Lab 3 : Class diagram implementation

In this lab you will implement two of the check-out stations peripherals namely the 16-key numpad and the 16x2 LCD display. Both peripherals use the pmod connectors presented in linux under /sys/class/gpio. The general purpose input/output (GPIO) pins are grouped in gpiochipXXX/. Check the label file to see what device they control. Figure 1 shows how they should be connected to the zybo.

FIgure 1 - Connecting the devices

GPIO

Since both devices are interfaced via GPIOs you should first get acquainted with GPIOs under linux. On BlackBoard you can find a guide on how to access them from the terminal and a C++ example (example.cpp) showing how to access them from code. There is also a shared library (libGPIO) that you should use for this lab and an example showing how to use it (included in the zip). The library implements the class ‘GPIO’ that represents one pin and lets you export, unexport, set direction, set value and get value.

Numpad

The numpad consists of 16 buttons connected in a grid. When a column is driven low, the rows can be checked to deduce if a button was pressed. Write a driver that does this, again encapsulated in a class with operations for initialising and checking. For testing you should write a main that instantiates the class and runs the check operation in an endless loop outputting the numbers pressed on standard out. For more details see the datasheet

Display
The display is a bit more advanced and requires a startup sequence to be executed. Make sure not to follow the timing too tight. After the startup sequence the display is controlled by sending commands or data according to the datasheet. Write a driver that makes it easy to output text on the display. For testing you should write a main that instantiates the driver class and outputs a hello world message.

The class diagram in figure 2 shows how the system could be implemented. Normally a class diagram would omit constructors, setters, getters and sometimes also private operations, but in this case all have been included. The table below summarises how the pins are connected.

In order to test the hardware you can run the command `hardware_test` in the terminal on the zybo. This will start a program that shows key presses on the display.

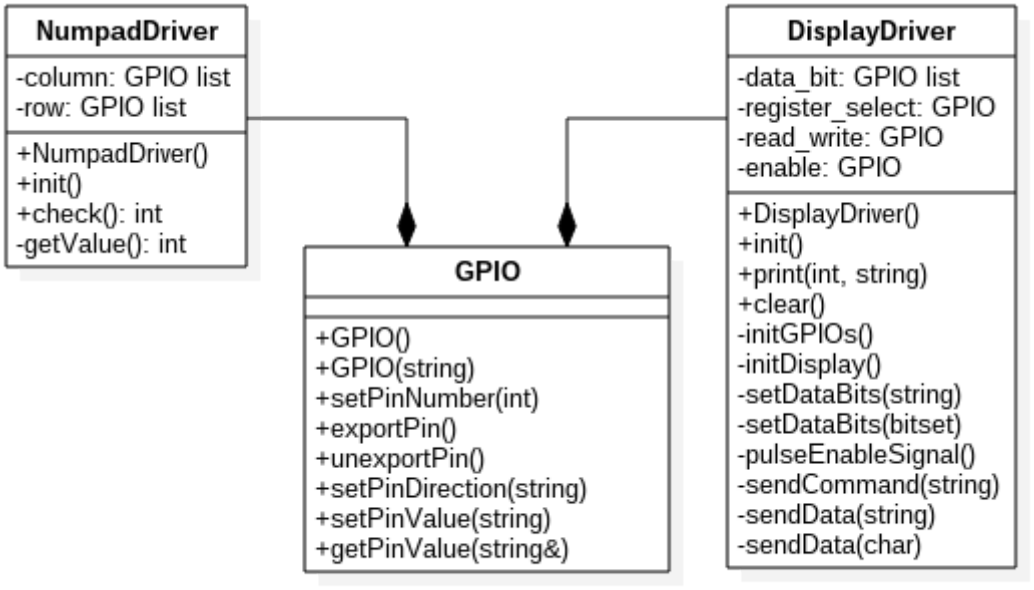

Figure 2 - Class diagram of the customer system

Pin connections

Device	Pin	Signal	Pmod	GPIO
Numpad	1	COL4	JE1	992
	2	COL3	JE2	993
	3	COL2	JE3	994
	4	COL1	JE4	995
	7	ROW4	JE7	996
	8	ROW3	JE8	997
	9	ROW2	JE9	998
	10	ROW1	JE10	999
Display	J1-1	DB0	JB1	1016
	J1-2	DB1	JB2	1017
	J1-3	DB2	JB3	1018
	J1-4	DB3	JB4	1019
	J1-7	DB4	JB7	1020
	J1-8	DB5	JB8	1021
	J1-9	DB6	JB9	1022
	J1-10	DB7	JB10	1023
	J2-1	RS	JC7	1012
	J2-2	R/W	JC8	1013
	J2-3	E	JC9	1014
	J2-4	NC	JC10	1015