

## SIMULATION & IMPLEMENTATION TOOLS

This Project is Firstly Designed and verified using "TTool" then implemented using simple "Editor"

Build & Compiled → ARM Cross Tool-Chain

Debugger → ARM GDB Debugger

## MASTERING EMBEDDED SYSTEM 1<sup>ST</sup> TERM PROJECT

BY

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PROJECT NAME

# PRESSURE DETECTION

An embedded system Pressure detection project involves designing and implementing a system that can detect objects in-front and stop vehicle accordingly.

# SYSTEM ARCHITECTURE



## • CASE STUDY

The system detects if the pressure exceeds 20bars in the cabin, then fire alarm to inform the crew for 60 sec.

**Assumption:** power, sensors and actuators never fail.

**Optionally:** Log the pressure values in ROM.



## • METHODOLOGY

Water-fall Model for 2 reasons

1. I am both Customer and Developer, that's grantee there is not any misunderstanding between the end-user and the developer.
2. The Water-fall Model suffers from teams' dependency and blocking; However, I am working alone and that means whatever Model I choose there will be blocking anyway.



## • REQUIREMENTS

The Requirements Diagram is identified next page.

## • SPACE-EXPLORATION/ PARTITIONING

We will use blue-bill Target (STM32F103C6) Processor ARM Cortex-M3 for this project.

## • SYSTEM ANALYSIS

The system analysis Diagrams are identified in the following pages.

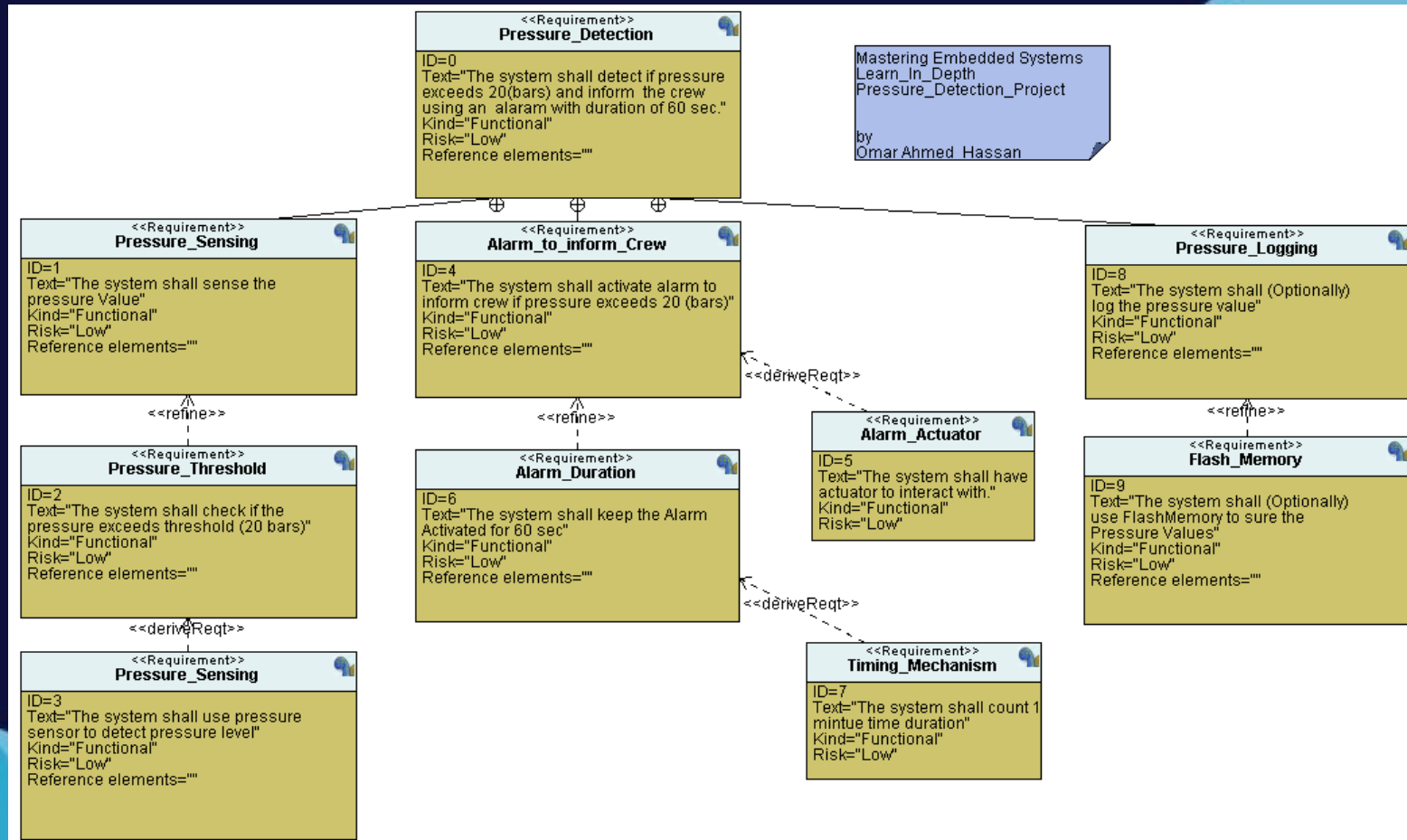
## • SYSTEM DESIGN

The system Design Diagrams are identified in the following pages.

“Learn in  
depth and  
you will be  
deeply  
happy.”

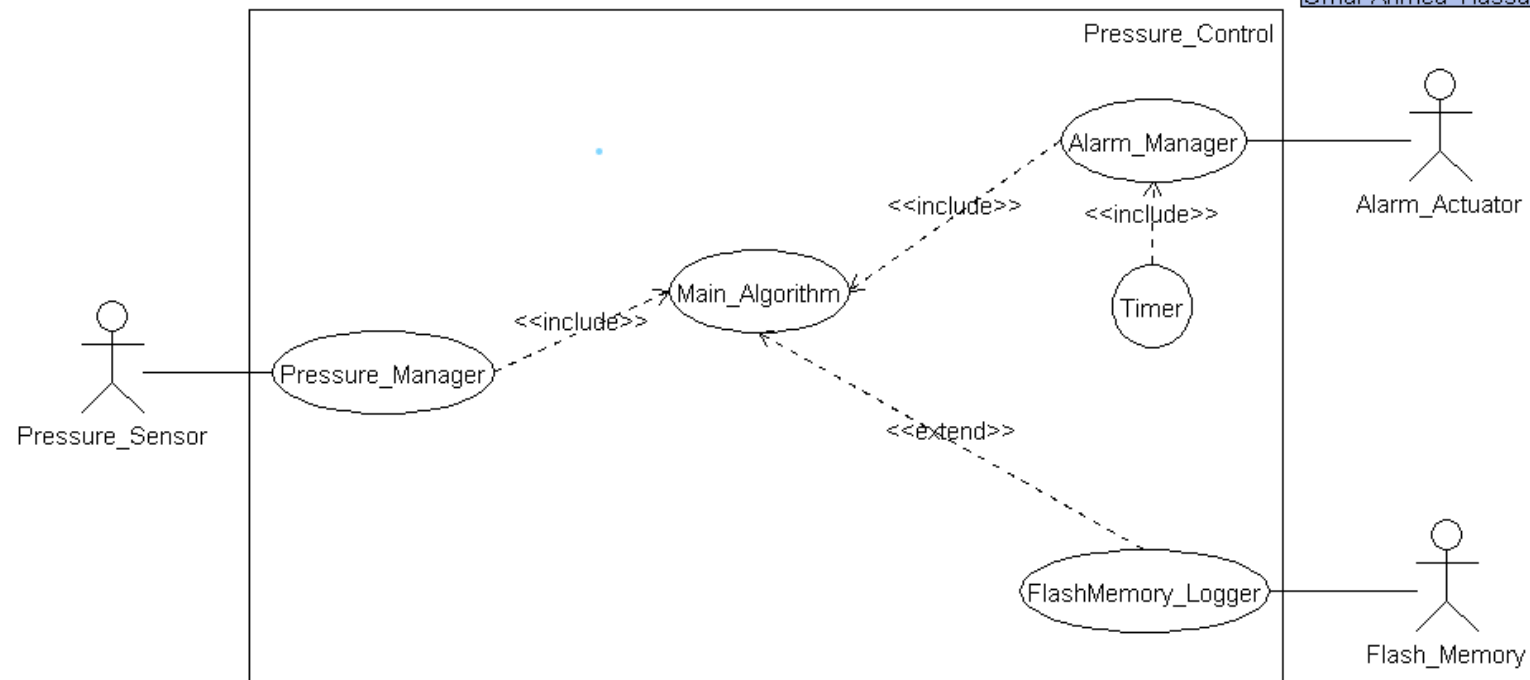
- Omar Ahmed -

# REQUIREMENTS DIAGRAM



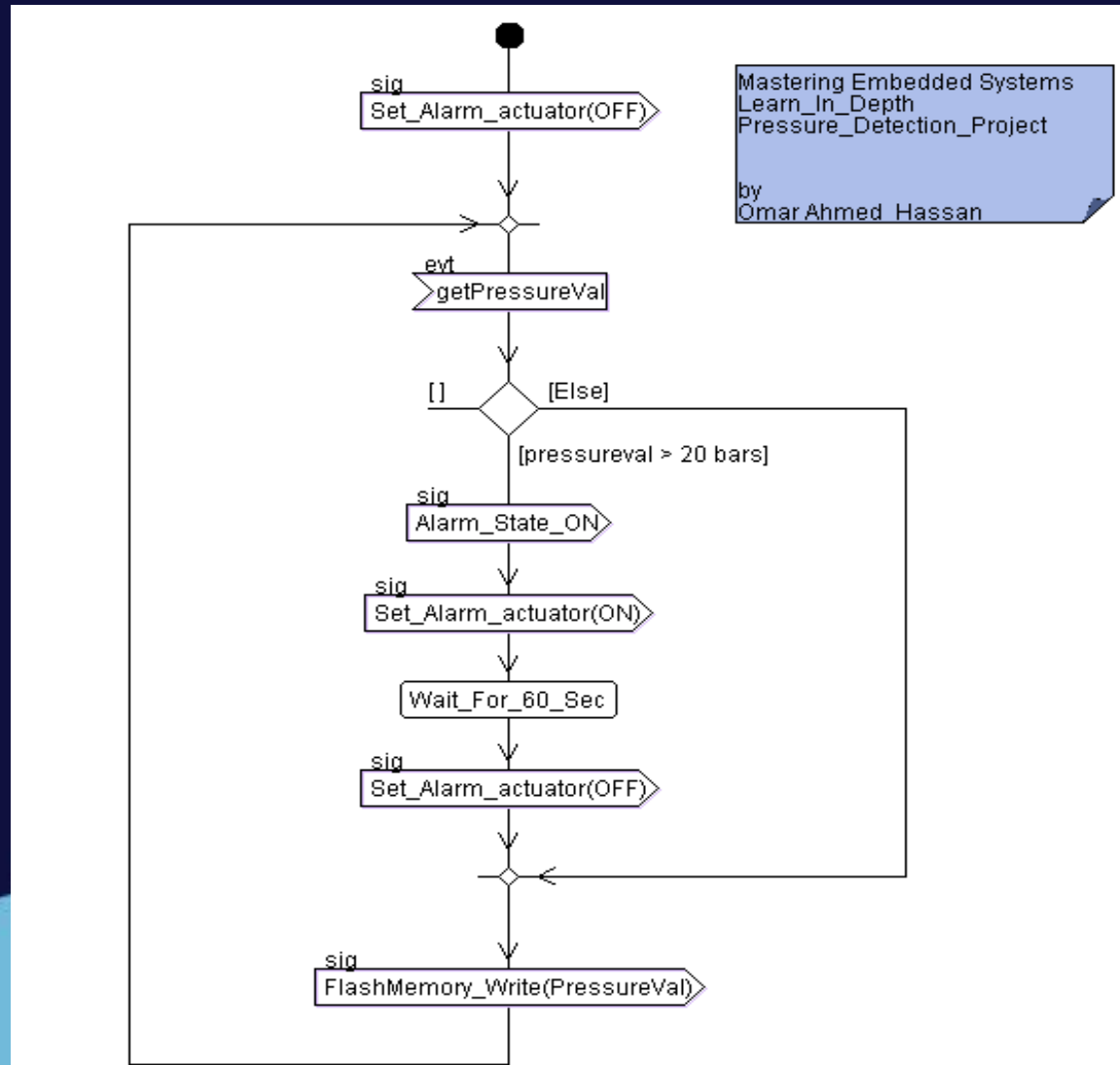
# SYSTEM ANALYSIS

- USE CASE DIAGRAM

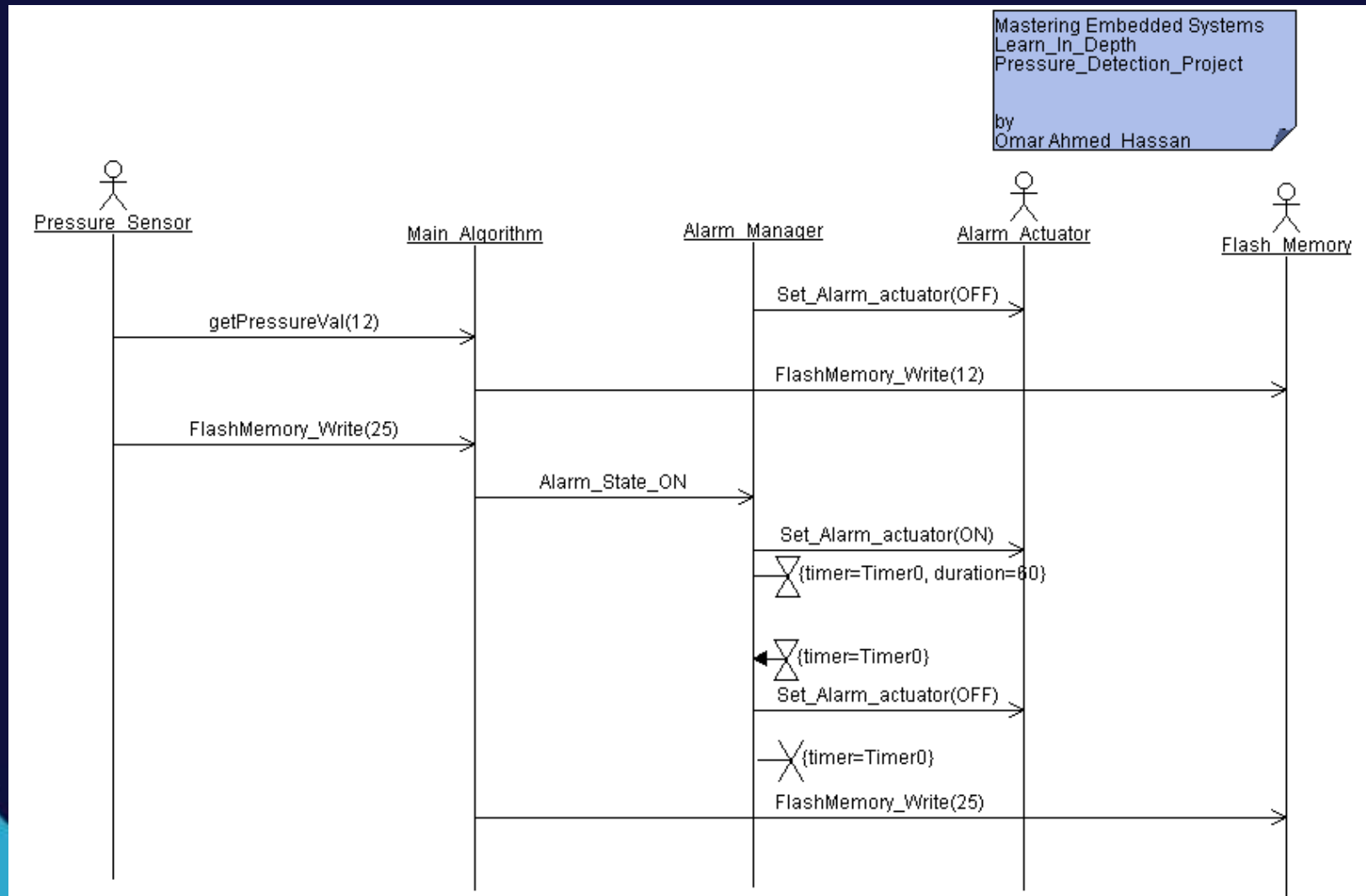




- ACTIVITY DIAGRAM

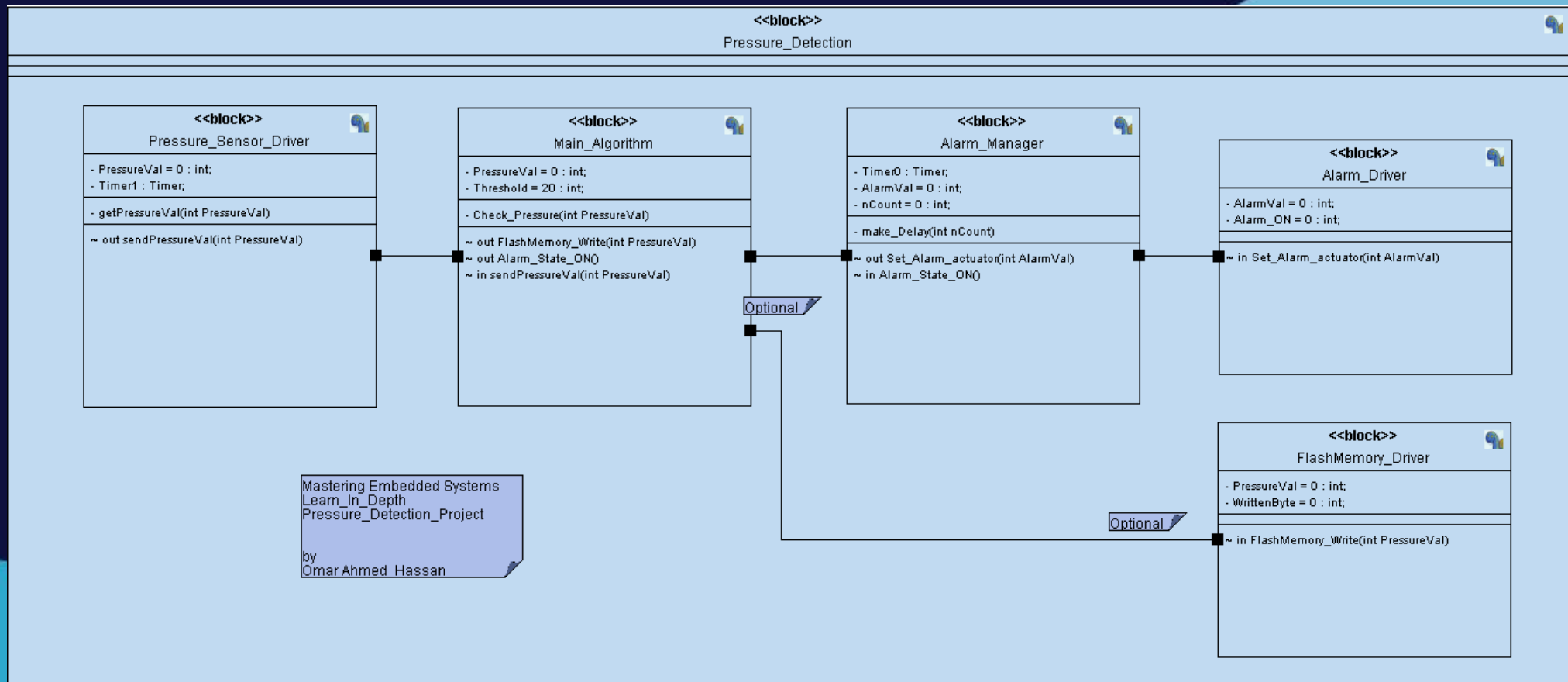


- SEQUENCE DIAGRAM



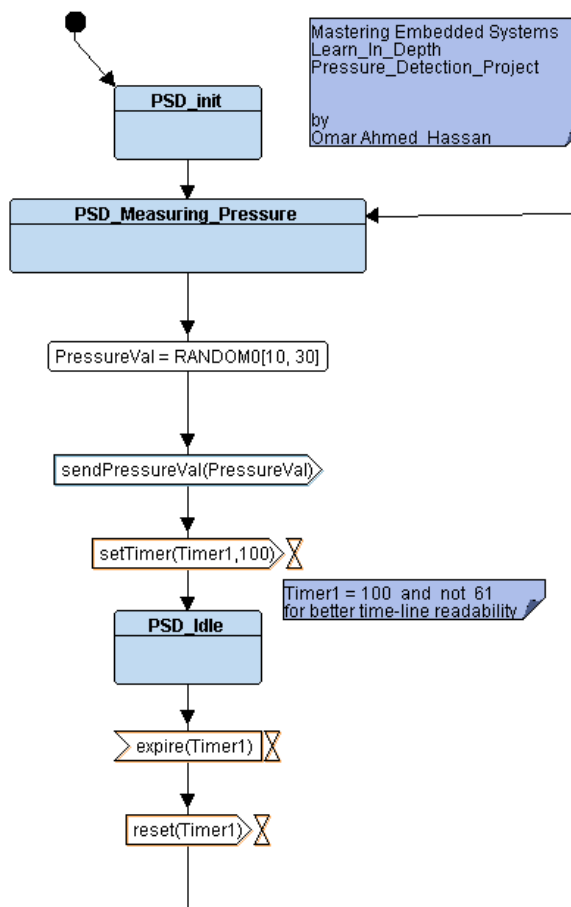
# SYSTEM DESIGN

## ● BLOCK DIAGRAM

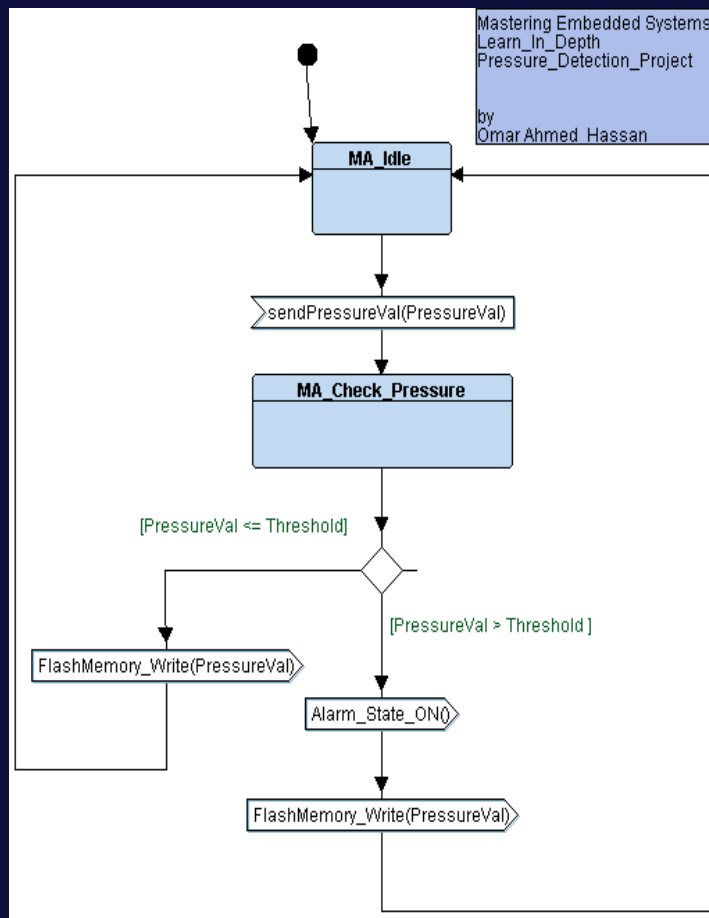


## STATE DIAGRAM OF EACH BLOCK

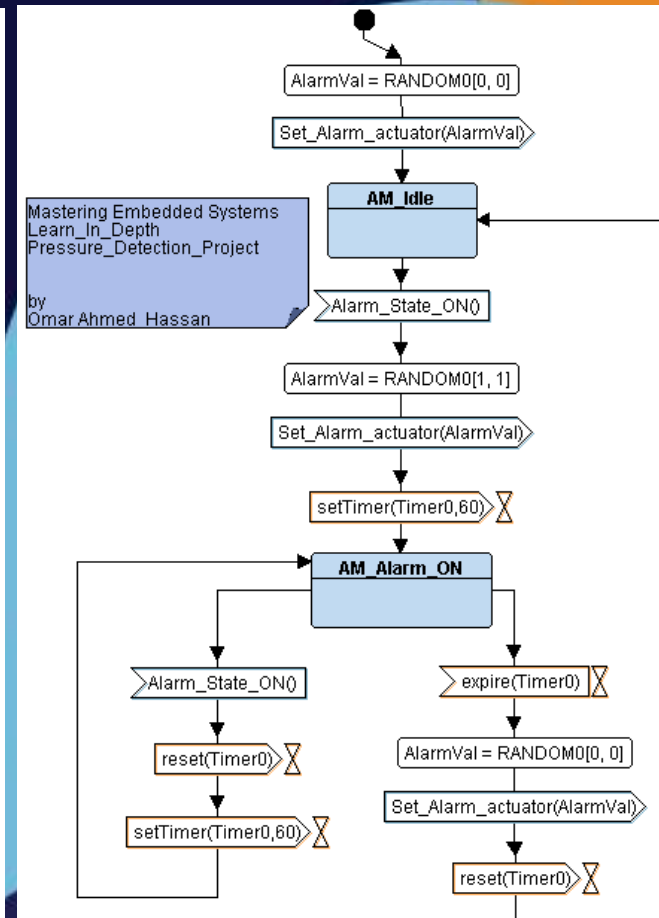
### Pressure Sensor Driver



### Main Algorithm



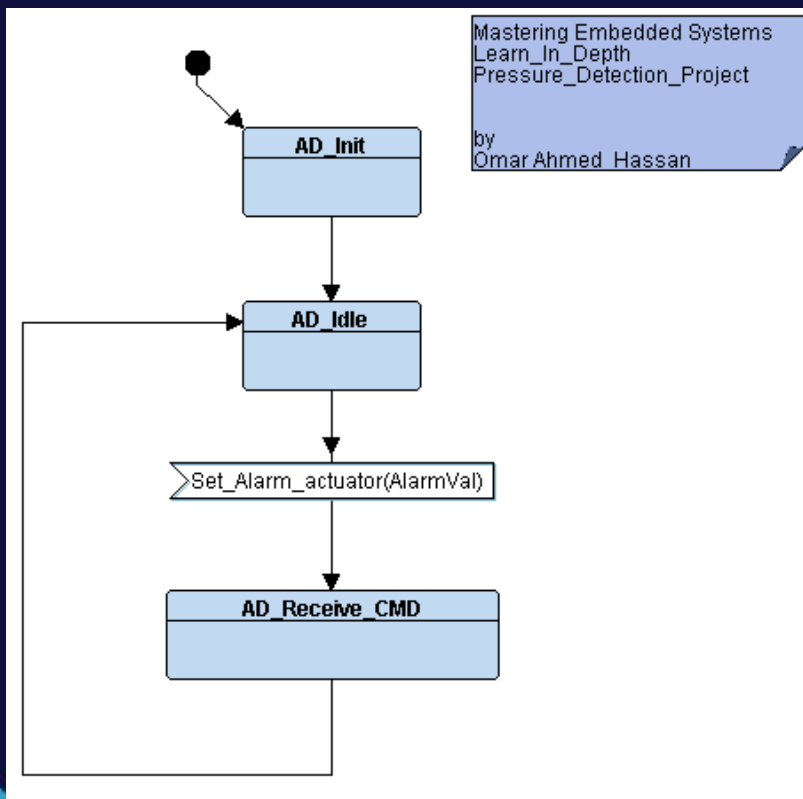
### Alarm Manager



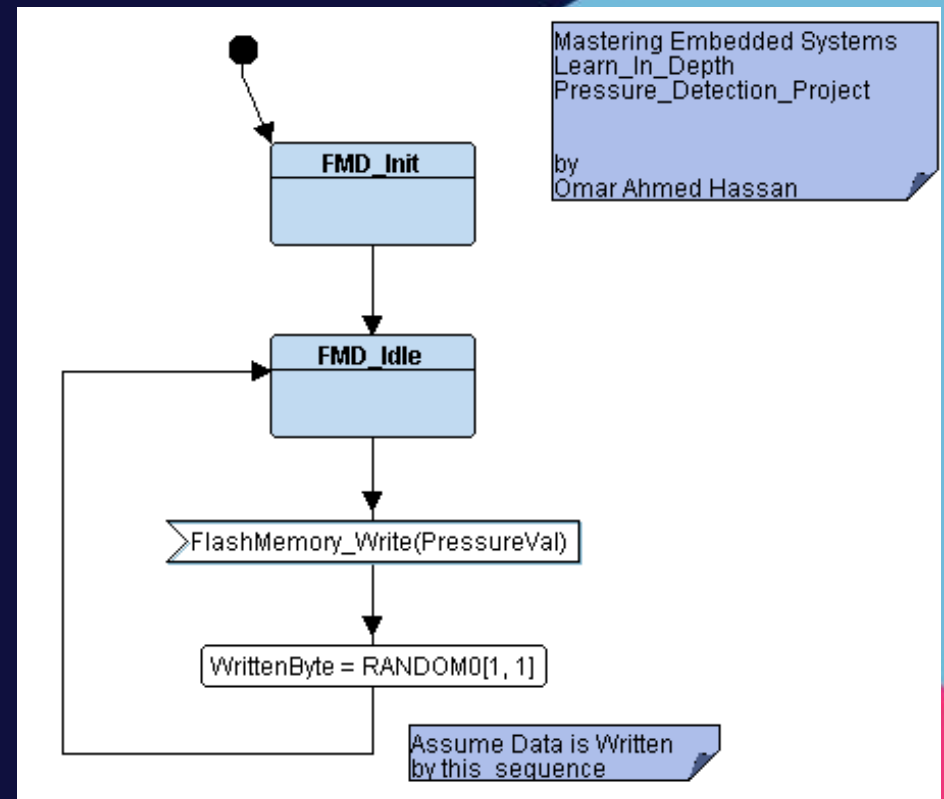


- STATE DIAGRAM OF EACH BLOCK

- Alarm Driver



- Flash Memory Driver

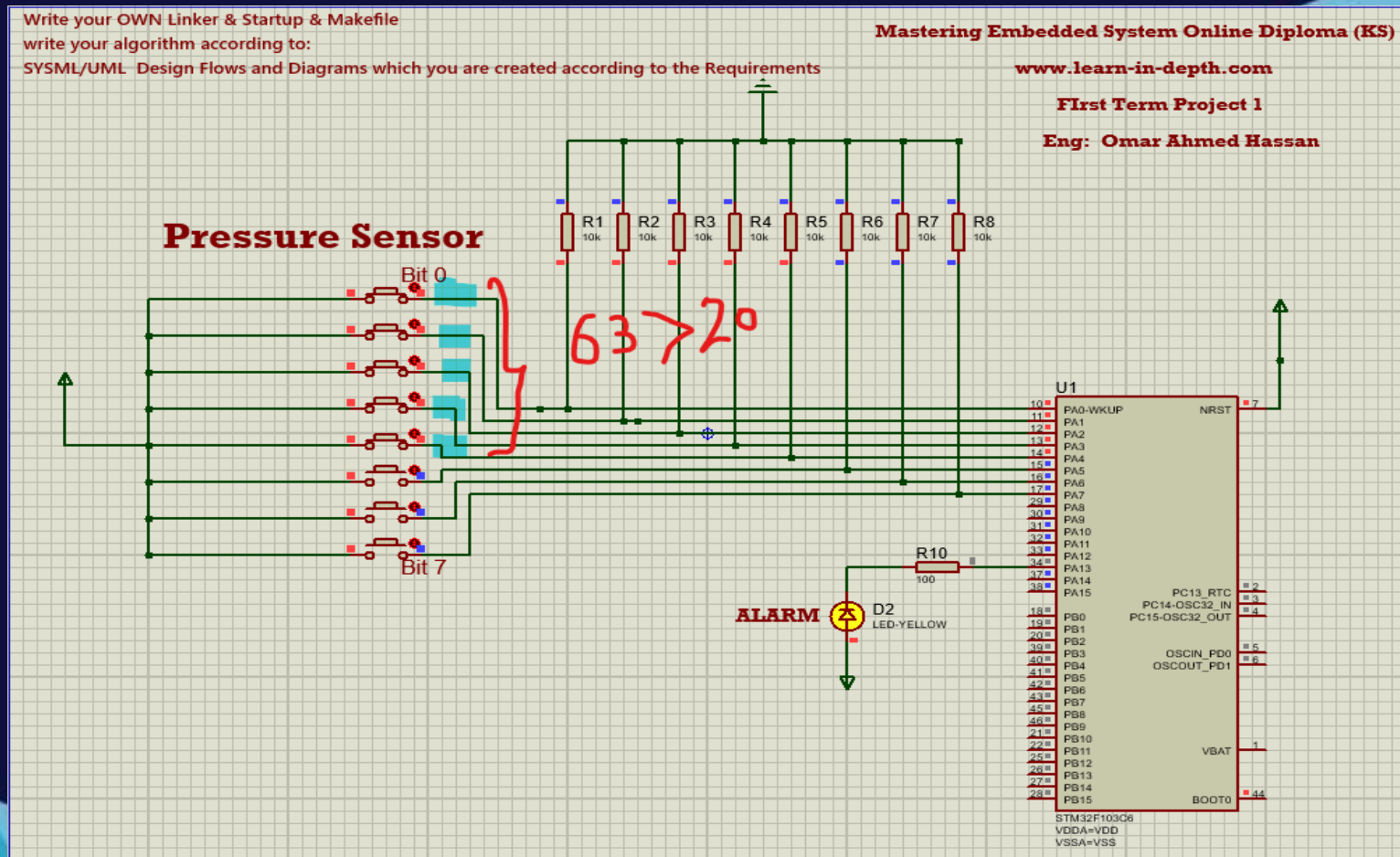




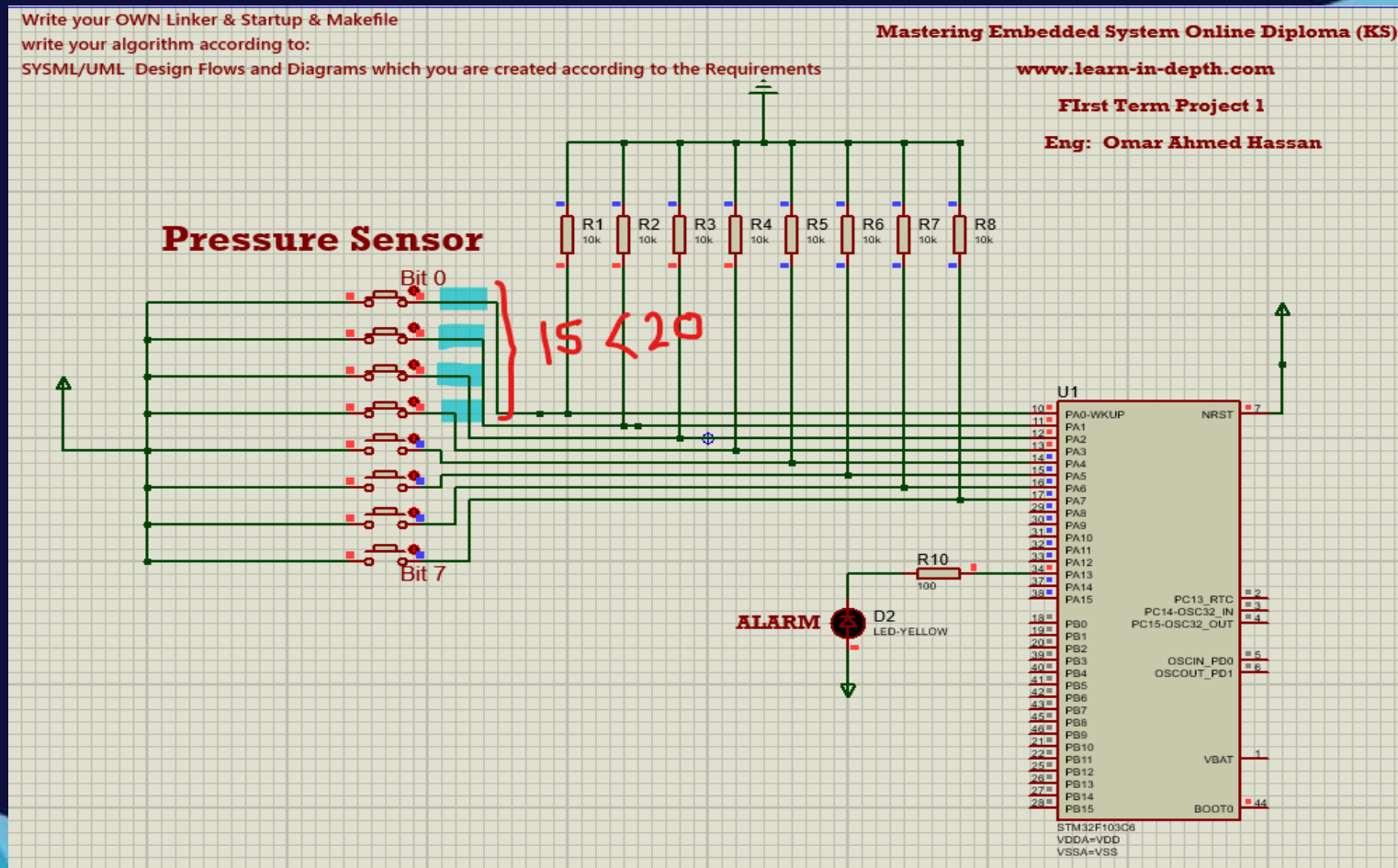
## INTERACTIVE SIMULATION

Due to the considerably large size of the figure,  
it is not feasible to include it within the confines of this page. However, it can be accessed via [Interactive Simulation](#).

- POSITIVE TEST (PRESSURE > THRESHOLD)



- **NEGATIVE TEST (PRESSURE > THRESHOLD)**

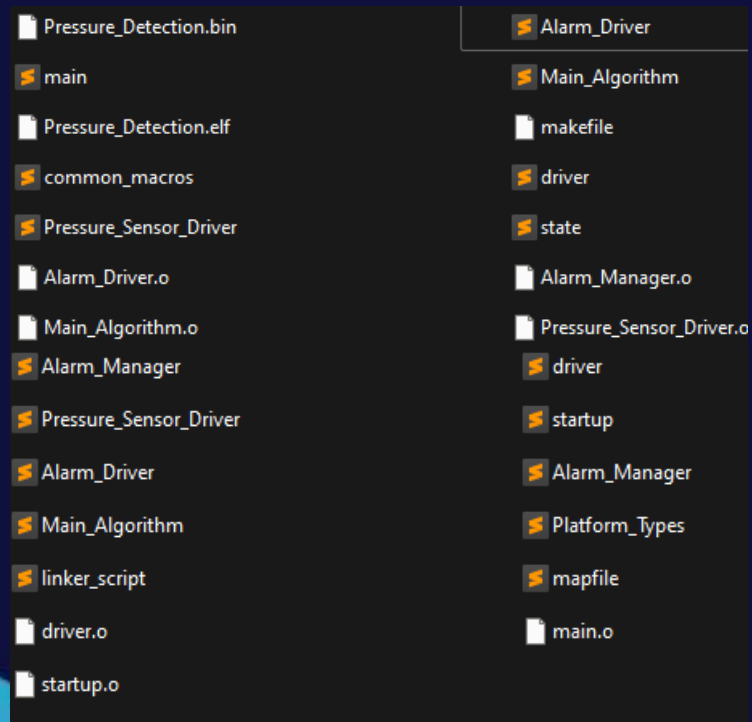




## SOURCE FILES

- Source codes were developed according to C89 Standards.
- Code was developed perfectly aligned to the System Design.
- Source files were fully implemented and debugged manually using only Editor (Sublime) + ARM Cross Toolchain.

### ▪ Source Files



### ▪ Code Generation

```
MINGW64/c:/Omar/Learn-in-depth/01 - Units/Unit 5/01 - Pressure_Detection_Proje...
OmarAhmed@OmarAhmed MINGW64 /c:/Omar/Learn-in-depth/01 - Units/Unit 5/01 - Pressu
re_Detection_Project/src
$ make
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . Alarm_Driver.c -
o Alarm_Driver.o
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . Alarm_Manager.c
-o Alarm_Manager.o
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . driver.c -o driv
er.o
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . main.c -o main.o
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . Main_Algorithm.c
-o Main_Algorithm.o
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . Pressure_Sensor_
Driver.c -o Pressure_Sensor_Driver.o
arm-none-eabi-gcc.exe -c -mthumb -mcpu=cortex-m3 -gdwarf-2 -I . startup.c -o sta
rtup.o
arm-none-eabi-ld.exe -T linker_script.ld Alarm_Driver.o Alarm_Manager.o driver.
o main.o Main_Algorithm.o Pressure_Sensor_Driver.o startup.o -Map=mapfile.map -
o Pressure_Detection.elf
arm-none-eabi-objcopy -O binary Pressure_Detection.elf Pressure_Detection.bin
=====bin GENERATED=====
OmarAhmed@OmarAhmed MINGW64 /c:/Omar/Learn-in-depth/01 - Units/Unit 5/01 - Pressu
re_Detection_Project/src
$
```

- Please feel free to access the source code on my GitHub profile : Repository

# EXECUTABLE SPECS

- Executable Sections & its size

```

MINGW64:/c/Omar/Learn-in-depth/01 - Units/Unit 5/01...
OmarAhmed@OmarAhmed MINGW64 /c/Omar/Learn-in-depth/01 - Units/Unit 5/01...
$ arm-none-eabi-objdump.exe -h Pressure_Detection.elf

Pressure_Detection.elf:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text          000004f8  08000000  08000000  00008000  2**2
    CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .bss           00000024  20000000  080004f8  00010000  2**2
    ALLOC
  2 .comment       00000011  00000000  00000000  000084f8  2**0
    CONTENTS, READONLY
  3 .ARM.attributes 00000033  00000000  00000000  00008509  2**0
    CONTENTS, READONLY

OmarAhmed@OmarAhmed MINGW64 /c/Omar/Learn-in-depth/01 - Units/Unit 5/01...
$ arm-none-eabi-size.exe Pressure_Detection.elf
   text    data     bss     dec     hex filename
   1272      0      36    1308    51c Pressure_Detection.elf
    
```

- Map File

```

Allocating common symbols
Common symbol      size      file
PSD_State_ID       0x1      main.o
MA_State           0x4      Main_Algorithm.o
AM_State           0x4      Alarm_Manager.o
AD_State           0x4      Alarm_Driver.o
PSD_State          0x4      Pressure_Sensor_Driver.o
DC_Motor_State     0x4      Alarm_Manager.o
AM_State_ID        0x1      Alarm_Manager.o
MA_State_ID        0x1      main.o
AD_State_ID        0x1      Alarm_Driver.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  0x4f8
*(.vectors)
.vectors           0x08000000  0x28 startup.o
                  0x08000000  vectors
*(.text)
.text              0x08000028  0x100 Alarm_Driver.o
                  0x08000028  ST_AD_init
                  0x0800006c  ST_AD_idle
                  0x08000098  ST_AD_Receive_CMD
                  0x080000c4  Set_Alarm_actuator
.text              0x08000128  0xac Alarm_Manager.o
                  0x08000128  ST_AM_Idle
                  0x08000154  ST_AM_Alarm_ON
                  0x08000194  Alarm_State_ON
.text              0x080001d4  0x98 driver.o
                  0x080001d4  getPressureVal
                  0x080001ec  GPIO_INITIALIZATION
.text              0x0800026c  0x94 main.o
                  0x0800026c  main
                  0x080002ac  setup
.text              0x08000300  0xa4 Main_Algorithm.o
                  0x08000300  ST_MA_Idle
                  0x0800032c  ST_MA_Check_Pressure
    
```

Mapfile : *mapfile.*