

Educational LCD display training kit

Learn how to connect an LCD display to a micro controller and program it with this training kit. The breadboard and jumper wires allows you to quickly and easily build different circuits without soldering.

Use free software from the internet to program the ATmega8A micro controller. The kit includes all parts, and instructions necessary to build a working alarm clock, display messages and detect objects using an IR compound eye.

Features:

No soldering required

16x2 backlit LCD display

IR compound eye sensor

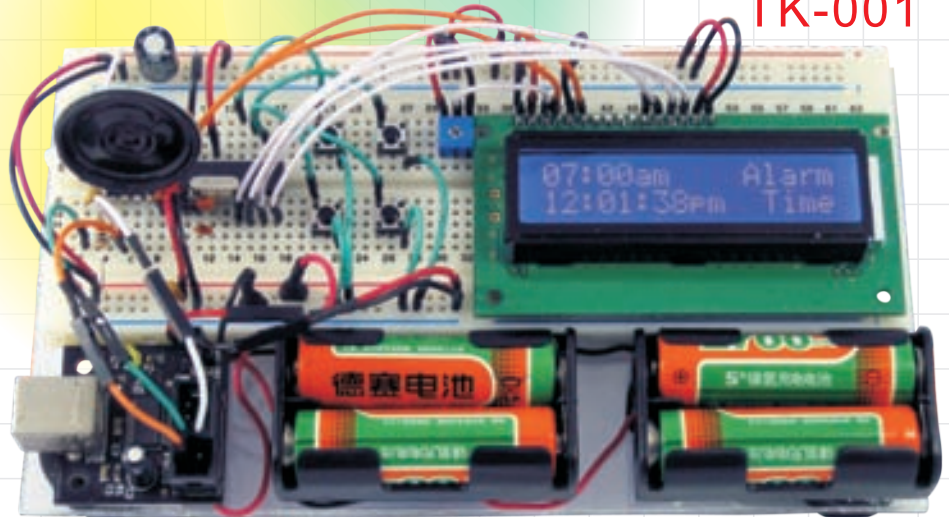
ATmega8A MCU

16MHz crystal oscillator

USB to serial interface

Large breadboard

Over 70 jumper wires



TK-001

LCD Display training kit

Using the Atmega8A processor

INTRODUCTION:

LCD displays are widely used in modern electronics and vary from simple black and white displays used in many wrist watches to Hi-resolution colour displays used in mobile phones and flat screen TV's. LCD displays are very important for communication between human operators and robots.

This kit will show you how to connect a common LCD display to a micro controller and allow you to program it using the provided USB to serial interface module. Using the sample software and supplied components you can build a simple alarm clock. Pay careful



Cameron, Russell, Australia:

Educational LCD display training kit - alarm clock
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DAGU and its staff are not and can neither be made responsible for any ill-considered treatment, operation, or assemblation of the LCD training kit nor for ignoring the instructions in the manual. All programs and drawings are suggestions. Although carefully designed and tested, they cannot be guaranteed to be foolproof or error-free. For this operability of assembled LCD training kit cannot be guaranteed. It is the user's responsibility to exercise caution while using this product.

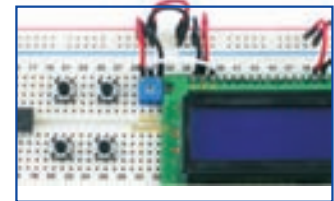
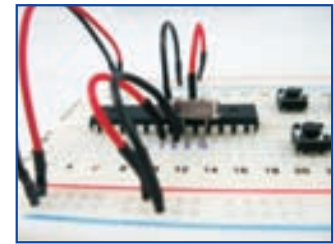
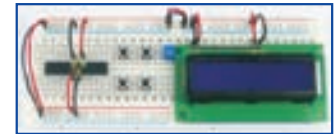
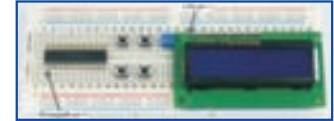
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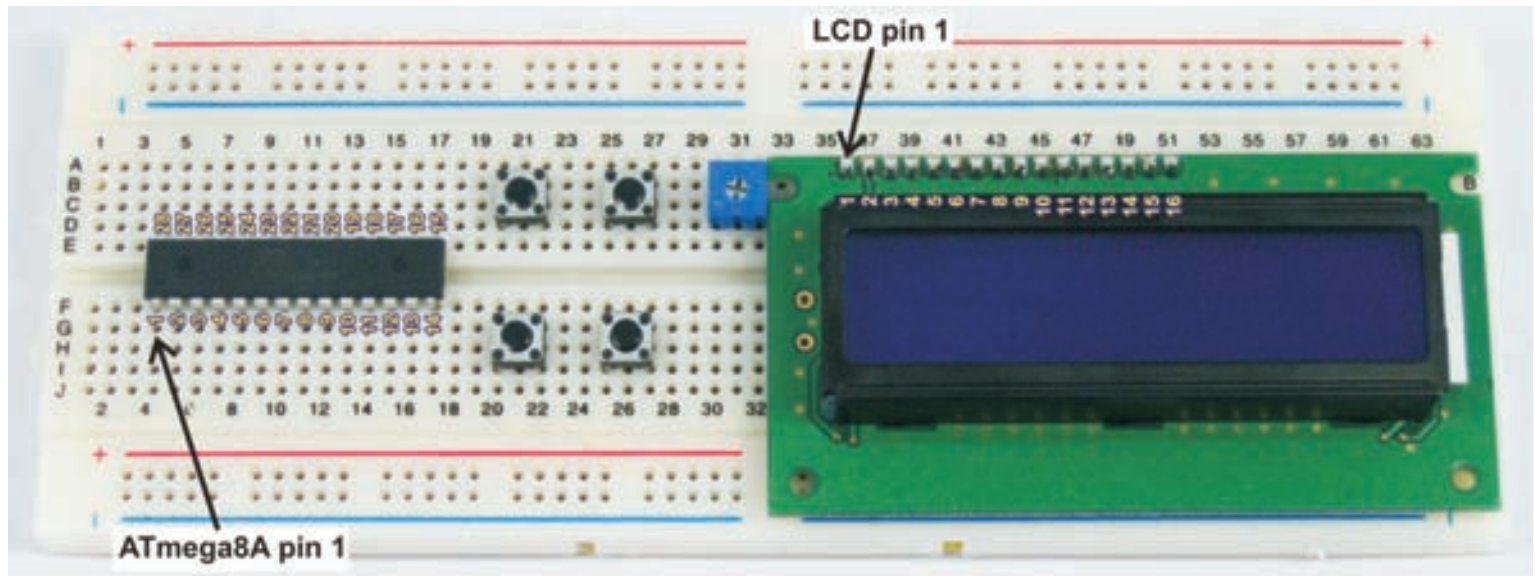
Please check the part list before you start assembly.

PARTS LIST

	Description	Quantity		Description	Quantity
	USB/serial interface module	1		10K trimpot	1
	USB cable for programming	1		10K resistor	1
	Large bread board	1		220R resistor	1
	Jumper wire pack	72		3mm red LED	1
	16 x 2 LCD display	1		16MHz crystal	1
	Atmega8A MCU with Arduino bootloader	1		miniature PCB mount push buttons	4
	22pF ceramic capacitor	2		28mm mylar speaker (32 ohm)	1
	100nF monolithic capacitor	2		acrylic fix board	1
	220uF 16V electrolytic	1		black EVA fitting	4
	10uF 16V electrolytic capacitor	1		battery box	2

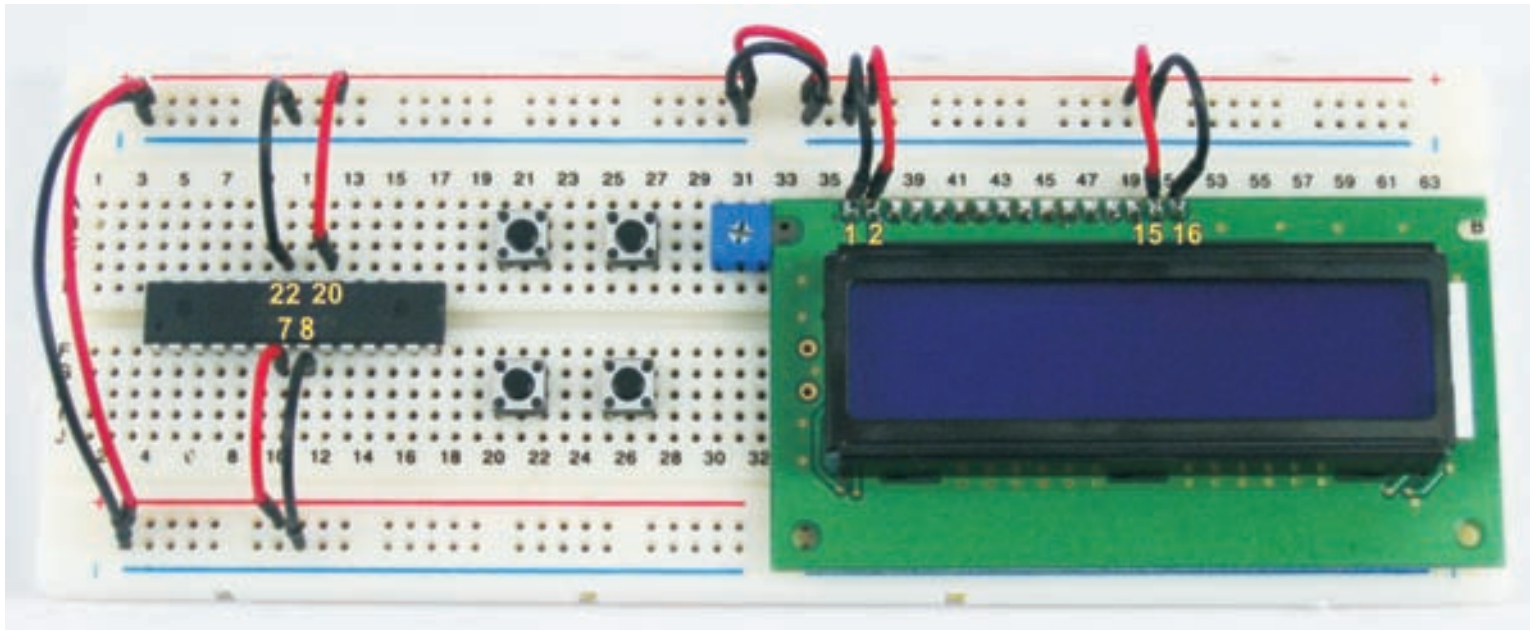
STEP 1

Place the microprocessor, push buttons, trimpot and LCD display on the breadboard as shown in the photo. Make sure that pin 1 of the processor and pin 1 of the display are both on the left



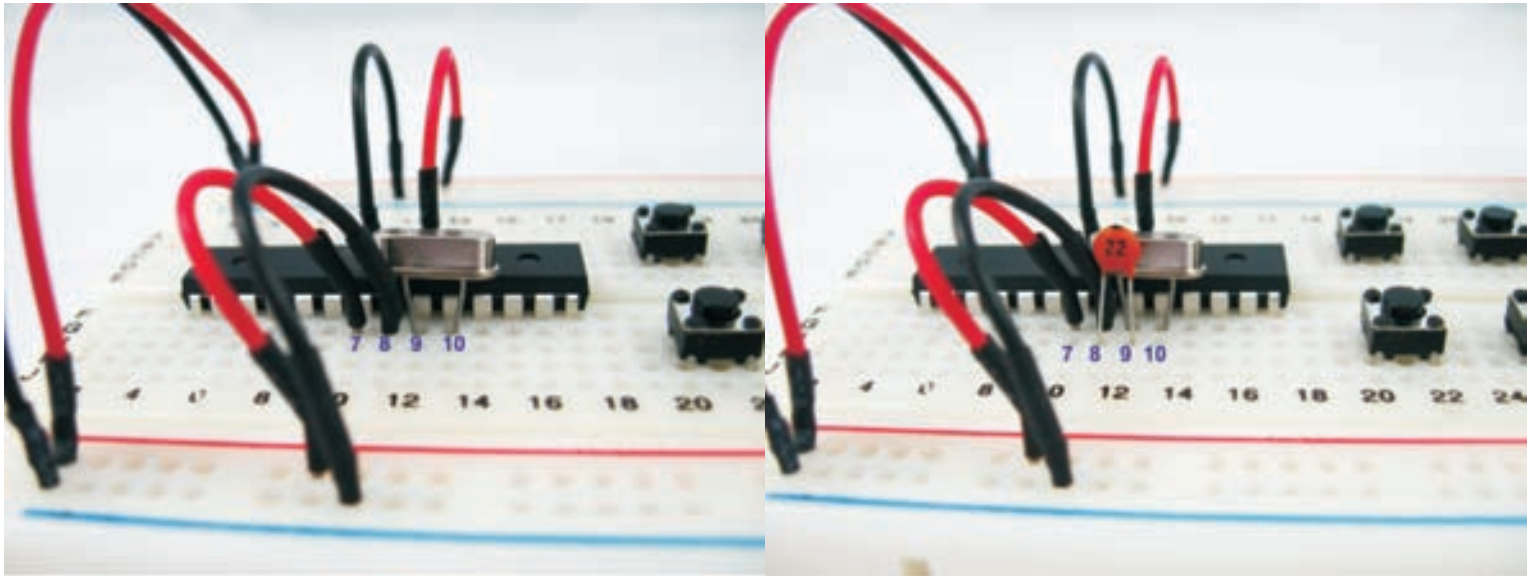
STEP 2

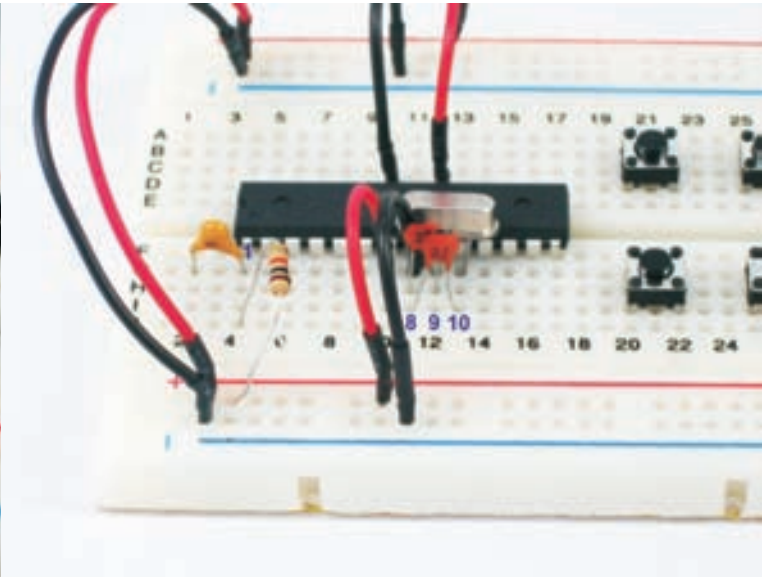
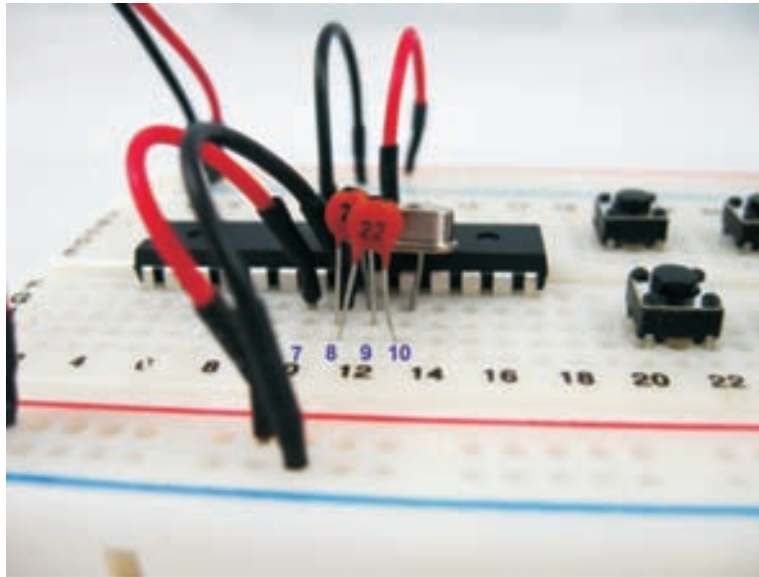
Connect the power wires using red for +5V (Vcc / Vdd). Use black for ground (Vee / Vss). Be careful to connect these wires to the correct pins otherwise you could damage your processor or display. Note the pin numbers in the photo.



STEP 3

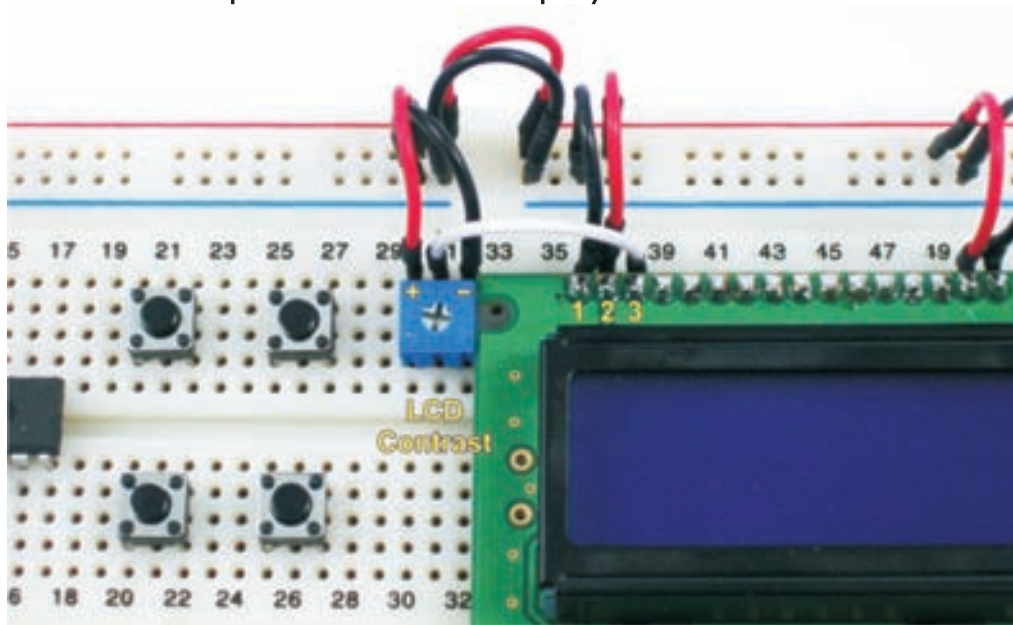
The Atmega8A needs an external crystal so that it can measure time accurately. It also needs an external reset for programming. Install the crystal, 22pF capacitors, 10K resistor and 100nF capacitor as shown. Pay careful attention to the IC pin numbers in the photos.



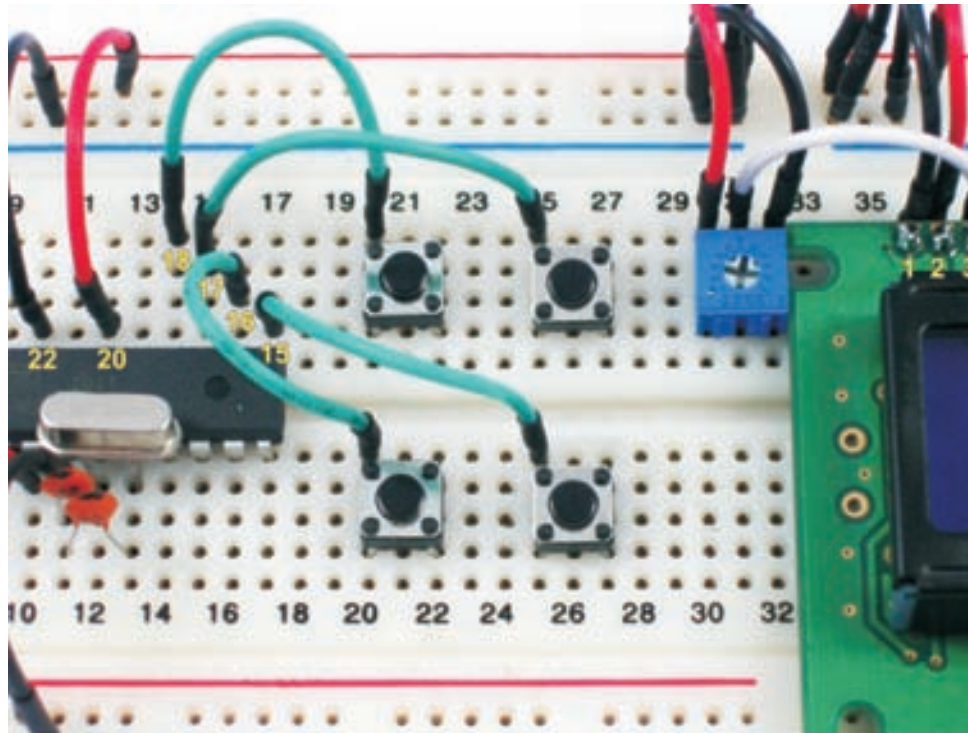


STEP 4

Connect the trimpot and push buttons. These are your controls. The trimpot adjusts the display contrast while the buttons allow you to set the time, turn on the alarm etc. Note that the middle pin of the trimpot connects to pin 3 of the LCD display.

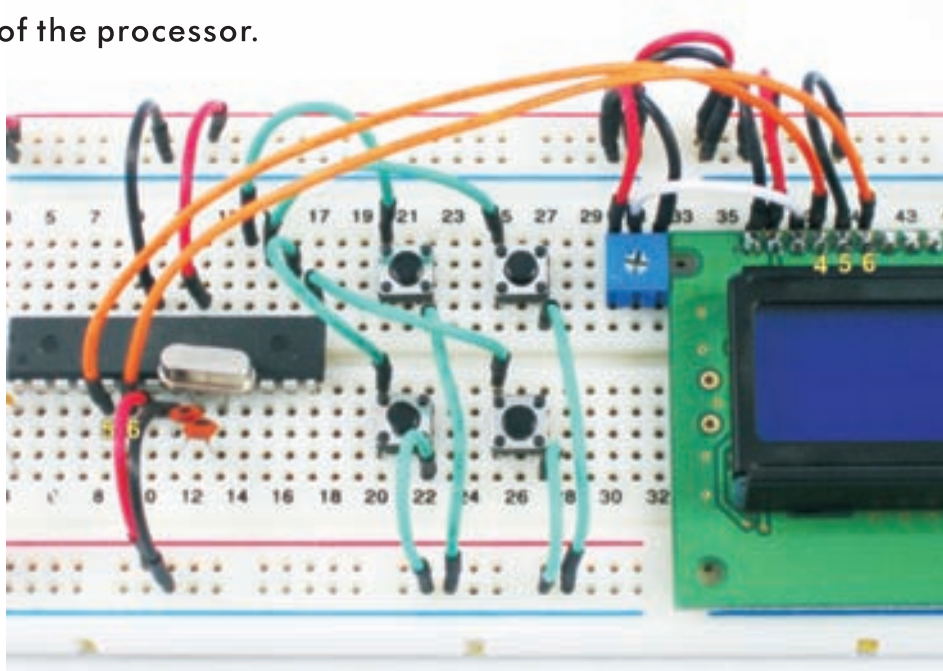


Connect each button to the processor as shown.

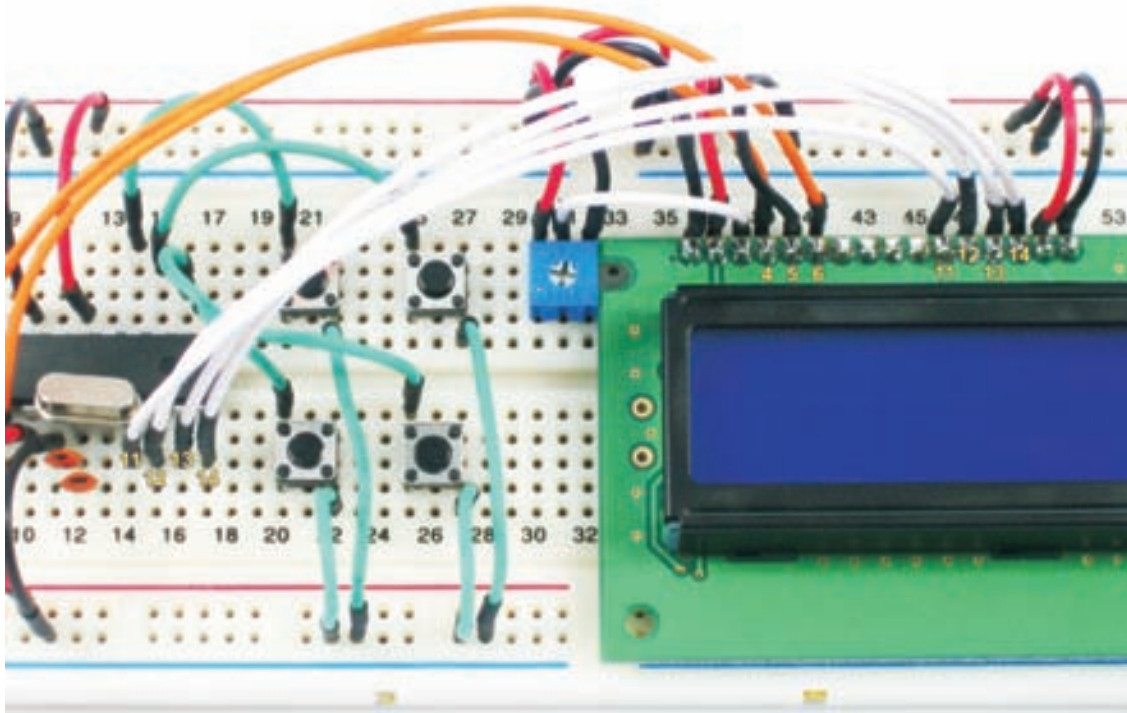


STEP 5

Connect the display to the processor. There are 3 control lines. Pin 5 of the LCD is not used and is connected to ground. Pin 4 of the LCD connects to pin 5 on the processor. Pin 6 of the LCD connects to pin 6 of the processor.

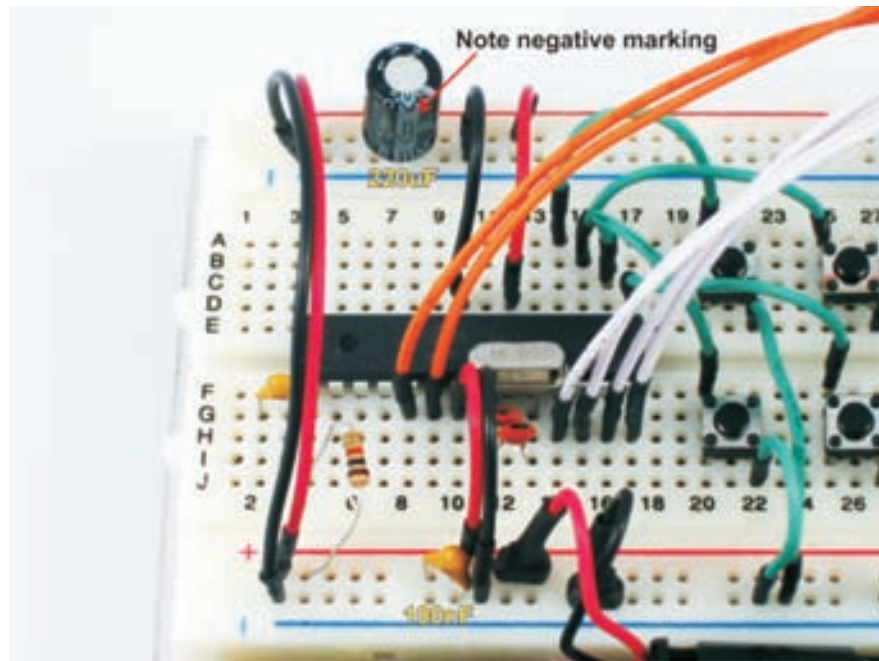


Now connect the data bus. Pins 11,12,13 and 14 of the processor connect to pins 11,12,13 and 14 on the LCD.

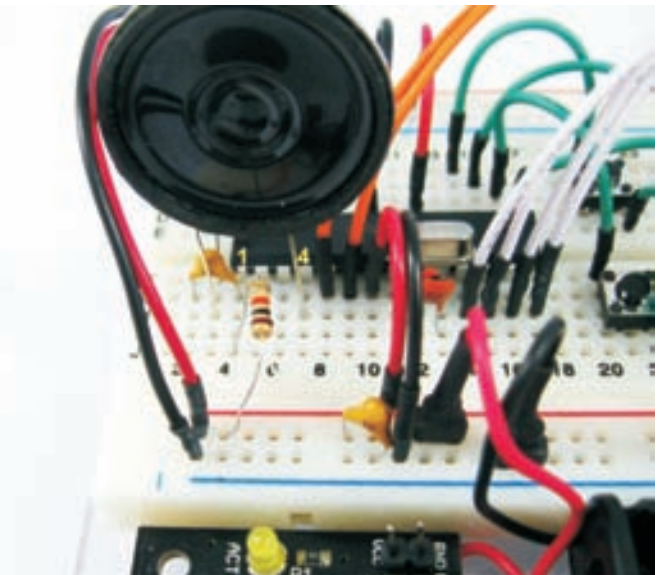
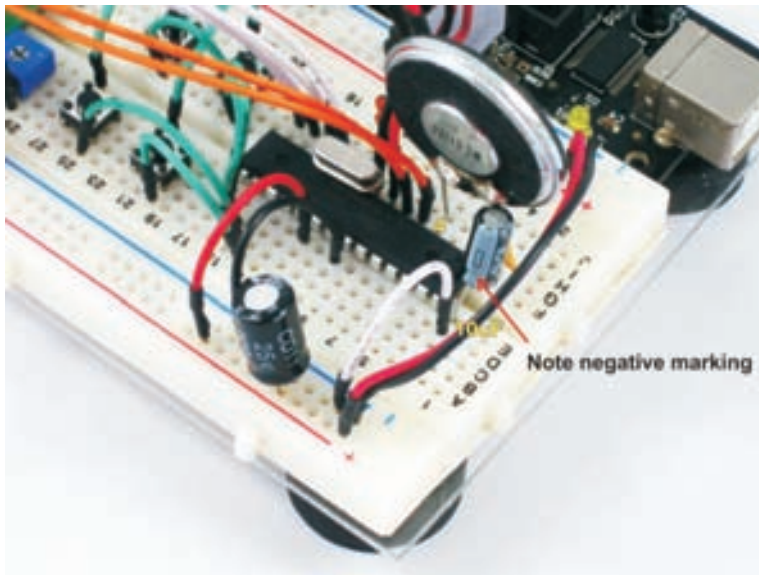


STEP 6

Electrical noise can be a problem in electronic circuits. The processor can malfunction if there is too much electrical noise. To ensure reliable operation we must add 2 capacitors.



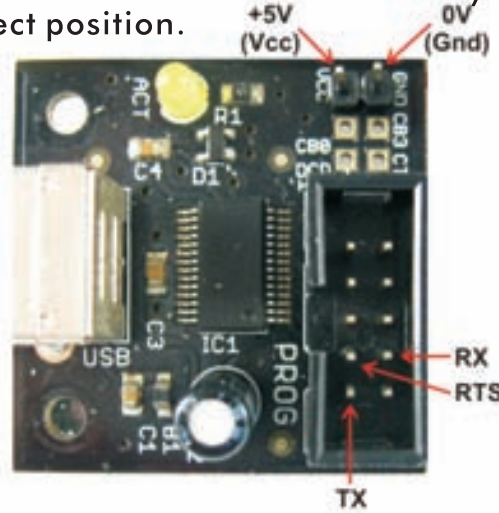
Our sample program is for an alarm clock so we need to add a small speaker. This speaker uses a capacitor in series to protect it from excessive DC current. Note the electrolytic capacitors must be put in the right way to prevent damage.

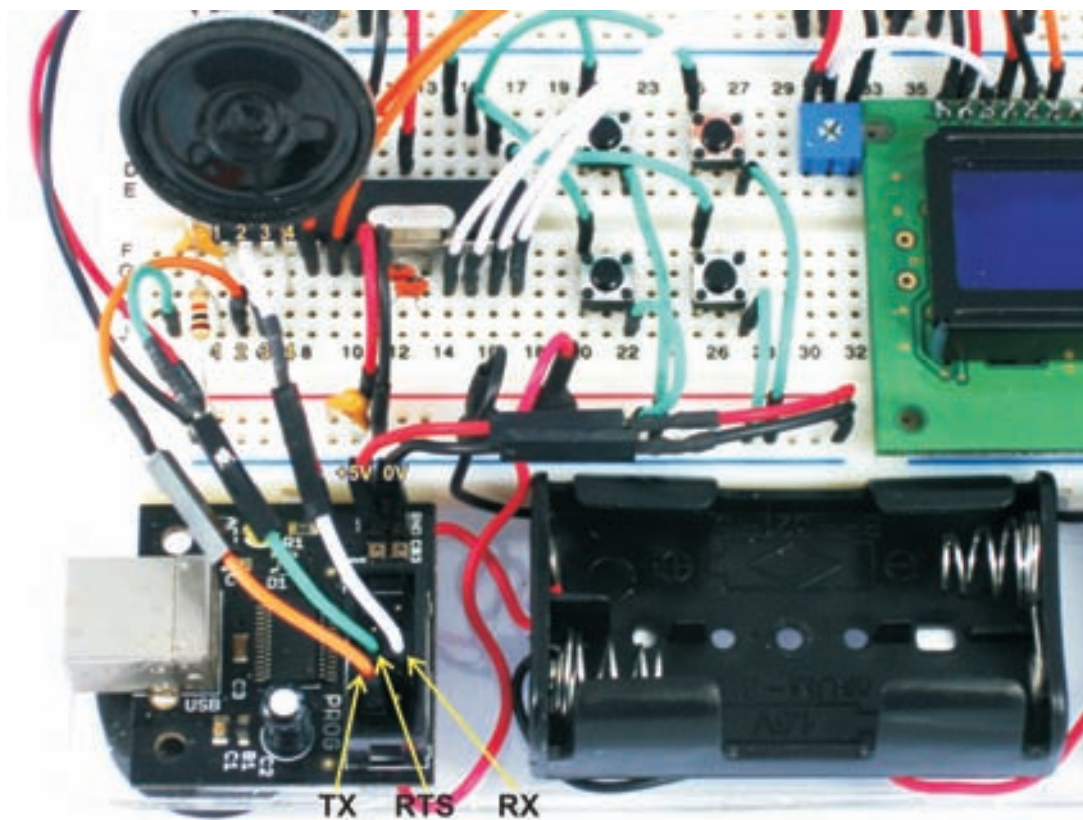


STEP 7

Finally we are ready to connect the USB interface. This will provide power for the circuit as well as allowing us to download the sample software. You must connect 5 wires as shown below. RTS connects to our reset (pin 1) via the 100nF capacitor. TX from our USB goes to RX (pin 2) on our processor. RX from our USB goes to TX (pin 3) of our processor. Note that each wire consist of a male-male and female-female wire joined together.

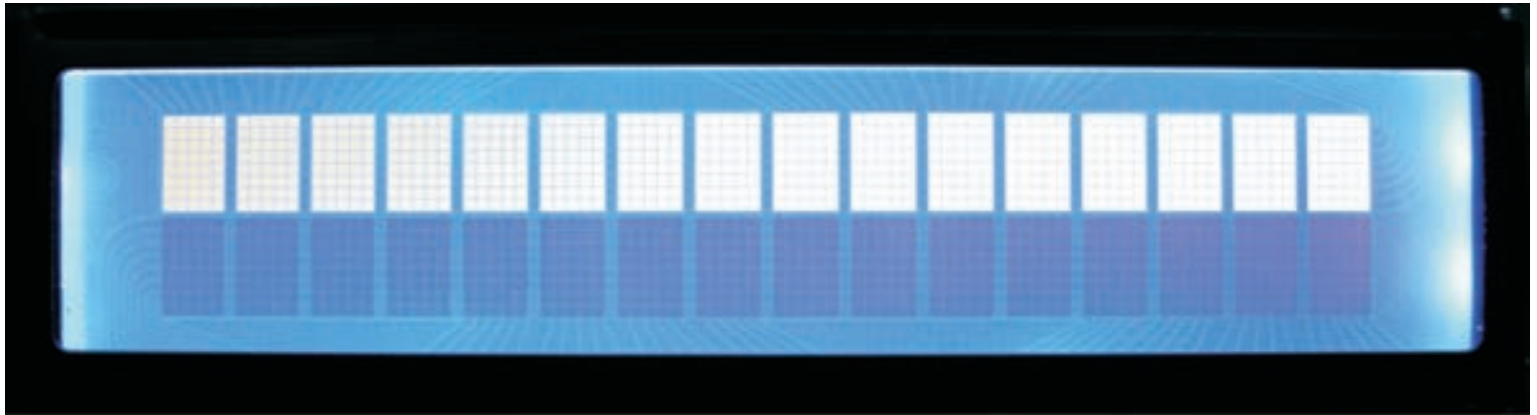
When these connections have been made, plug in the USB cable. If the LCD display does not light up then quickly unplug the USB cable and recheck all of your wires. Make sure that all red and black wires are in their correct position.

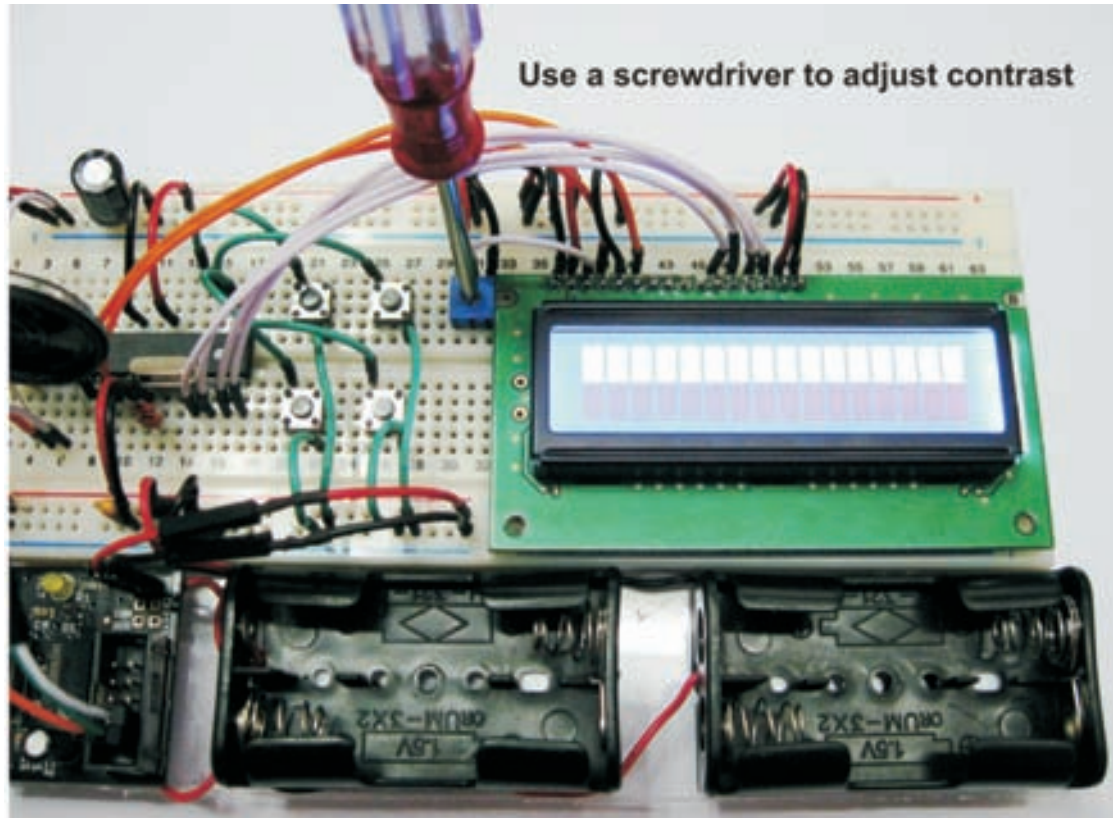




STEP 8

With the USB cable plugged in and your circuit powered you can now adjust the contrast on your LCD until the test pattern can be clearly seen. If you are using batteries you may need to adjust this setting as the batteries loose power.





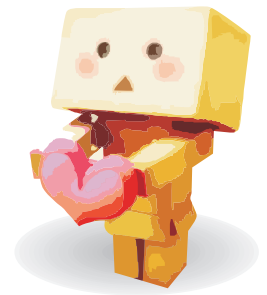
STEP 9

Download and Install the Arduino programming software from this website:

<http://arduino.cc/en/Main/Software>

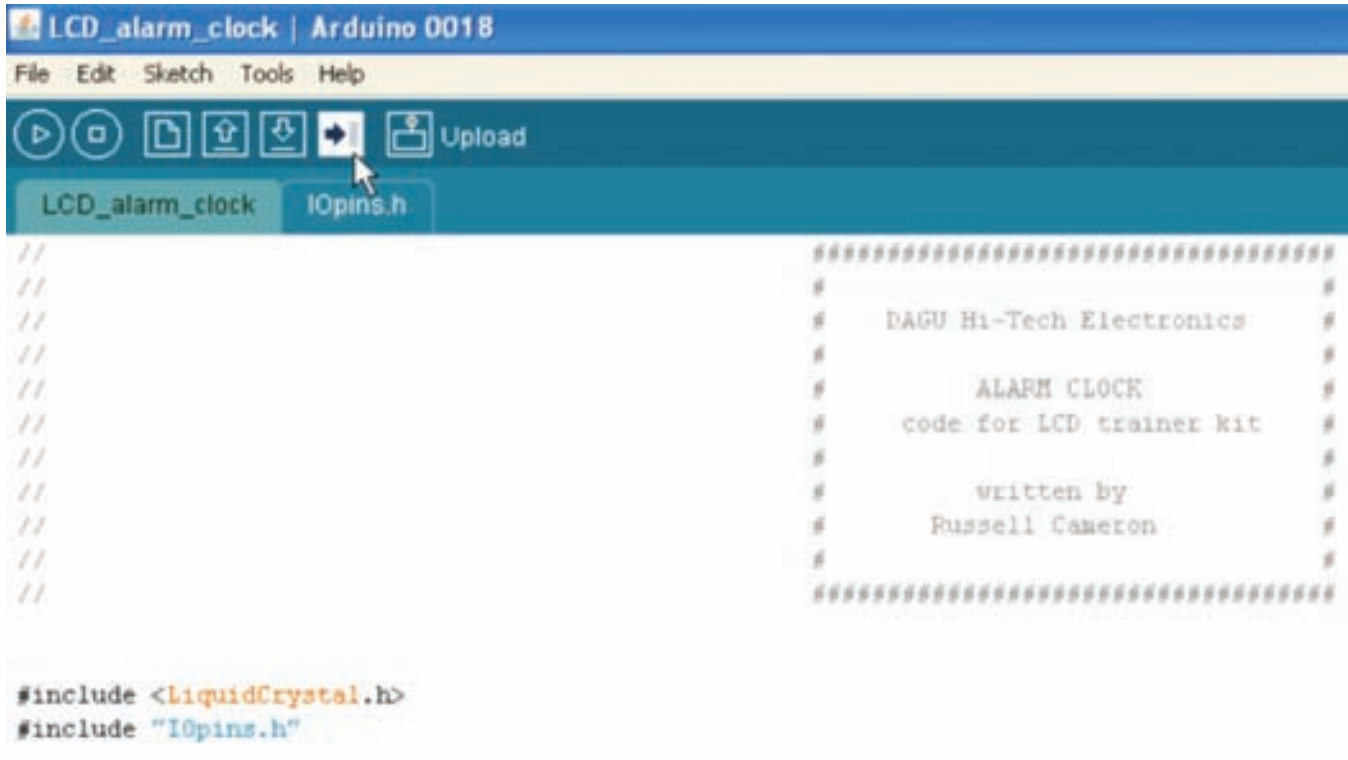
Once you have the software installed you can download the “alarm clock” program from our website:

http://arexx.com.cn/Upload/DownFiles/LCD_alarm_clock.rar



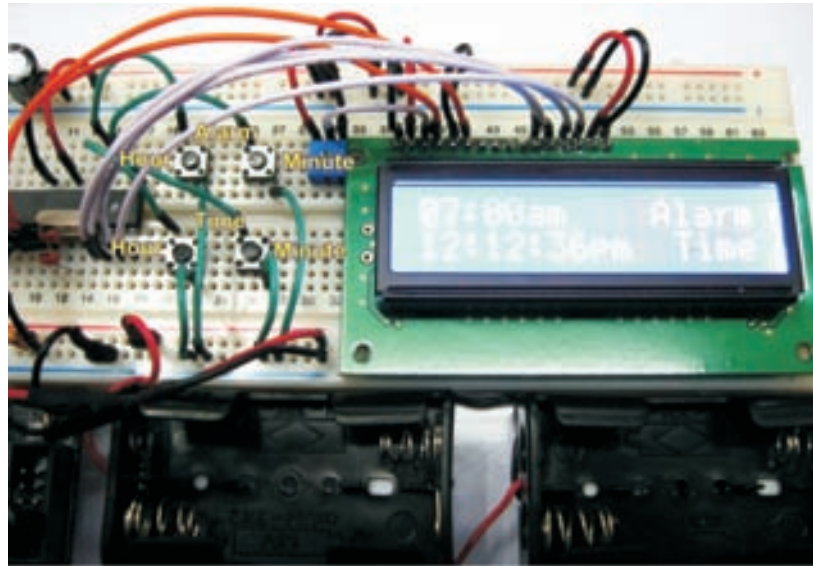
The screenshot shows the Arduino IDE interface. The title bar reads "LCD_alarm_clock | Arduino 0018". The menu bar includes "File", "Edit", "Sketch", "Tools", and "Help". The "Tools" menu is open, showing options: "Auto Format" (Ctrl+T), "Archive Sketch", "Fix Encoding & Reload", "Serial Monitor" (Ctrl+Shift+M), "Board", "Serial Port", and "Burn Bootloader". The "Board" option is selected, opening a submenu with a list of boards. The boards listed are: "Arduino Duemilanove or Nano w/ ATmega328", "Arduino Diecimila, Duemilanove, or Nano w/ ATmega168", "Arduino Mega", "Arduino Mini", "Arduino BT", "Arduino Fio", "LilyPad Arduino w/ ATmega328", "LilyPad Arduino w/ ATmega168", "Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328", "Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168", "Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328", "Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168", "Arduino NG or older w/ ATmega8", "Arduino NG or older w/ ATmega8", and "ATmega8-noxtal @8MHz". The "Arduino NG or older w/ ATmega8" option is highlighted. The background code in the editor includes comments and includes for the LiquidCrystal and IOPins libraries.

Now we are ready to upload the program into the processor.



When you click on the upload button the software will compile the program. After a few seconds the yellow LED on the USB should start flashing as the program uploads to the Atmega8A processor. If this does not happen then re-check your wiring.

Once the program has uploaded you must then wait for about 5 seconds before the program runs. The LCD display should now look like this.



USING THE CLOCK PROGRAM

The clock program is simple to operate. Pressing individual buttons will increment the hour and minute values accordingly and can be used to set the time as well as when the alarm will sound.

Pressing both "Hour" and "Minute" buttons together for the alarm will turn the alarm on or off. Pressing both "Hour" and "Minute" buttons together for the time will select 12Hr or 24Hr clock. Pressing any button while the Alarm is sounding will silence the alarm.

When the alarm is turned on the display will show "()" before the word "Alarm".

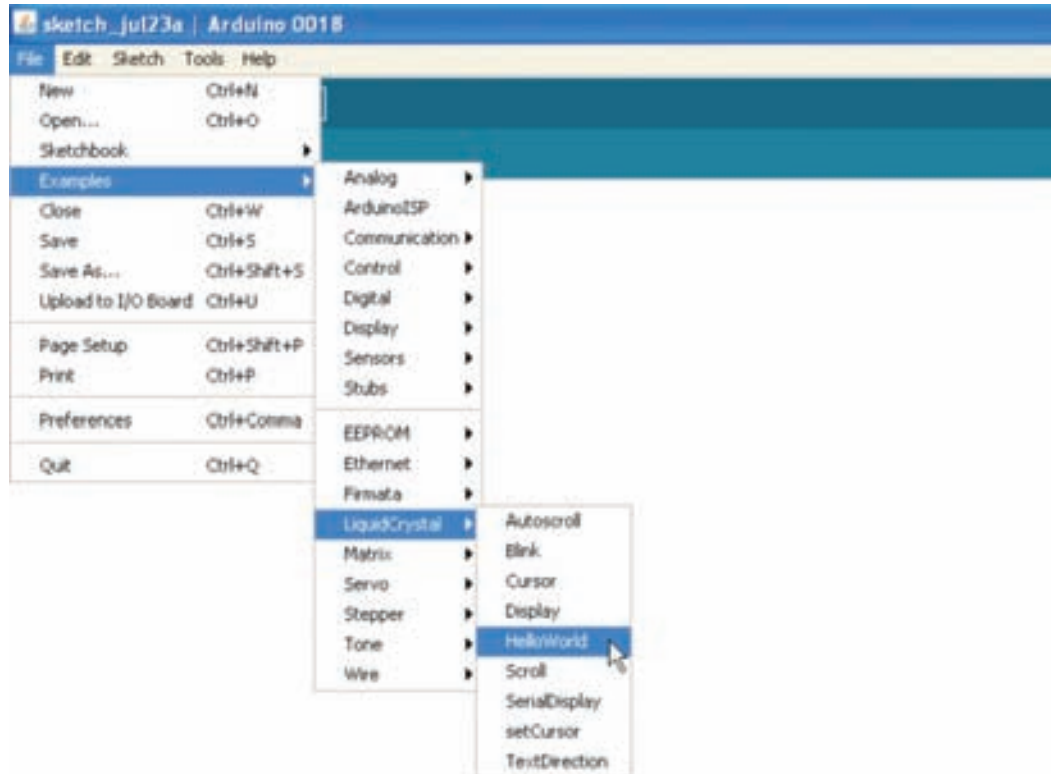
OTHER USES FOR YOUR KIT

LCD displays are great for robotic projects because they can let you see what the robot is doing. They can be used for displaying information from sensors or they can display a menu with options for you to choose from.

The Arduino programming software includes sample programs that can easily be adapted to work with your display. By studying the "Liquid Crystal" library and the example programs you can learn how to write your own programs.

Help for the "Liquid Crystal" library can be found here: <http://www.arduino.cc/en/Reference/LiquidCrystal>

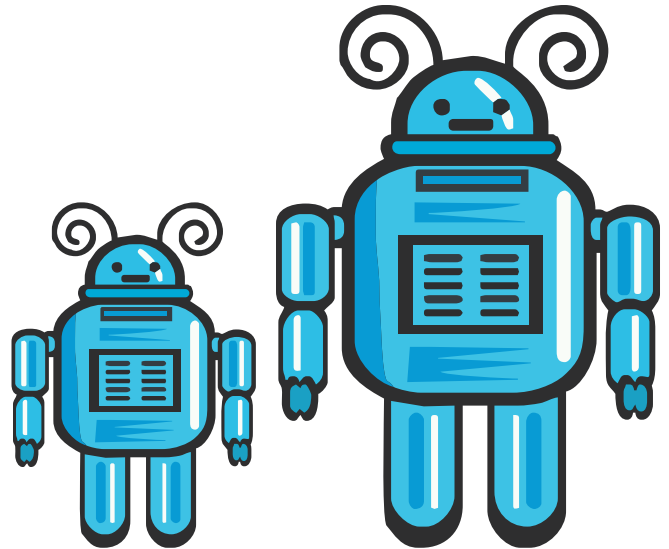
Let's have a look at an example program and learn how to install it. Run the Arduino programming environment and open the example program called "HelloWorld".



Now you need to make one small change to the program to tell it how the LCD display is connected to the Atmega8A.

This change must be made to all of the example programs before they will work.

This line tells the program that the LCD display pins RS, EN, D4, D5, D6, D7 are connected to digital pins 3, 4, 5, 6, 7, 8 of the Atmega8A.



```
http://www.arduino.cc/en/Tutorial/LiquidCrystal
*/

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

// initialize the library with the number of the interface pins
LiquidCrystal lcd(10, 11, 5, 4, 3, 2); LiquidCrystal lcd(3,4,5,6,7,8);

void setup() {
  // set up the LCD's number of rows and columns:
  lcd.begin(16, 2);
  // Print a message to the LCD.
  lcd.print("hello, world!"); lcd.print("Happy Birthday!");
}

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);
}
```

Change this line

Make it say what you want

While you are making changes to the sample program, change the message to display whatever you want.

Once this line has been changed, upload the program. If it will not upload then check that you have the correct serial port and board selected in the tools menu as previously shown. The display will now show your message and display how many seconds have elapsed since the program started.



Now experiment with the other examples.



Detecting Objects and measuring distance using the IR compound eye

Included in the kit is an infra-red compound eye. Like the compound eye of an insect this eye consist of multiple light sensors, each with it's own lens. Unlike an insect eye our compound eye also has it's own light source which allows it to see in the dark. Note: IR = infra-red, LED = light emitting diode.

There are four clear IR LEDs in the centre of the PCB and eight dark IR photo-transistors around the outside. The photo-transistors are arranged as pairs to increase range and sensitivity. These pairs are arranged as upper, lower, left and right sensors. By comparing the inputs of these sensors we can determine if an object is nearby and in what direction.

Because sunlight and the lights inside your house also produce IR light the eye measures the sensors with the IR LEDs turned off to measure ambient IR and then again with the IR LEDs turned on to measure IR reflected by an object.

By subtracting the IR readings with the LEDs off from the readings with the LEDs on we are left with the light reflected by an object. If the object is to the left then it will be closer to the left sensor than the right sensor. This will cause the left sensor to have higher readings than the right sensor.

By averaging the readings from the upper, lower, left and right sensors we can get a rough idea of the distance of the object. This does not produce an accurate distance measurement as the readings depend on the size, colour and shape of the object. You can determine if an object is getting closer or moving further away.

Installing the IR compound eye

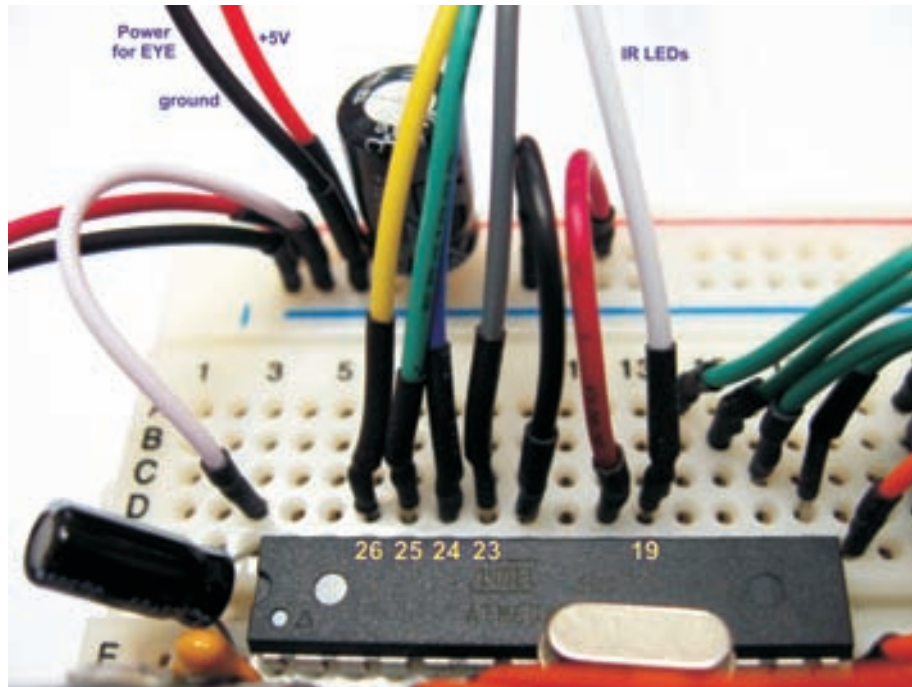
The compound eye needs power, one digital output and 4 analog inputs. The digital output turns the IR LEDs on or off. The four analog inputs give us our upper, lower, left and right sensor readings. Start by connecting the wires to the compound eye as shown.

- | | |
|-----------|--------------|
| 1. Red | +5V |
| 2. yellow | lower sensor |
| 3. green | right sensor |
| 4. blue | upper sensor |
| 5. grey | left sensor |
| 6. white | IR LEDs |
| 7. black | ground |





Now connect them to the clock as shown

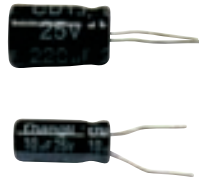


Now download the sample program “LCD distance.rar” as you did with the “Alarm Clock” program and upload it to your board.

Problem	Solution
When the program runs a button appears to be pressed even when it has not been touched.	Remove the button, rotate it 90 degrees and then put it back in the bread board.
The display does not light up when power is connected.	Immediately disconnect the power and check all power wires (red and black). If you are using batteries then check that the batteries are good.
The contrast on the display cannot be adjusted or the display is not well lit.	Check that the 10K trimpot is connected properly. If you are using batteries then they may need replacing or recharging.
The program will not load or does not run. The display backlight is on.	Is the processor installed with pin 1 on the left side? Check your crystal and 22pF capacitors are installed correctly. Is the 10K resistor connected between pin 1 of the processor and +V? Check your serial port and board type are set correctly. Check your power wires are connected properly. Is your USB interface connected correctly?
The program will not load. The yellow light only flashes one or two times.	Is the RTS wire connected to the 100nF capacitor? Is the capacitor connected to pin 1 of the processor? Is the TX wire connected to pin 2 and the RX wire connected to pin 3?
The alarm does not make any sound.	In 12Hr mode, check that the am/pm is set correctly. Is the alarm turned on with "()" displayed? Is the speaker connected to pin 4 of the processor and the 10uF capacitor? Is the negative side of the capacitor connected to ground?
Strange characters appear on the display.	This can happen when the processor is receiving a new program but will disappear when the new program begins. If it happens while the program is running then check the wires connecting the LCD to the processor.

Capacitors used in this kit

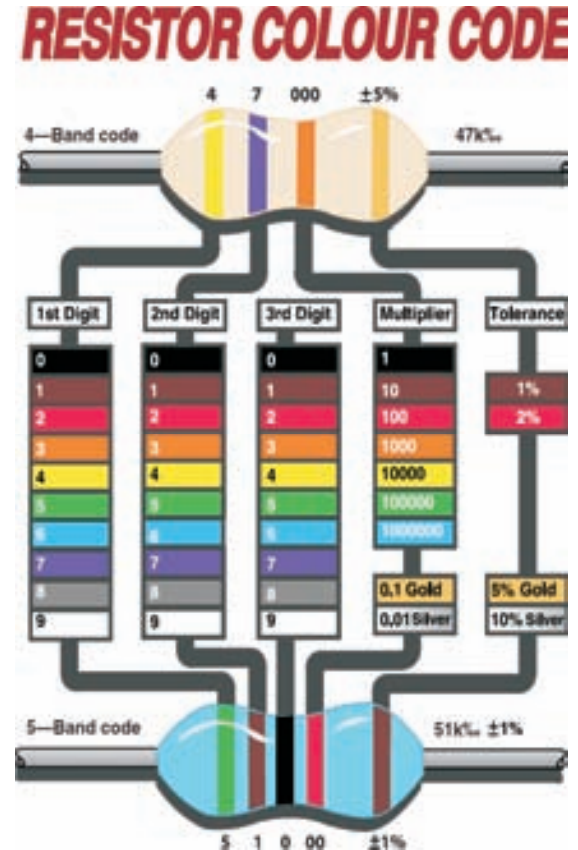
Electrolytic Capacitors are commonly used in power supplies and for AC coupling. They are called electrolytic capacitors because they use an electrolyte in their construction.



Monolithic Capacitors are a high density ceramic capacitor. They have a low ESR (equivalent series resistance) that makes them ideal for noise suppression in electronic circuits.

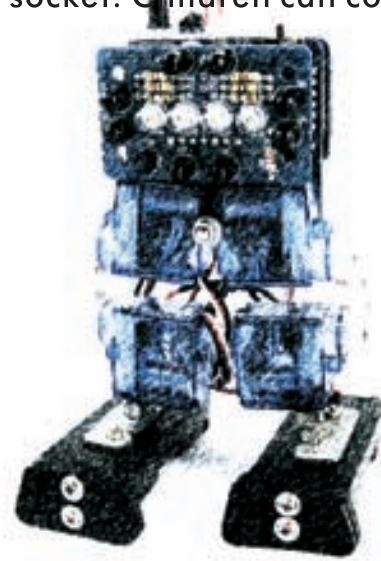


Ceramic capacitors are ideal for high frequency circuits and are commonly used in radio and computer equipment.



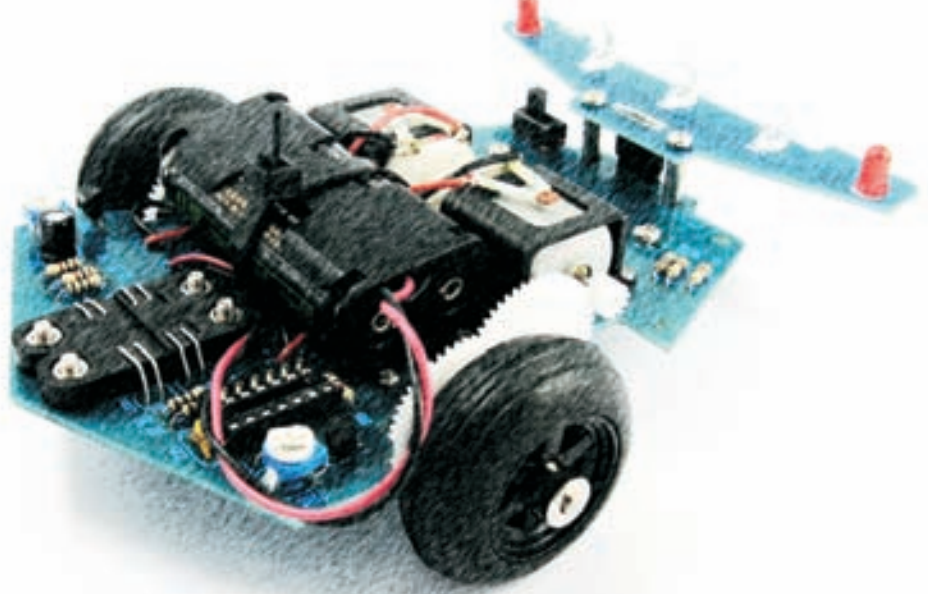
Mini Bi-ped is a small bi-pedal robot using the ATmega8A processor. This is a simple walking robot. It has an infra-red eye that can follow the movement of objects at close range. The robot has a backpack PCB which allows it to play music and be controlled with a universal TV remote. The robot can be programmed using free software from the internet such as the Arduino programming environment or WinAVR.

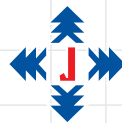
The kit comes pre-programmed with demonstration software and the Arduino bootloader. Advanced users can program the robot via an ISP socket. Children can control the robot with the TV remote



LINE FOLLOWING

1. Red indicating LEDs on the wing light to indicate when the car is turning left or right
2. Eye catching wing design with 3pcs 7-colour flashing LEDs
3. Uses infra-red sensors to follow a black line on a white background
4. Educational - teaches mechanical assembly and soldering skills.





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