Lab 4 (Week 9 and 10)

Instructions

- Complete each task and demonstrate the working program to your tutor. Tasks should be demonstrated using the board provided.
- **Part A of this lab must be marked by the end of the lab session in week 9. The rest of the lab must be marked by the end of the lab session in week 10.**
- Make reasonable assumptions if something is not explicitly specified. State all those assumptions to the tutor when you are getting marked.

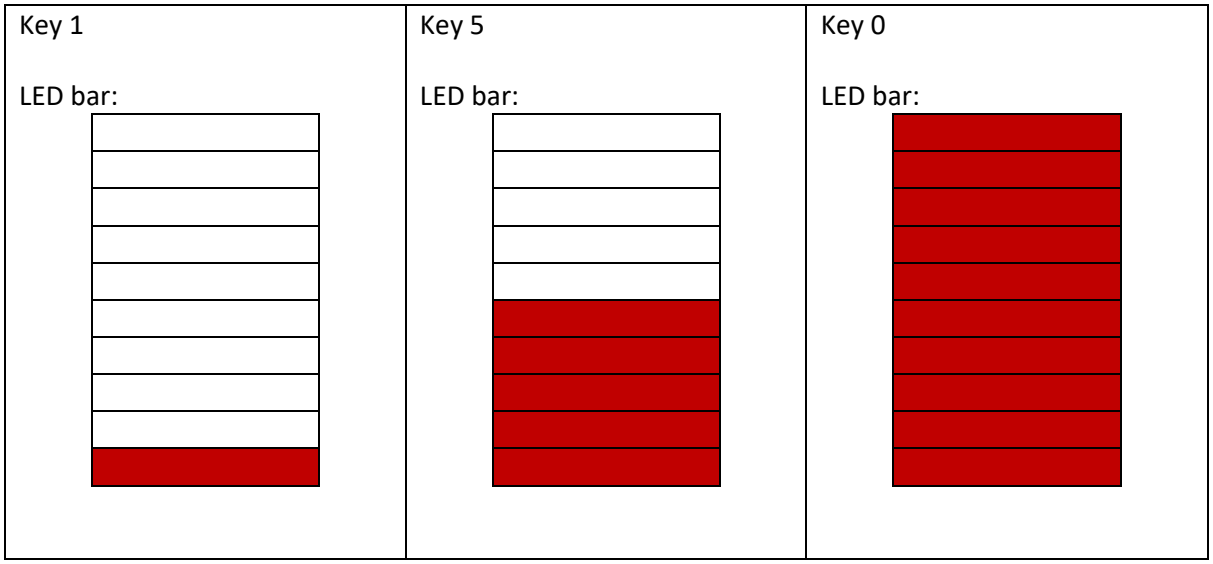
Part A – Lift floor select buttons (3 marks)

The keypad represents the floor select buttons on the lift. Write a program to detect keypad presses and display the floor number on the LED bar. Keys 1-9 to represent floors 1-9 and key 0 represents the 10th floor. The other buttons do not need to be handled.

The keypad should be connected to PORTL, with none of the wires crossed over (same as in the board testing sheet). The low 4 bits will be connected to the rows, and the high 4 bits will be used to read the column outputs.

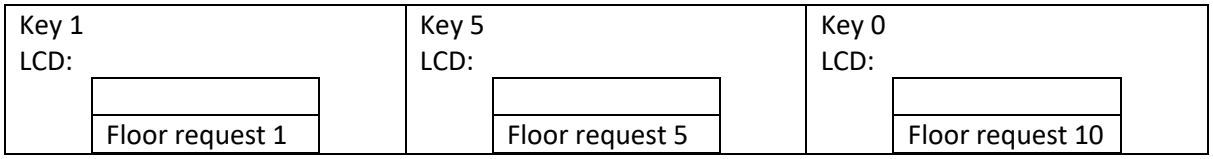
You will need to activate the pull-up resistors on the input pins to reliably detect key presses.

Examples:



Optional: Make the lift "modernised" by displaying the floor request on the left bottom corner of the LCD display (you can use the binary to ASCII converter you wrote in lab 1). An example program that uses the LCD is provided on the course page under lab 4.

Examples:



Part B – Speed measurement (3 Marks)

Connect the motor (labelled MOT) to the potentiometer (labelled POT) and use it to control the motor's speed. Connect the Opto-interrupter's emitter (labelled OpE) to one of the +5V pins, and the output (labelled OpO) to INT2 (labelled TDX2). Write a program to calculate the speed of the motor's rotation in revolutions per second and display it on the LED bar. You should update the display at least every 500ms.

Optional: Display the speed of the motor on the LCD panel.

Part C – LED brightness (4 Marks)

Connect the strobe LED to OC3B (labelled PE2 on the board). Note that this pin labelled PE2 has been done so by a mistake and it is actually connected to PE4 pin of the microcontroller. Use timer 3 in PWM mode to control the average voltage supplied to the strobe LED. The LED should fade from full brightness to completely off each second. The average voltage supplied should decrease linearly. For generating a delay to update the PWM dutycycle, you may use a software delay (using software loop) or another timer such timer0.

Part D (optional) – Lift door opening and closing (0 Marks)

The opening and the closing of the lift door are denoted by the motor rotation. Connect the motor to OC3B (labelled PE2 on the board, note that this PE2 labelled pin is actually connected to PE4 pin of the microcontroller). Opening and closing are distinguished by rotating the motor at two different speeds – for instance 20% of full PWM speed for opening and 80% of full PWM speed for closing. You should select the two distinct speeds such that a speed change of the motor is clearly observable. The motor should rotate for one second when the door opens or close.

You can simulate the door opening and closing functionality by using the two push buttons (left push button for door open and right button for door close).

Some of the boards may have an issue where supplying a PWM signal to the motor causes the board to reset, or freeze. To fix this, connect the MOT pin to the POT pin, then remove the right-most isolation jumper above the potentiometer and connect your PWM pin (PE2) to the rightmost jumper pin. Turning the potentiometer will then introduce resistance in series with the motor, and it should be possible to find a position where the motor spins but does not crash the board. You may not be able to reach 100rps with this configuration. **Do not lose the PE2 jumper.**