

# MAR Sensors

Interfacing 16\*2  
LCD with Arduino

# Liquid Crystal Display - LCD

- Liquid Crystal Display or LCD is combination of two states of matter, the solid and the liquid.
- LCD uses a liquid crystal to produce a visible image.
- Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games.
- LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology.

- Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes.
- Light is projected from a lens on a layer of liquid crystal.
- This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image.
- This image is then displayed on the screen.

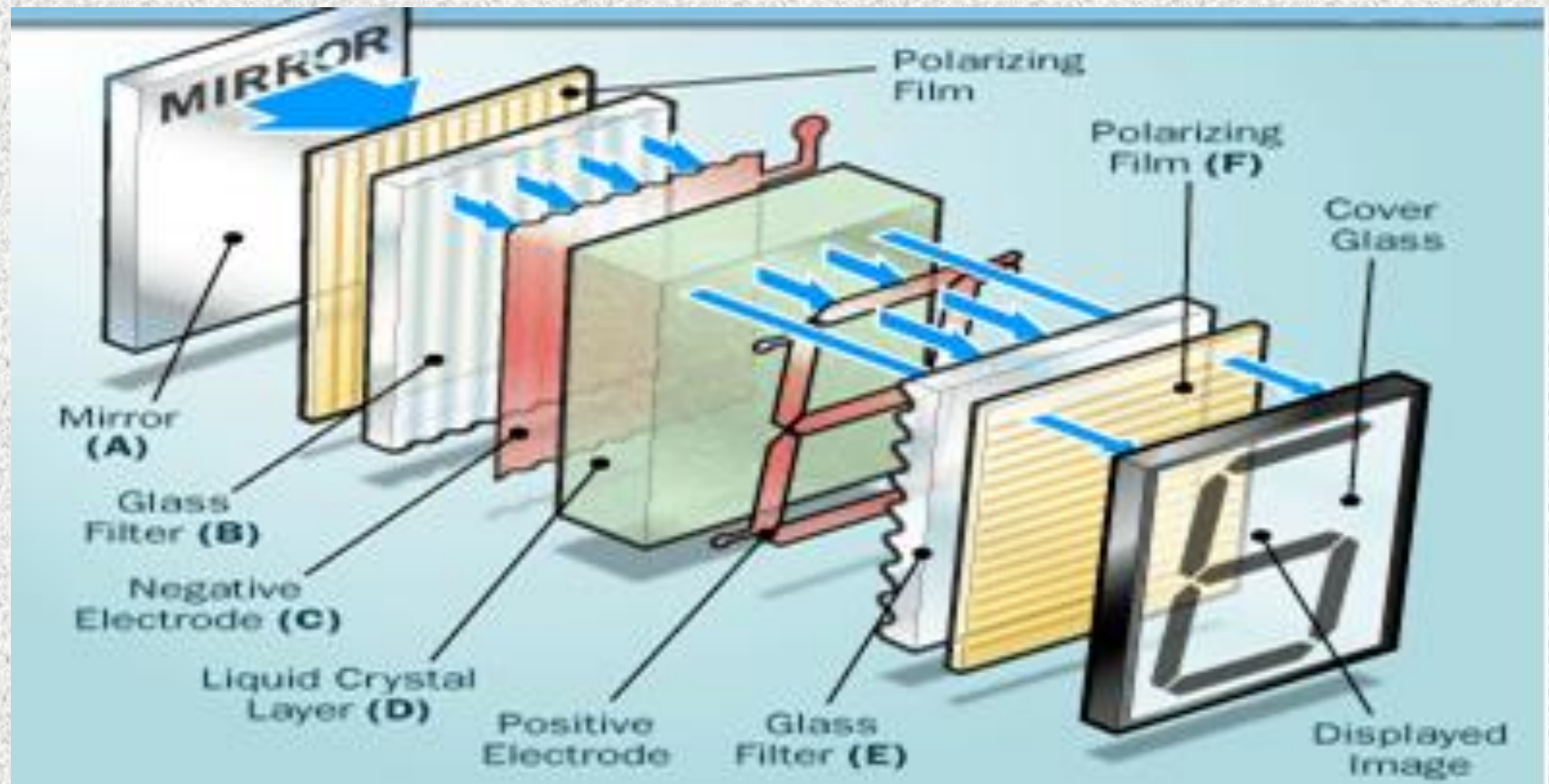


- LCD is either made up of an active matrix display grid or a passive display grid.
- Most of the Smartphone's with LCD display technology uses active matrix display, but some of the older displays still make use of the passive display grid designs.



- Liquid crystal display screen works on the principle of blocking light rather than emitting light.
- LCD's requires backlight as they do not emits light by them.
- We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube.
- Cathode ray tube draws more power compared to LCD's and are also heavier and bigger.

# Construction of LCD



Facts that should be considered while making an LCD:

- The basic structure of LCD should be controlled by changing the applied current.
- Polarized light must be used.
- Liquid crystal should be able to control both of the operation to transmit or should also be able to change the polarized light.

# How LCDs work

- The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist.
- This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter.
- As a result a little light is allowed to pass the polarized glass through a particular area of the LCD.



- Thus that particular area will become dark compared to other.
- The LCD works on the principle of blocking light.
- While constructing the LCD's, a reflected mirror is arranged at the back.
- An electrode plane is made of indium-tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device.
- The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.

- Next comes to the second piece of glass with an electrode in the form of the rectangle on the bottom and, on top, another polarizing film.
- It must be considered that both the pieces are kept at right angles.
- When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back.

- As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist.
- Thus the light is blocked from passing through. That particular rectangular area appears blank.

# Advantages of LCD

- LCD's consumes less amount of power compared to CRT and LED.
- LCD's consist of some microwatts for display in comparison to some mill watts for LED's.
- LCDs are of low cost.
- Provides excellent contrast.
- LCD's are thinner and lighter when compared to cathode ray tube and LED.



# Disadvantages of LCD

- Require additional light sources
- Range of temperature is limited for operation
- Low reliability
- Speed is very low
- LCD's need an AC drive

# Applications of LCD

- Liquid crystal thermometer
- Optical imaging
- The liquid crystal display technique is also applicable in visualization of the radio frequency waves in the waveguide
- Used in the medical applications
- LCD monitors, Cameras, smartphones and many more...

# 16\*2 LCD interfacing with Arduino



- 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:
  - 1) 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.



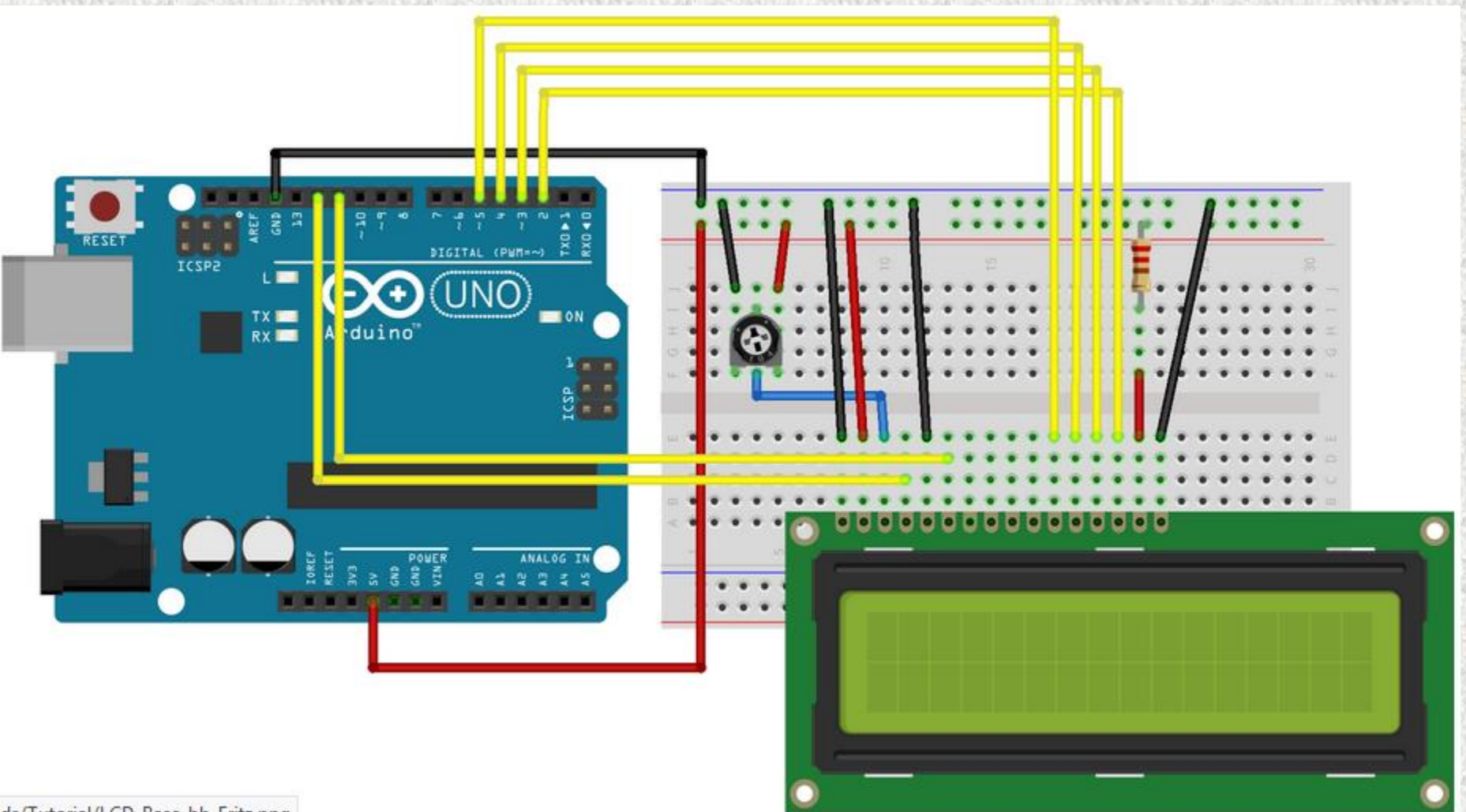
- 2) A **Read/Write (R/W) pin** that selects reading mode or writing mode,
- 3) An **Enable pin** that enables writing to the registers
- 4) 8 **data pins (D0 -D7)**. The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

- There's also a **display contrast 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.

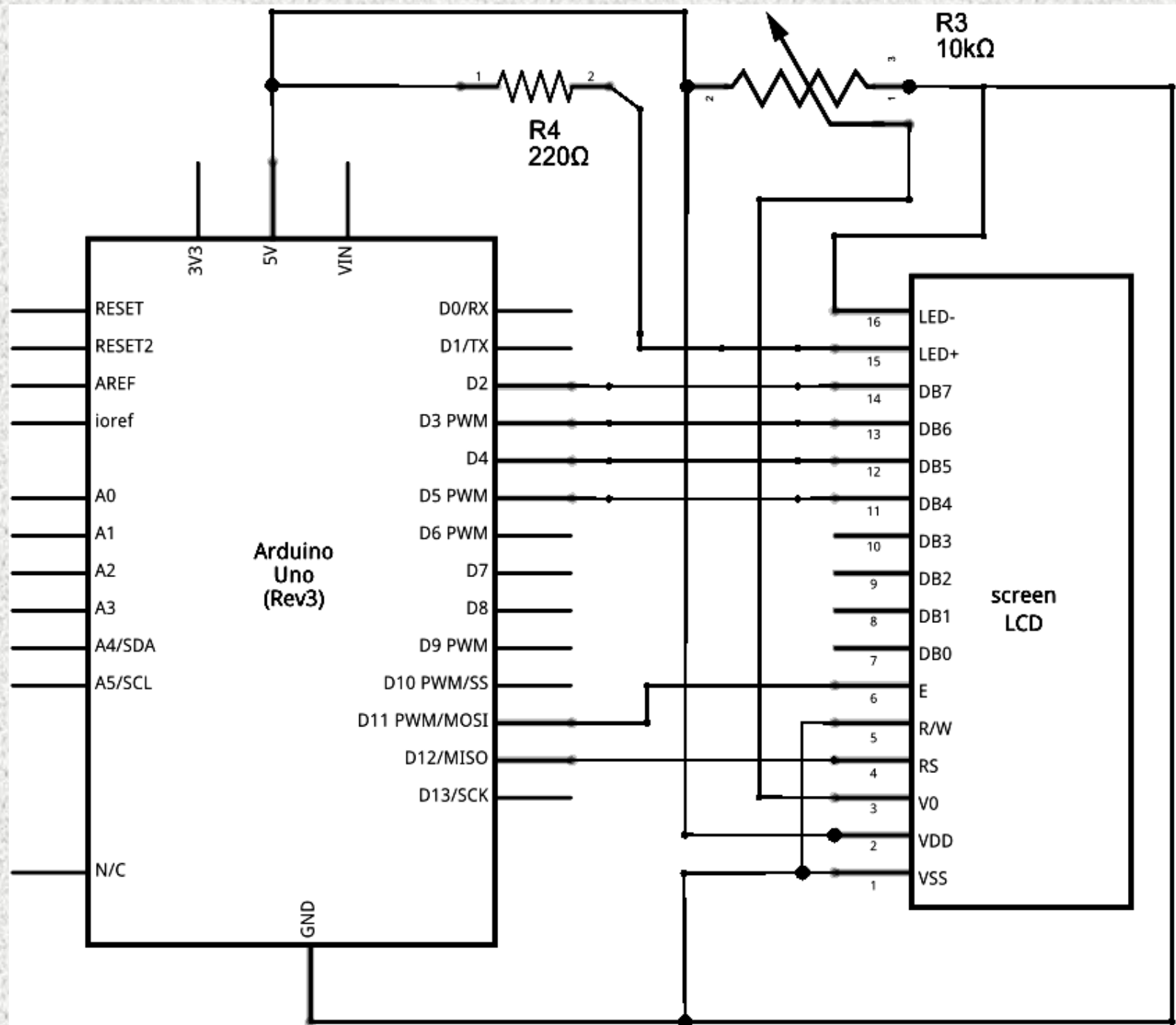
# Circuit connections

To wire your LCD screen to your board, connect the following pins:

- LCD RS pin to digital pin 12
- LCD Enable pin to digital pin 11
- LCD D4 pin to digital pin 5
- LCD D5 pin to digital pin 4
- LCD D6 pin to digital pin 3
- LCD D7 pin to digital pin 2
- Additionally, wire a 10k pot to +5V and GND, with it's wiper (output) to LCD screens VO pin (pin3). A 220 ohm resistor is used to power the backlight of the display, usually on pin 15 and 16 of the LCD connector







- LiquidCrystal Library - Hello World  
Demonstrates the use a 16x2 LCD display. The LiquidCrystal library works with all LCD displays that are compatible with the Hitachi HD44780 driver.
- This sketch prints "Hello World!" to the LCD and shows the time.

The circuit:

- LCD RS pin to digital pin 12
- LCD Enable pin to digital pin 11
- LCD D4 pin to digital pin 5
- LCD D5 pin to digital pin 4
- LCD D6 pin to digital pin 3
- LCD D7 pin to digital pin 2

- LCD R/W pin to ground
- LCD VSS pin to ground
- LCD VCC pin to 5V
- 10K resistor:
  - ends to +5V and ground
  - wiper to LCD VO pin (pin 3)



```
// include the library code:  
#include <LiquidCrystal.h>
```

```
// initialize the library with the numbers of the interface  
pins  
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
```

```
void setup() {  
  // set up the LCD's number of columns and rows:  
  lcd.begin(16, 2);
```

```
// Print a message to the LCD.  
  lcd.print("hello, world!");  
}  
void loop() {  
  // set the cursor to column 0, line 1  
  // (note: line 1 is the second row, since counting begins  
  // with 0):  
  lcd.setCursor(0, 1);  
  // print the number of seconds since reset:  
  lcd.print(millis() / 1000);  
}
```