FORMAN CHRISTIAN COLLEGE
A Chartered University
Embedded Systems CSCS306
LAB-04

This lab is online and time constrained. It should be completed within prescribed time. Failure in doing so will result upto 50% drop in lab performance grade. Make sure to keep this graded and signed lab handout with you to be presented at a later stage if required.

You need to submit a report comprising of an introduction to the said lab, circuit diagram, image of your final circuit and code. Each lab will be graded out of 100. Rubric for this lab is as follows:

Hardware properly wired and working	**20%**
Code	**50%**
Report	**30%**

Group Members:

Lab Task

In this lab we will play with an I2C LCD (2 line or 4 line) and learn how to write code in Arduino that can make an LCD work as user input device. Make sure you have downloaded and included the lcd library. Interface your LCD with Arduino using 4-bit data mode. Interface keypad and LCD with Arduino.

You will design a simulation of a dyes and chemical manufacturing plant. There are two main processes that need to be automated.
1. Diazotization
2. Coupling

A diazo process would require to mix a given amount of chemicals and then another chemical in liquid form is added to this mix in a specified time. Care must be taken that temperature of the reaction solution should not rise above a given point. There are two vessels. Vessel A carries the reaction solution, while vessel B carries the chemical in liquid form that should be added in the reaction solution. It should be kept in mind that the reaction is exothermic and large amount of heat is generated during the process. Vessel A has an external jacket in which water at a temperature less than -10ºC is circulated through a chiller plant to pull down the temperature. A pump is used to switch the supply of chilled water to the jacket. Motor is used with a gear coupling on Vessel A for stirring purposes.

Our job is to automate diazotization process. We will assume that chemicals have been added and user will punch required information on the LCD using a keypad. As an example, consider the following information provided by user on the LCD:

Diazo Temp: 35
Diazo duration: 100

Here, on the LCD, strings are hard coded while numeric values are entered by the user.

Temperature is in centigrade, while duration is in seconds. Both should be punched using a keypad. Once entered, user will press # key on the keypad to submit the data. As soon as the data is submitted, process starts. Here for the time being we will assume that vessel B's outlet is pre-calibrated.

LED-A is used to simulate the dropping of liquid in the reaction solution.

LED-B is used to simulate the motor that is used to stir the solution in vessel B. The motor of the stirrer once ON is *never* switched OFF unless process is completed.

LED-C is used to simulate the chiller plant pump which will switch ON when temperature is above the given value, and should switch OFF when temperature is equal to or less than the given value.

To sense temperature you can use an LM35DZ temperature sensor.

If temperature goes above the given threshold,

- liquid dropping from vessel B should be switched OFF
- it is switched ON again only when the temperature drops back to the threshold value.
- the chiller plant motor should be turned ON to circulate chilled water through the vessel jacket. Once the temperature is back to the given threshold, chiller plant motor should be turned OFF.
- liquid dropping should be terminated for the duration while temperature remains above the threshold value.

Once the reaction duration is finished, all LEDs should be turned OFF and a message saying "Diazotization Completed Successfully" should be displayed on the LCD.

Note we will not cater for the time at this point. Rather user will punch '' key on keypad when it is desired to turn of the process.*