

### LABORATORY WORK 1

#### INTRODUCTION

In this lab session, we will get to know the Arduino board and development environment. We will then implement a simple circuit to display "hello world" on an LCD screen. Finally, we will do an analog read on a potentiometer to display the percentage that the potentiometer is turned.



#### MATERIALS

- 1x Arduino board
- 1x Breadboard
- 1x HD44780 compatible 2x16 character LCD
- 1x 100k ohm potentiometer
- 1x 10k ohm potentiometer

#### PRE-LAB

No pre-lab homework, as this is the introductory first week of the lab.

#### LABORATORY WORK

The LiquidCrystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins:

A register select (RS) pin that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.

A Read/Write (R/W) pin that selects reading mode or writing mode

An Enable pin that enables writing to the registers

8 data pins (D0 -D7). The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

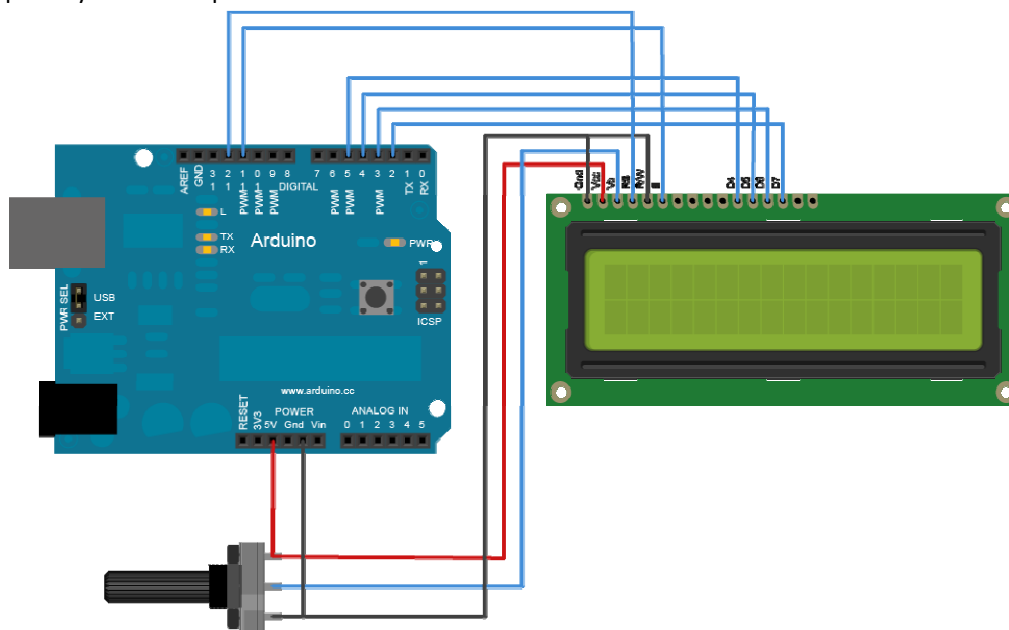
There's also a display constrast pin (Vo), power supply pins (+5V and Gnd) and LED Backlight (Bklt+ and Bklt-) pins that you can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.

The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register. The LiquidCrystal Library simplifies this for you so you don't need to know the low-level instructions.

The Hitachi-compatible LCDs can be controlled in two modes: 4-bit or 8-bit. The 4-bit mode requires seven I/O pins from the Arduino, while the 8-bit mode requires 11 pins. For displaying text on the screen, you can do most everything in 4-bit mode, so example shows how to control a 2x16 LCD in 4-bit mode.

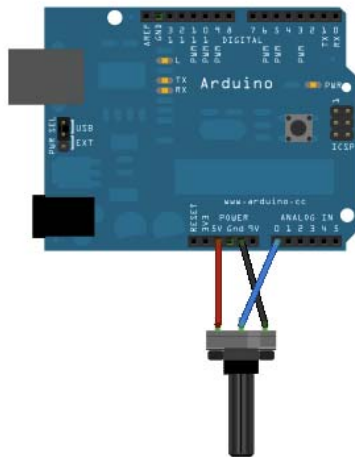
Follow the steps below to complete your goal for this lab session.

1. Setup your circuit below (USE 10K POT). Make all connections carefully. Pay special attention to the polarity of the components.



2. Load LiquidCrystal example from Arduino IDE and upload. Observe that hello world text is displayed on the screen. Show your progress to the lab assistants.

3. Add 100k pot as seen below.



4. Load AnalogRead serial example and study it. Make necessary changes in your LCD example to display the percentage (e.g. 0% for full left turn and 100% for full right turn) of the analog input on the LCD. Show your progress to the lab assistants.