“Distraction Destroyer” Pomodoro Timer 03 Developer Guide

System overview:

The goal of the project was to create a timer with the ability to sense an object placed on top of it, such as a smartphone, to act as a tool for distraction free work using the Pomodoro method. The timer is fully enclosed up to IP43, making it safe for use even around possible splashes and spills. Additionally, the timer is robust against shaking and bouncing, such as it may experience while being moved in everyday use. The timer utilizes I2C communication to control the display, allowing a smaller microcontroller to be used. The smartphone or other distraction object to be kept is detected using a photoresistor, where low light is interpreted as the object being present, and higher light levels are interpreted as no object being present. The timer also features a dimmable display.

Electrical specifications:

Property	Value
Maximum Supply Voltage	5.25V
Minimum Supply Voltage	4.75V
Maximum Supply Current	500mA
Nominal Supply Current	200mA
Operating Temperature	-40C to 50C

User guide:

Setup:

When starting up the timer from an off state, do the following steps first:

1. Remove the back of the timer, using a ¼” square screwdriver to loosen the screws.
2. Plug the blue usb cable into the battery. See figure x for location.
3. Replace the back of the timer.

Operation:

If the timer is not yet turned on (the display has no lights on), follow the instructions under “Setup”. If the timer still does not turn on, follow the instructions under “Charging”. Then, use the following instructions to use the Pomodoro Timer:

1. Select the desired length of time using the switch to the left of the display. Available options are 5 minutes and 25 minutes, per the pomodoro study method.
2. If desired, adjust the display brightness using the knob on the lower right.
3. Place your distraction object on top of the timer, being sure that it completely covers the photosensor. It is suggested to place your smartphone face down here to minimize distraction.
4. Press the red button to start the timer. Remember that if the distraction object is removed before the time is up, the alarm will go off.
5. When the alarm goes off, if using the timer again return to step 1 of operation. If stopping use for an extended period, continue to step 6.

6. Remove the back of the timer using a ¼” square screwdriver to loosen the screws.
7. Unplug the blue usb cable from the battery, if it is connected. See figure x for location.
8. Replace the back of the timer.

Charging:

Occasionally, the timer will require that the internal battery be charged. To charge the timer’s battery, follow these steps:

1. Remove the back of the timer using a ¼” square screwdriver to loosen the screws.
2. Unplug the blue usb cable from the battery, if it is connected. See figure x for location
3. Plug a micro USB cable into the battery, plug the other end into a power source.
4. Allow at least 3 hours to charge.
5. Remove the micro USB cable.
6. Replace the back of the timer if not using it immediately.
7. If using immediately, begin setup at step 2.

Design artifact figures:

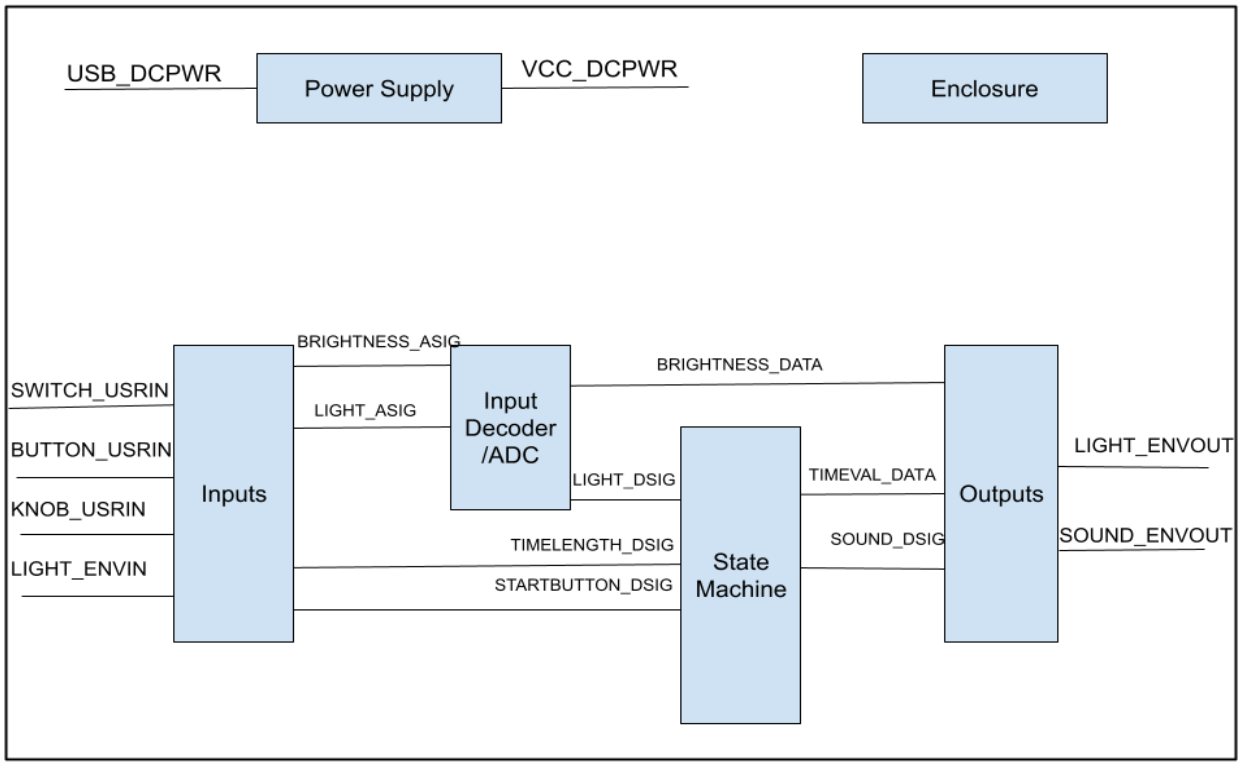

Figure 1

Figure 1 shows the block diagram of the timer system. The diagram is organized using functional decomposition, meaning each block has one cohesive purpose. The Input Decoder/ADC and the State Machine are both within the Arduino Nano microcontroller. The outputs include the speaker and the current limiting resistor that is in series with it, as well as the seven segment LEDs and the I2C backpack they are connected to. The power supply consists of a battery pack and its connection to the Arduino Nano. The inputs use two variable resistances (photoresistor, potentiometer) and two types of switches (pushbutton, toggle switch) to generate analog signals that the Nano’s input pins can read.

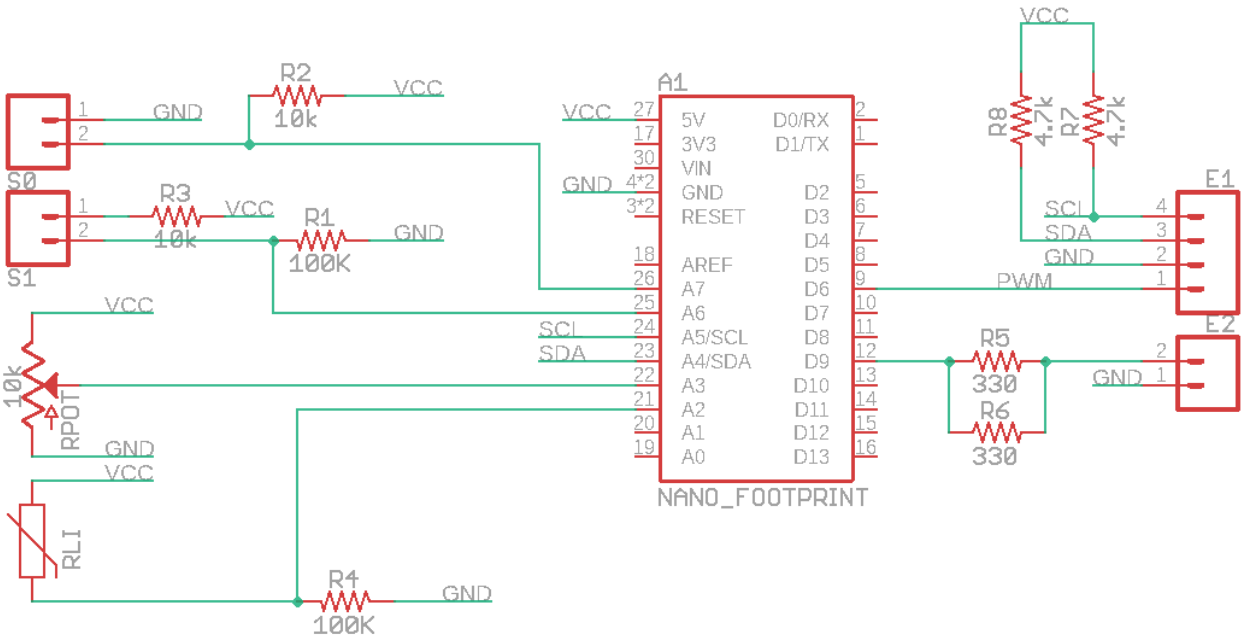

Figure 2

Figure 2 shows the timer's complete electrical schematic. The four inputs discussed on the previous page are shown on the left, and the two outputs are shown on the right. A parts list detailing all of the components shown above can be found in Table 1 at the end of this document.

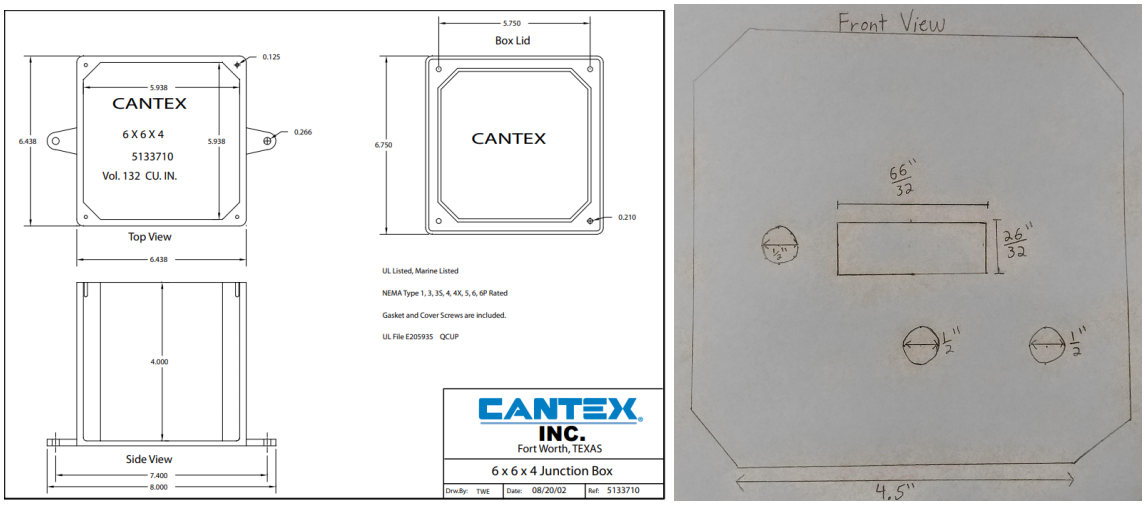

Figure 3

Figure 3 shows the mechanical drawings of the enclosure used for the timer. A 6x6x4" junction box was used, with holes made in it to allow the inputs and outputs to pass through. The front of the timer features 4 different modifications, and corresponds to the bottom of the original junction box. The side of the junction box that sits on the left when the timer is viewed from the front has the speaker and speaker shroud. The side of the junction box that sits on the top when the timer is viewed from the front has the photoresistor.

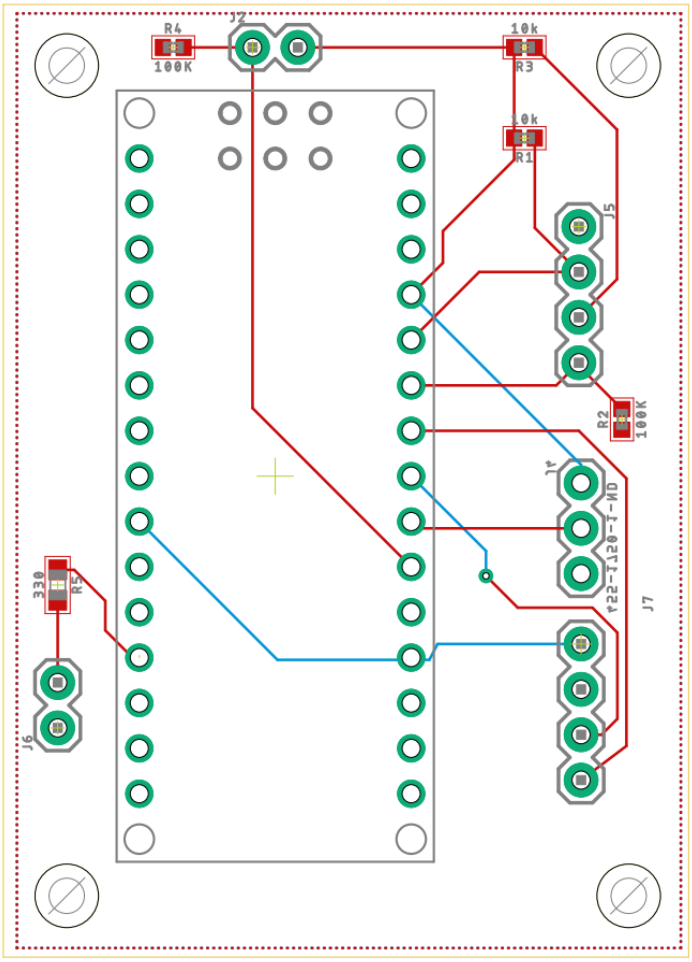

Figure 4

Figure 4 shows the layout of the custom printed circuit board that was designed and manufactured for this project. This minimizes the volume of wires needed in the timer, making it both neater and smaller. Because each input and output device connects individually to the board, each can be disconnected or replaced individually with no soldering required, with the exception of the photoresistor which is mounted on the board as a through hole component. The PCB has two layers, both of which are used as ground planes. Traces in the top layer are shown in red, while traces in the bottom layer are shown in blue.

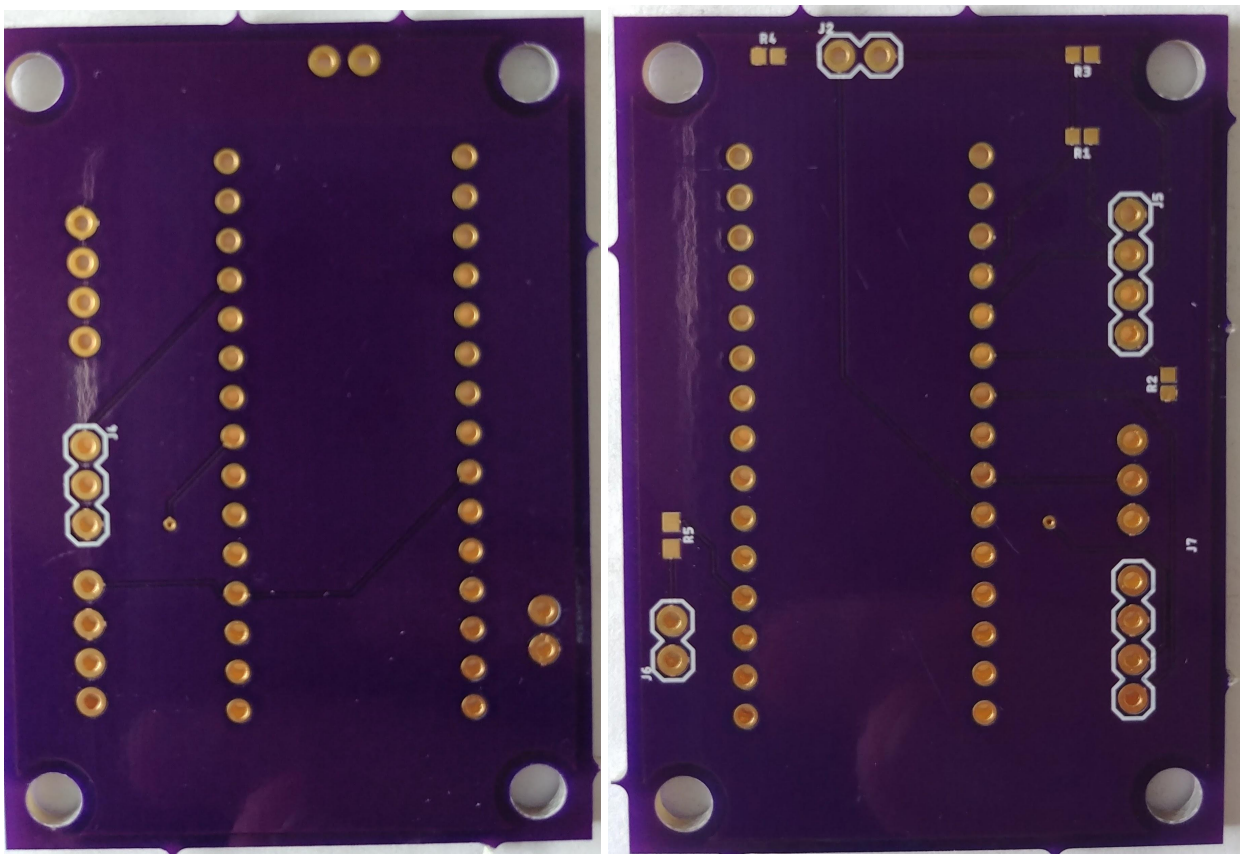

Figure 5

Figure 5 shows photos of the custom printed circuit board that was manufactured for this project, prior to soldering any other parts onto it. The PCB has a hole near each corner to assist in mounting it securely in the enclosure. The dimensions of the PCB are 1.5” by 2.1”. Its small size makes it cost effective to have manufactured, and allows it to be easy to place inside of the enclosure.

Part information:

Name	Type	Value	Quantity
R1, R4	Resistor	100k	2
R2, R3	Resistor	10k	2
R5, R6	Resistor	330	2
R7, R8	Resistor	4.7k	2
RPOT	Potentiometer	10k	1
RLI	Photoresistor		1
S0	Toggle Switch		1
S1	Button		1
A1	Microcontroller		1
USB to USB mini cable	bus		1
5V rechargeable battery pack	battery		1
E1	7-segment LED w/ I2C backpack		1
Custom Project Board	Board		1
Soldering Protoboard	Board		1
E2	Speaker	0.5W	1
Junction Box	Enclosure	NEMA 4X	1
Speaker Trim	Enclosure		1
Speaker Shroud	Enclosure		1
Display Trim	Enclosure		1

Table 1