

# LED Grandfather Clock

## Version 1.0

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### Parts For This Project

Quantity	Part	Vendor	Part Number	Source
1	Arduino Uno Rev 3	Radio Shack	276-128	<a href="http://www.radioshack.com">www.radioshack.com</a>
7	RGB LED	Radio Shack	276-028	<a href="http://www.radioshack.com">www.radioshack.com</a>
3	IRF-510 MOSFET N-Channel	Radio Shack	276-2072	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	100 ohm 1/4W Resistors	Radio Shack	271-1311	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	10K ohm 1/4W Resistors	Radio Shack	271-1335	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	9V Power Supply	Radio Shack	273-0355	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	Size 'K' Power Supply Plug	Radio Shack	273-0342	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	CR1225 Coin Cell Battery	Radio Shack	23-794	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	Printed Circuit Board	Express PCB	N/A	<a href="http://www.expresspcb.com">www.expresspcb.com</a>
	OR Arduino Proto Shield	Radio Shack	276-0140	<a href="http://www.radioshack.com">www.radioshack.com</a>
1	Pushbutton	DigiKey	SW400-ND	<a href="http://www.digikey.com">www.digikey.com</a>
3	220 ohm Bussed Resistor Array	DigiKey	4608X-1-221LF-ND	<a href="http://www.digikey.com">www.digikey.com</a>
1	0.1" Header Pins	DigiKey	SAM1035-50-ND	<a href="http://www.digikey.com">www.digikey.com</a>
1	DS1307 RTC	DigiKey	DS1307+-ND	<a href="http://www.digikey.com">www.digikey.com</a>
1	32.768 KHz Crystal	DigiKey	X802-ND	<a href="http://www.digikey.com">www.digikey.com</a>
1	0.1uF Capacitor	DigiKey	399-4264-ND	<a href="http://www.digikey.com">www.digikey.com</a>
1	12mm Coin Cell Battery Holder	DigiKey	3001K-ND	<a href="http://www.digikey.com">www.digikey.com</a>
1	Mirrored Acrylic Reflector	Pololu	N/A	<a href="http://www.pololu.com">www.pololu.com</a>
1	White Acrylic Diffuser	Pololu	N/A	<a href="http://www.pololu.com">www.pololu.com</a>
1	4-40 x 1/2" L Nylon Pan Head Screws	McMaster Carr	93135A110	<a href="http://www.mcmaster.com">www.mcmaster.com</a>
8	4-40 x 3/4" L Nylon Standoffs	McMaster Carr	96110A012	<a href="http://www.mcmaster.com">www.mcmaster.com</a>
1	4-40 x 1/2" L SS Threaded Studs	McMaster Carr	95412A409	<a href="http://www.mcmaster.com">www.mcmaster.com</a>
1	4-40 x 7/16" L Nylon Standoffs	McMaster Carr	92745A472	<a href="http://www.mcmaster.com">www.mcmaster.com</a>
1	4-40 Nylon Nuts	McMaster Carr	94812A112	<a href="http://www.mcmaster.com">www.mcmaster.com</a>
1	Fillsta Table Lamp	Ikea	501.550.18	<a href="http://www.ikea.com">www.ikea.com</a>

# Assembly Instructions

## Introduction:

There is a theme in many of my projects to display information in an approximate way. I'm often more interested in a sense of the data than the exact numbers. In this project, I applied that thinking to timekeeping and created a LED Grandfather Clock that strikes the passage of time while not actually telling you what time it is.

Please read the instructions all the way through before starting the project.

All of the supporting files for this project can be downloaded (use the ZIP button) from:  
<https://github.com/vinmarshall/Radio-Shack-LED-Grandfather-Clock>

## Step 1: Program The Arduino



If you don't already have it, download the Arduino software from <http://www.arduino.cc/>.

Open the Arduino software and connect the Arduino to your computer via USB. Under the "Tools" drop down menu, select your board type (Arduino UNO for this project) and serial port (/dev/tty.usbmodem\*\*\*).

The code for this project is in ./grandfather\_clock\_code directory in the download. Open it with the Arduino software and download the program to the Arduino.

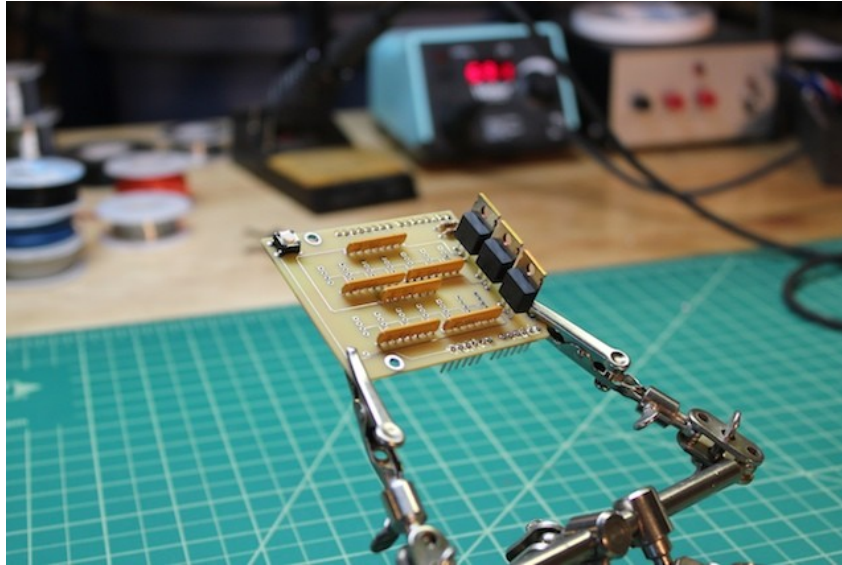
If you have any problems with connecting and programming the Arduino, consult the help available in the Arduino forums at <http://arduino.cc/forum/>.

Once the Arduino has been successfully programmed, disconnect it from the computer and put it aside for now.

Check for the most recent version of the code here:

[https://github.com/vinmarshall/Radio-Shack-LED-Grandfather-Clock/blob/master/grandfather\\_clock\\_code/grandfather\\_clock\\_code.pde](https://github.com/vinmarshall/Radio-Shack-LED-Grandfather-Clock/blob/master/grandfather_clock_code/grandfather_clock_code.pde)

## Step 2: Build The Circuit Board



The circuit board for this project gets built in two steps. All of the components except for the LEDs get assembled in this step.

First, cut the header pins that will plug into the Arduino:

- 2 x 6 pins for the Analog and Power side
- 2 x 8 pins for the Digital side

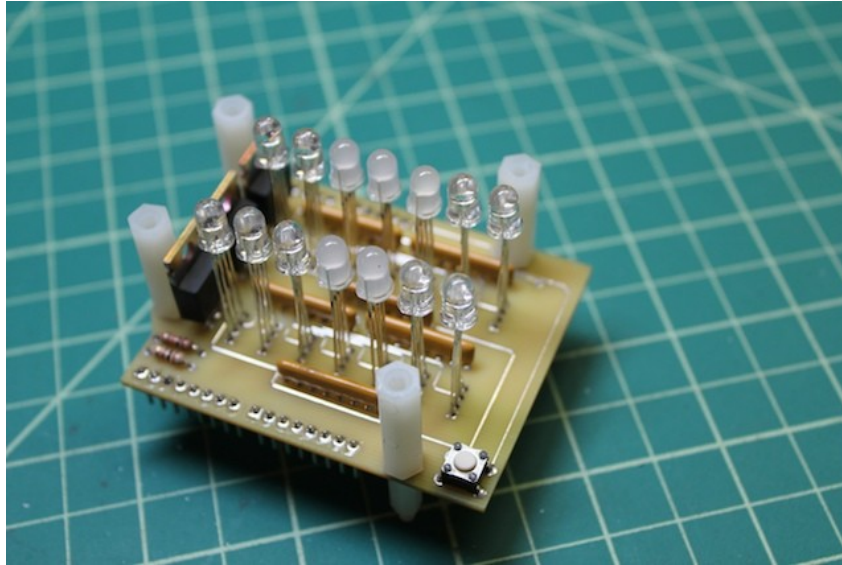
Next, press the long ends of the header pins into the female headers on the Arduino board. Two pins on each side of the Arduino's headers closest to the power jack and the USB jack will remain empty. Place the empty circuit board onto the protruding short end of the header pins. Verify that the mounting holes are properly aligned and solder all of the pins in place from the top of the board.

Remove the Arduino from the circuit board and place it aside after these pins are soldered in place.

Then install the remainder of the components – except for the LEDs – as per the `led_grandfather_clock_shield.bmp` drawing in the `./PCB` directory and the circuit board BOM in the `./parts` directory of the download. Your circuit board will look slightly different than what is pictured above.

Be careful when handling and installing the MOSFETS, as they are sensitive to ESD – static shocks. Touch something grounded before handling them. When installing the MOSFETS in the board, press them in as far as they will go – make sure they stick out a little bit less than 3/4" above the circuit board so that they will clear the next part to be mounted above.

### Step 3: Install The LEDs



Each of the LEDs needs to align with the corresponding hole in the acrylic reflector. To ensure that, install the LEDs with the reflector temporarily in place.

Nylon standoffs get attached to the top and bottom of the circuit board. The 3/16" hex x 7/16" long nylon standoffs go on the bottom of the board – they will eventually attach to the Arduino. The threaded end should point away from the board. The 1/4" round x 3/4" long nylon standoffs go on the top of the board.

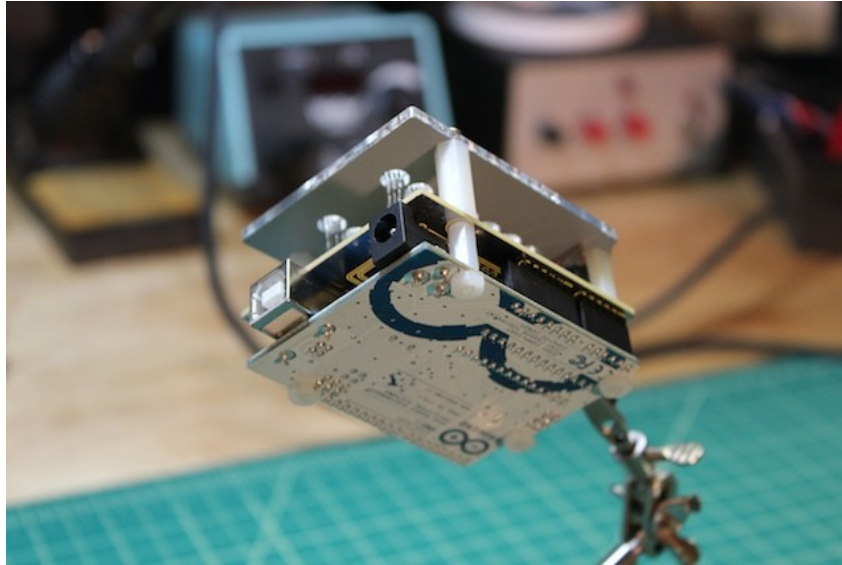
Install the 4-40 x 1/2" L stainless steel studs into one end of the 3/4" long standoffs and attach the two sets of standoffs to the board as pictured above. Your board will look slightly different than the picture. Only tighten these hand tight.

Temporarily attach the mirrored acrylic reflector onto the top of the 3/4" standoffs with the 4-40 pan head screws.

To install the LEDs, first gently spread each of the pins slightly. The holes in the PCB are on a 0.1" spacing – the same as a prototyping breadboard. Then press an LED through a hole in the reflector and line the pins up with the corresponding holes in the circuit board. The longest pin of the LED goes in the hole next to the one with the square pad. Getting all of the pins to fit will probably require prodding from tweezers or a small screwdriver. Push each LED in until the base of the LED lens is about halfway through the reflector. The reflector should hold the LEDs in place as you solder the pins.

Working one at a time, install and solder each of the LEDs in this manner. Start with the position nearest the MOSFETs.

## Step 4: Attach The Arduino



The Arduino, already programmed, is ready to go. Press the circuit board onto the Arduino ensuring that all pins line up correctly. The nylon standoffs may take a bit of wrestling – particularly the one nearest the USB jack. Rotate that standoff so that a flat is aligned with the plastic header next to it.

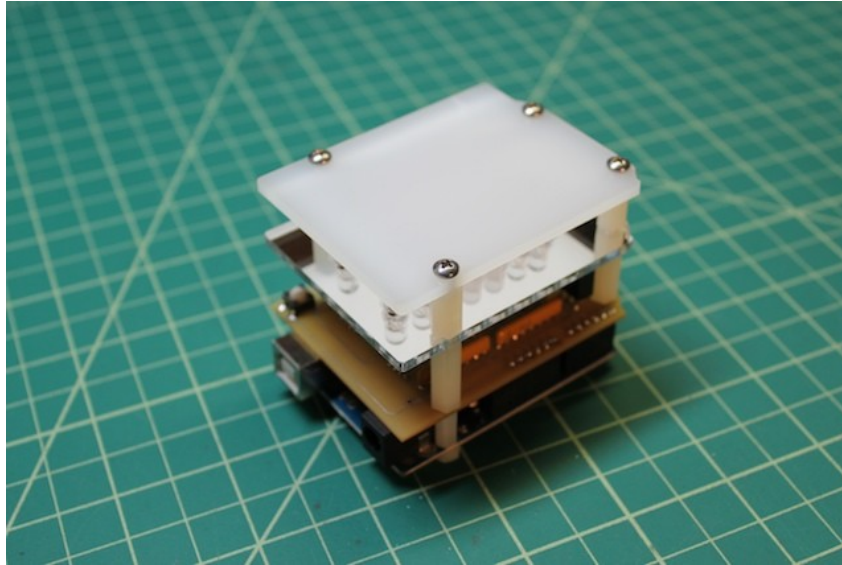
Once the Arduino and the circuit board are mated, spin the nylon nuts onto the bottom of the standoffs. Only tighten them hand tight.

At this point, we can power up and test the circuit. First, install the K size plug onto the 9V power supply so that the tip is positive. Then power up the Arduino. If you don't see light at first, try pressing the reset button.

If you still don't see light, double check that the Arduino was successfully programmed and double check your wiring.



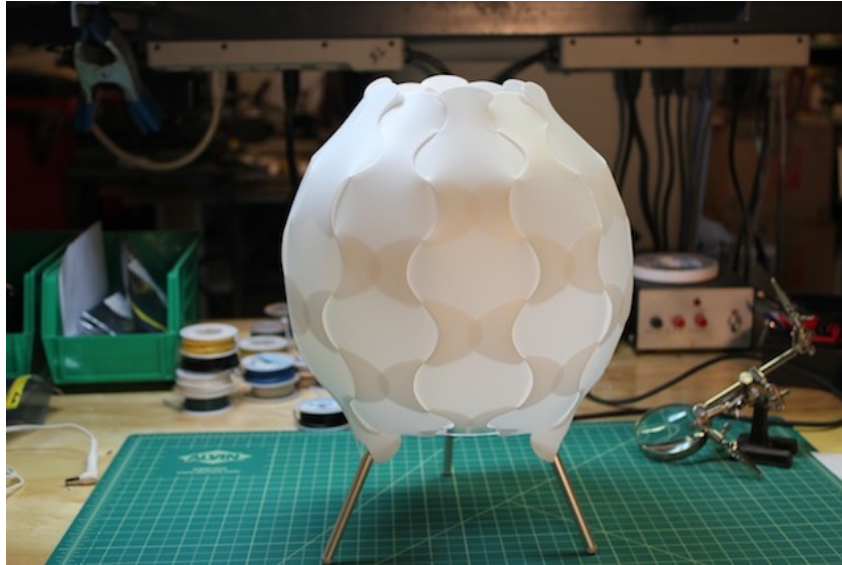
## Step 5: Install The Reflector and Diffuser



The acrylic reflector and diffusion elements help the LEDs to be a lot more effective. These parts can both be sourced from Pololu.com's laser cutting service. Order using the `led_grandfather_clock_laser_template.dxf` file in the `./mechanical` directory.

To install these parts, first remove the pan head screws holding the reflector in place. Replace them with another set of 4-40 x 1/2" studs. Screw another set of 3/4" nylon spacers onto those studs, again tightening only hand tight. Place the translucent white plastic diffusion element on top of those standoffs and attach it with the pan head screws that were holding the reflector in place.

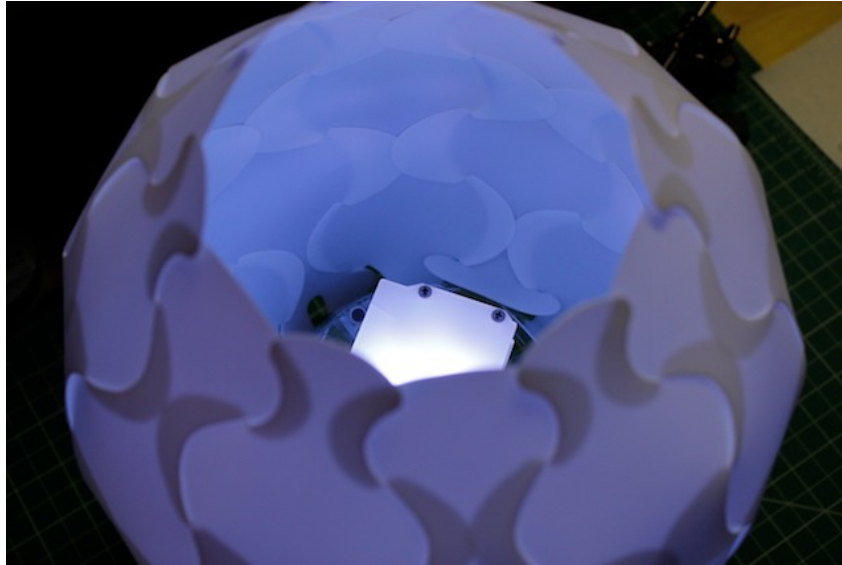
## Step 6: Build The Lamp



Follow the Swedish pictograms to assemble the Ilean lamp.



## Step 7: Put It All Together



At this point, the lamp is assembled and the circuit is built. Route the power cord up through the base of the lamp, plug it into the circuit, and drop it into place.

When daylight savings comes around, just turn off the power, pull out the circuit, and reprogram the Arduino. The time on the clock will automatically be updated to the time on your computer.

The circuit will keep time even when it is not plugged in. The coin cell battery will keep the clock going for about 10 years without external power.

Check for the latest version of this document at:  
<https://github.com/vinmarshall/Radio-Shack-LED-Grandfather-Clock>

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