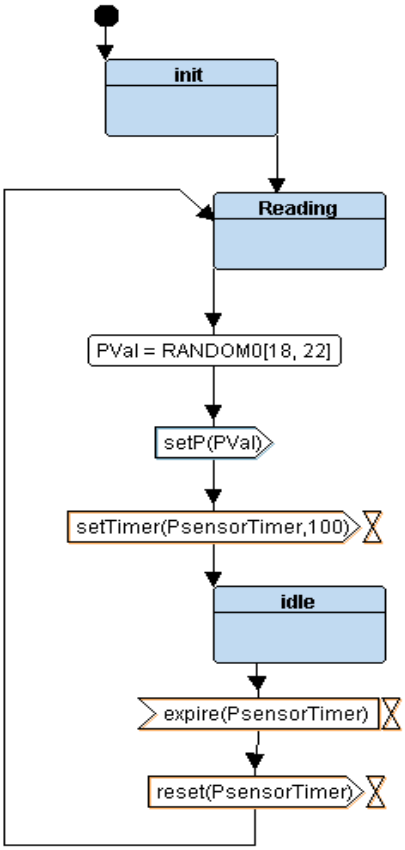

Figure 7 Pressure sensor SM

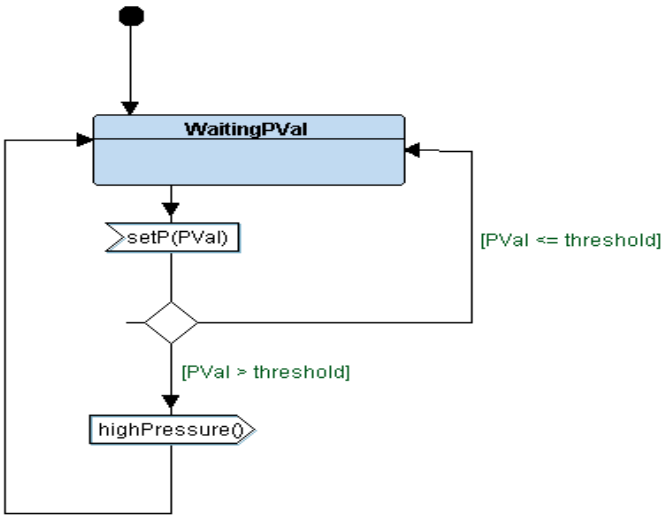

Figure 8 main algorithm SM

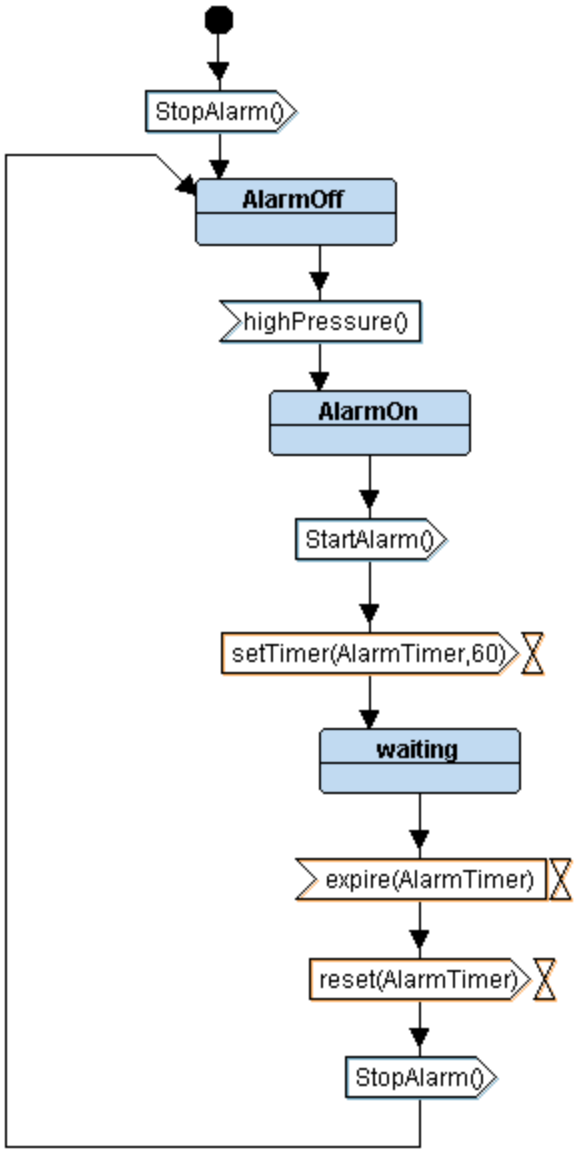

Figure 9 alarm monitor SM

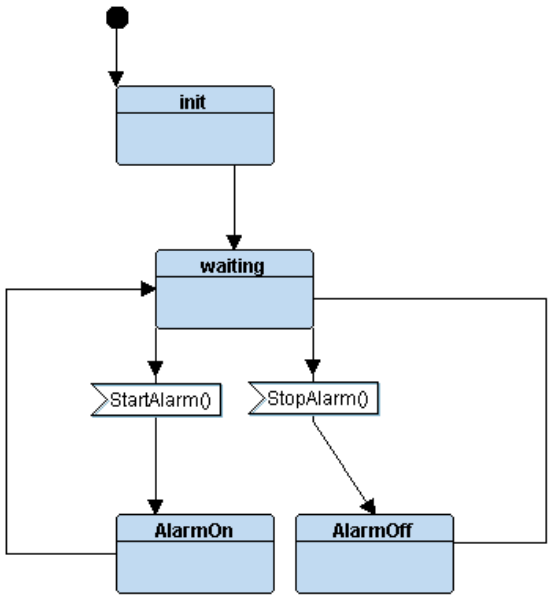

Figure 10 alarm actuator SM

9. Simulation on TTool

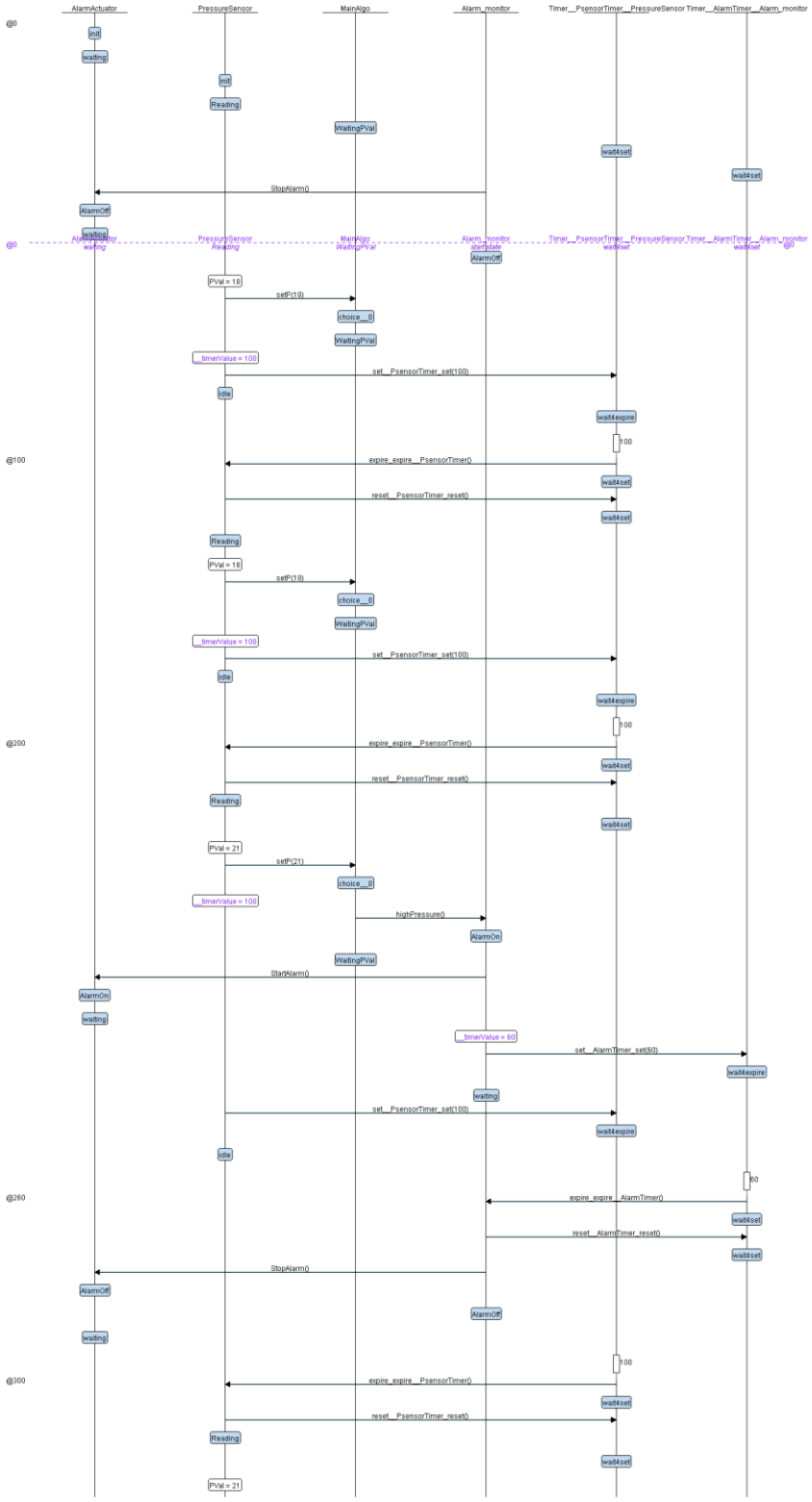

Figure 11 Verifying on TTool

By Alfred Fayez

10. Simulating on Proteus

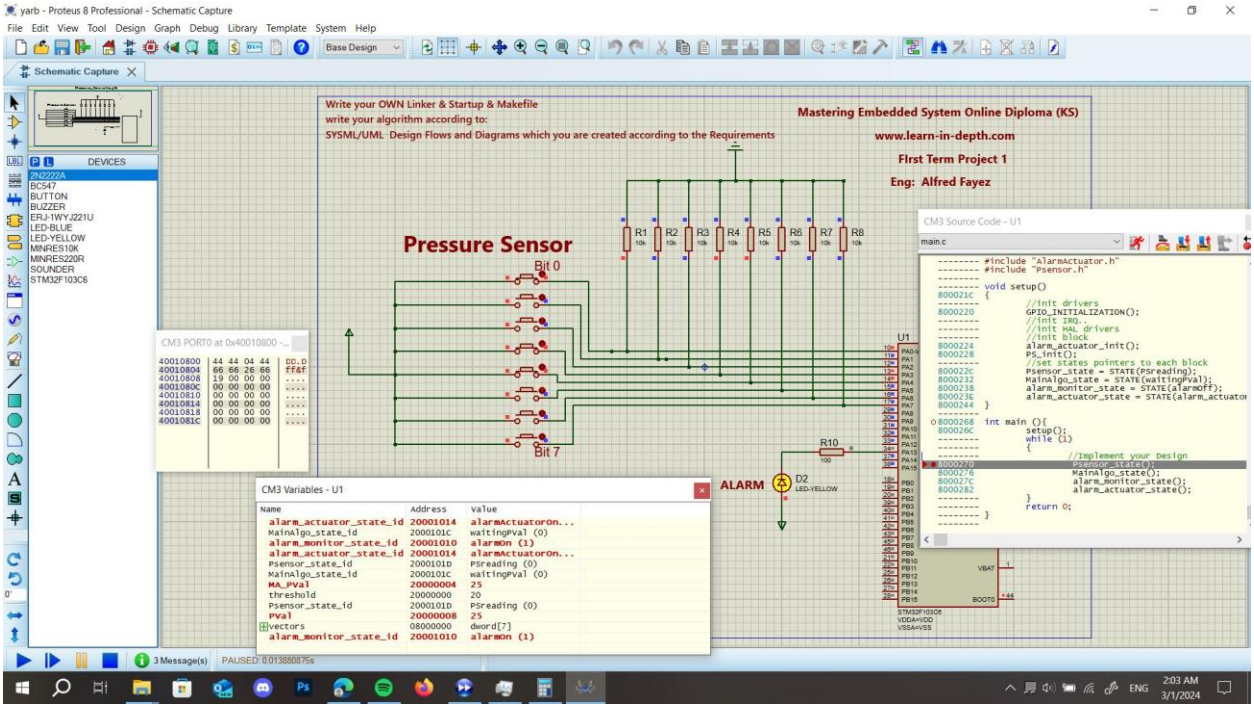

Figure 12 proteus simulation case p=25

The Pressure sensor value is 25 > 20 hence, the LED is on

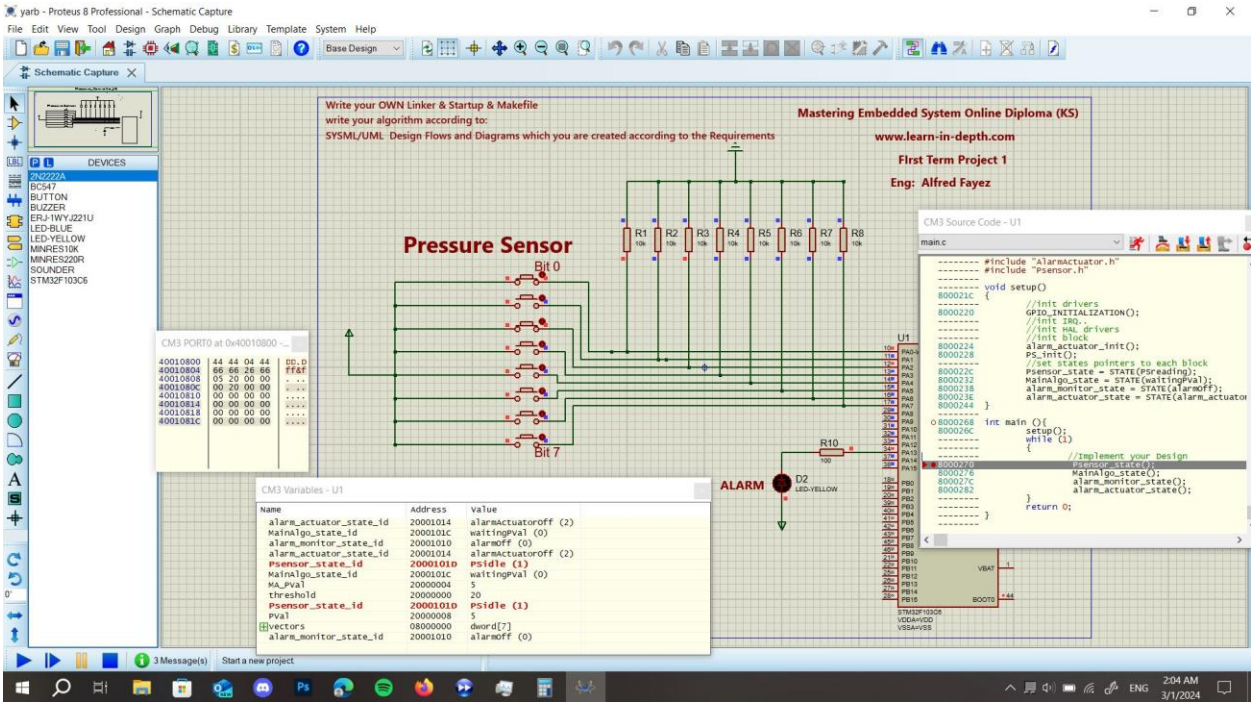

Figure 13 proteus simulation case p=5

The Pressure sensor value is 5 < 20 hence, the LED is off

11. Symbol Table Of The Object Files & The .elf File

```
alarm_monitor.o:
00000004 C alarm_monitor_state
00000001 C alarm_monitor_state_id
         U Delay
00000000 T highPressure
00000070 T ST_alarmMonitorWaiting
0000004c T ST_alarmOFF
0000001c T ST_alarmOn
         U startAlarm
         U stopAlarm

AlarmActuator.o:
00000000 T alarm_actuator_init
00000004 C alarm_actuator_state
00000001 C alarm_actuator_state_id
         U Set_Alarm_actuator
0000005c T ST_alarm_actuator_waiting
0000000c T ST_alarmActuatorOff
00000034 T ST_alarmActuatorOn
00000074 T startAlarm
00000090 T stopAlarm

driver.o:
00000000 T Delay
00000020 T getPressureVal
00000074 T GPIO_INITIALIZATION
00000038 T Set_Alarm_actuator

main.o:
         U alarm_actuator_init
         U alarm_actuator_state
00000001 C alarm_actuator_state_id
         U alarm_monitor_state
00000001 C alarm_monitor_state_id
         U GPIO_INITIALIZATION
0000004c T main
         U MainAlgo_state
00000001 C MainAlgo_state_id
         U PS_init
         U Psensor_state
00000001 C Psensor_state_id
```

Figure 14 symbole table 1

```
MainAlgo.o:
         U highPressure
00000000 B MA_PVal
00000004 C MainAlgo_state
00000001 C MainAlgo_state_id
00000000 T setP
00000020 T ST_waitingPVal
00000000 D threshold

Psensor.o:
         U Delay
         U getPressureVal
00000000 T PS_init
00000004 C Psensor_state
00000001 C Psensor_state_id
00000000 B PVal
         U setP
00000058 T ST_PSidle
0000001c T ST_PSreading

startup.o:
         U _E_bss
         U _E_DATA
         U _E_txt
         U _S_bss
         U _S_DATA
00000000 W Bus_fault
00000000 T Default_Handler
00000000 R g_p_fn_vectors
00000000 W H_fault_Handler
         U main
00000000 W MM_fault_Handler
00000000 W NMI_Handler
0000000c T Reset_Handler
00000000 b stack_top
00000000 W Usage_fault_Handler
```

Figure 15 symbol tables 2

```
HighPessureDetection.elf:
2000040c B _E_bss
20000004 D _E_DATA
08000418 R _E_txt
20000004 B _S_bss
20000000 D _S_DATA
08000094 T alarm_actuator_init
20000418 B alarm_actuator_state
20000414 B alarm_actuator_state_id
2000040c B alarm_monitor_state
20000410 B alarm_monitor_state_id
08000360 W Bus_fault
08000360 T Default_Handler
08000140 T Delay
080003fc R g_p_fn_vectors
08000160 T getPressureVal
080001b4 T GPIO_INITIALIZATION
08000360 W H_fault_Handler
08000000 T highPressure
20000004 B MA_PVal
08000250 T main
20000420 B MainAlgo_state
2000041c B MainAlgo_state_id
08000360 W MM_fault_Handler
08000360 W NMI_Handler
080002dc T PS_init
20000424 B Psensor_state
2000041d B Psensor_state_id
20000008 B PVal
0800036c T Reset_Handler
08000178 T Set_Alarm_actuator
08000284 T setP
08000204 T setup
080000f0 T ST_alarm_actuator_waiting
080000a0 T ST_alarmActuatorOff
080000c8 T ST_alarmActuatorOn
08000070 T ST_alarmMonitorWaiting
0800004c T ST_alarmOFF
0800001c T ST_alarmOn
08000334 T ST_PSidle
080002f8 T ST_PSreading
080002a4 T ST_waitingPVal
```

Figure 16 symbol table 3.

12. Sections In Each File

```
alarm_monitor.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000090  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000c4  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000c4  2**0
                  ALLOC
  3 .debug_info   00000a22  00000000  00000000  000000c4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001e1  00000000  00000000  00000ae6  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    000000e0  00000000  00000000  00000cc7  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000da7  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000200  00000000  00000000  00000dc7  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    0000059e  00000000  00000000  00000fc7  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  00001565  2**0
                  CONTENTS, READONLY
 10 .debug_frame  00000088  00000000  00000000  000015e4  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  0000166c  2**0
                  CONTENTS, READONLY

AlarmActuator.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         000000ac  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000e0  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000e0  2**0
                  ALLOC
  3 .debug_info   00000a4b  00000000  00000000  000000e0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001df  00000000  00000000  00000b2b  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000168  00000000  00000000  00000d0a  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000e72  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000201  00000000  00000000  00000e92  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    000005e2  00000000  00000000  00001093  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  00001675  2**0
                  CONTENTS, READONLY
 10 .debug_frame  000000c8  00000000  00000000  000016f4  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000017bc  2**0
                  CONTENTS, READONLY
```

Figure 17 sections 1

```
driver.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         000000c4  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000f8  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000f8  2**0
                  ALLOC
  3 .debug_info   00000a05  00000000  00000000  000000f8  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001de  00000000  00000000  00000afd  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000140  00000000  00000000  00000cdb  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000e1b  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   000002ca  00000000  00000000  00000e3b  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    00000563  00000000  00000000  00001105  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  00001668  2**0
                  CONTENTS, READONLY
 10 .debug_frame  000000a0  00000000  00000000  000016e4  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  00001784  2**0
                  CONTENTS, READONLY

main.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000080  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000b4  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000b4  2**0
                  ALLOC
  3 .debug_info   00000a9a  00000000  00000000  000000b4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000001d6  00000000  00000000  00000b4e  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000058  00000000  00000000  00000d24  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000d7c  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000238  00000000  00000000  00000d9c  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    00000627  00000000  00000000  00000fd4  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  000015fb  2**0
                  CONTENTS, READONLY
 10 .debug_frame  00000048  00000000  00000000  00001678  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000016c0  2**0
                  CONTENTS, READONLY
```

Figure 18 sections 2

```
MainAlgo.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000058  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000004  00000000  00000000  0000008c  2**2
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000004  00000000  00000000  00000090  2**2
                  ALLOC
  3 .debug_info   00000a62  00000000  00000000  00000090  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 0000020e  00000000  00000000  00000af2  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000088  00000000  00000000  00000d00  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000d88  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   000002d8  00000000  00000000  00000da8  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    0000058e  00000000  00000000  00001080  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  0000160e  2**0
                  CONTENTS, READONLY
 10 .debug_frame  00000054  00000000  00000000  0000168c  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  000016e0  2**0
                  CONTENTS, READONLY

Psensor.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000080  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000b4  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000004  00000000  00000000  000000b4  2**2
                  ALLOC
  3 .debug_info   00000a4e  00000000  00000000  000000b4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 0000020a  00000000  00000000  00000b02  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    0000009c  00000000  00000000  00000d0c  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000da8  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   000002db  00000000  00000000  00000dc8  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    00000581  00000000  00000000  000010a3  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007c  00000000  00000000  00001624  2**0
                  CONTENTS, READONLY
 10 .debug_frame  00000068  00000000  00000000  000016a0  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  00001708  2**0
                  CONTENTS, READONLY
```

Figure 19 sections 3

```
startup.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000090  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000c4  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000c4  2**0
                  ALLOC
  3 .vectors      0000001c  00000000  00000000  000000c4  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, DATA
  4 .debug_info   000001c3  00000000  00000000  000000e0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  5 .debug_abbrev 000000d6  00000000  00000000  000002a3  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_loc    0000007c  00000000  00000000  00000379  2**0
                  CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000020  00000000  00000000  000003f5  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_line   00000207  00000000  00000000  00000415  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  9 .debug_str    000001cd  00000000  00000000  0000061c  2**0
                  CONTENTS, READONLY, DEBUGGING
 10 .comment      0000007c  00000000  00000000  000007e9  2**0
                  CONTENTS, READONLY
 11 .debug_frame  00000050  00000000  00000000  00000868  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 12 .ARM.attributes 00000033  00000000  00000000  000008b8  2**0
                  CONTENTS, READONLY

HighPessureDetection.elf:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000404  08000000  08000000  00010000  2**2
                  CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .data         00000004  20000000  08000404  00020000  2**2
                  CONTENTS, ALLOC, LOAD, DATA
  2 .debug        00006da4  00000000  00000000  00020004  2**2
                  CONTENTS, READONLY, DEBUGGING
  3 .comment      0000007b  00000000  00000000  00026da8  2**0
                  CONTENTS, READONLY
  4 .ARM.attributes 00000033  00000000  00000000  00026e23  2**0
                  CONTENTS, READONLY
  5 .bss          00001024  20000004  20000004  00020004  2**2
                  ALLOC
```

Figure 20 sections 4