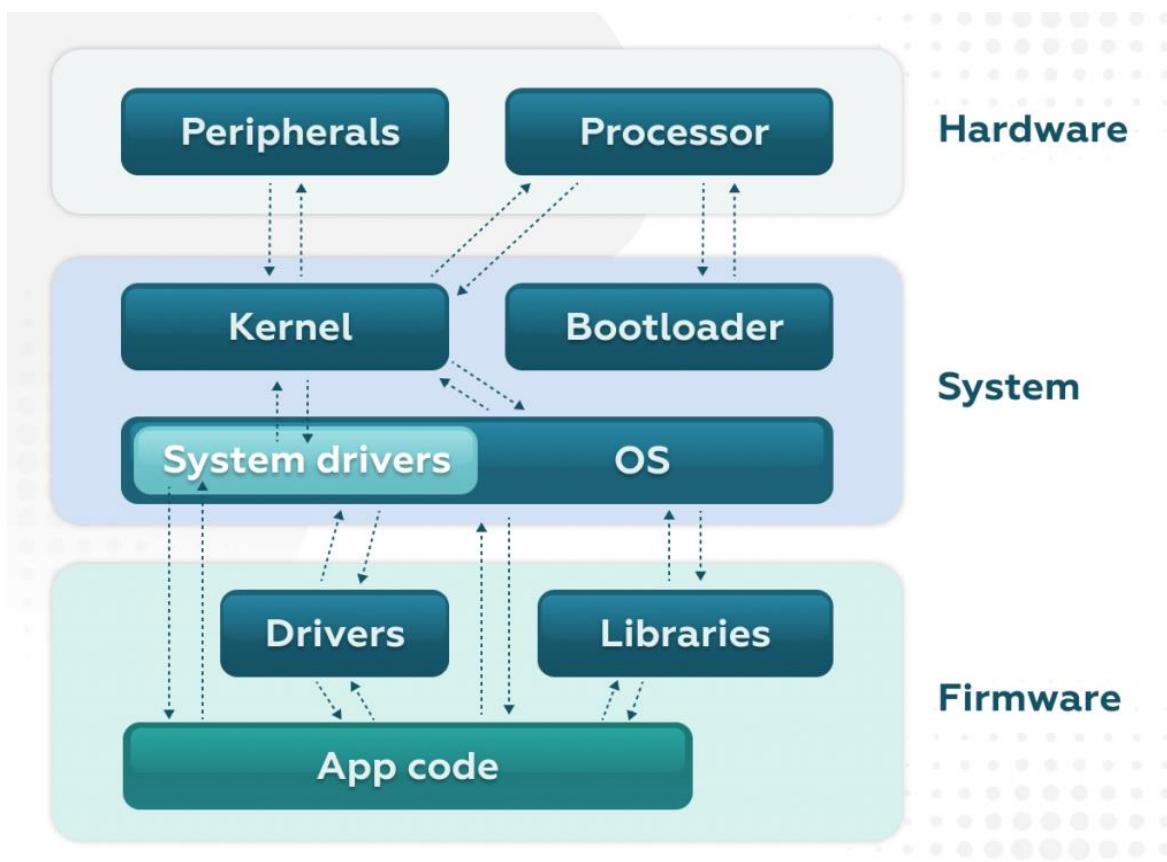


Task 1

What is a Firmware Library?

A Firmware Library is a collection of pre-written, reusable functions designed to control hardware components in embedded systems. It provides a structured way to interact with hardware peripherals such as GPIO pins, timers, communication interfaces (UART, SPI, I2C), ADCs, and more.

In embedded systems, firmware runs directly on the microcontroller and interacts closely with hardware registers. Writing direct register-level code repeatedly can be complex and error-prone. Firmware libraries simplify this by providing well-defined functions that abstract low-level hardware details.



Why APIs are important in embedded systems?

An API (Application Programming Interface) defines how different parts of a program communicate with each other. In embedded systems, APIs are important because they separate the applications logic from the hardware implementation.

Instead of writing hardware code directly inside the main program, we define function declarations in a header file. These function declarations form the API.

The application only calls these functions. It does not need to know how they are implemented.

This is important because:

- It improves code organization
- It makes debugging easier
- It allows code reuse
- It makes debugging easier
- It makes hardware changes easier

Lab code explanation

The lab code implements a simple GPIO module using three separate files:

gpio.h – Does not contain actual logic, only the function declarations. This file acts like an interface between the application and the implementation.

gpio.c – This file contains the actual implementation of the functions declared in **gpio.h**. This is where the real hardware related operations are written.

main.c – This file contains the main program. It includes **gpio.h** and calls the GPIO functions.

The following code is used to compile and link the files together to create an executable file called **task1_demo**:

```
gcc main.c gpio.c -o task1_demo
```

Output:

```
MINGW64:/c/Users/Reya Pradeep/vsdsquadron-mini-core/task1
Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~
$ ls
AppData/          Music/
'Application Data'@  'My Documents'@
Contacts/         NTUSER.DAT
Cookies@          NTUSER.DAT{153e5019-4070-11ed-b4bf-ea861bf31c00}.TxR.0.regtrans-ms
Desktop/          NTUSER.DAT{153e5019-4070-11ed-b4bf-ea861bf31c00}.TxR.1.regtrans-ms
Documents/        NTUSER.DAT{153e5019-4070-11ed-b4bf-ea861bf31c00}.TxR.2.regtrans-ms
Downloads/        NTUSER.DAT{153e5019-4070-11ed-b4bf-ea861bf31c00}.TxR.bif
Favorites/        NTUSER.DAT{153e501a-4070-11ed-b4bf-ea861bf31c00}.TM.bif
IntelGraphicsProfiles/ NTUSER.DAT{153e501a-4070-11ed-b4bf-ea861bf31c00}.TMContainer000000000000000000000000001.regtrans-ms
Links/            NTUSER.DAT{153e501a-4070-11ed-b4bf-ea861bf31c00}.TMContainer00000000000000000000000000000000002.regtrans-ms
'Local Settings'@ NetHood@

OneDrive/          Untitled2.ipynb
Pictures/          Untitled3.ipynb
PrintHood@        Untitled4.ipynb
Recent@           Untitled5.ipynb
'Saved Games' /   Videos/
Searches/          get-pip.py*
SendTo@           ntuser.dat.LOG1
'Start Menu'@     ntuser.dat.LOG2
Templates@        ntuser.ini
Untitled.ipynb     untitled.py
Untitled1.ipynb    vsdsquadron-mini-core/

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~
$ cd vsdsquadron-mini-core

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core (main)
$ ls
README.md  docs/  task1/

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core (main)
$ cd task1

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core/task1 (main)
$ ls
README.md  gpio.c  gpio.h  main.c

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core/task1 (main)
$ gcc main.c gpio.c -o task1_demo

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core/task1 (main)
$ ls
README.md  gpio.c  gpio.h  main.c  task1_demo.exe*

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core/task1 (main)
$ ./task1_demo
Starting firmware application
GPIO 5 initialized as OUTPUT
GPIO 3 initialized as INPUT
GPIO 5 write value: 1
GPIO 3 read value
Button state: 1
GPIO 5 write value: 0
Firmware application finished

Reya Pradeep@LAPTOP-GOOHREKQ MINGW64 ~/vsdsquadron-mini-core/task1 (main)
$
```

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