Square NeoPixel Display with Black LED Acrylic

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https://learn.adafruit.com/square-neopixel-display-with-black-led-acrylic

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Overview

NeoMatrix Square Pixels
Build a square pixel display with Adafruit's 8x8 NeoMatrix and Feather M4. Use Black LED acrylic and 3D printed grid to create an evenly diffused LED effect. Electronics are housed in an elegant looking snap fit case with built-in on/off switch. LED animations are easily customizable with CircuitPython.

Parts

Adafruit Feather M4 Express - Featuring ATSAMD51
It's what you've been waiting for, the Feather M4 Express featuring ATSAMD51. This Feather is fast like a swift, smart like an owl, strong like a ox-bird (it's half ox,...
https://www.adafruit.com/product/3857

Black LED Diffusion Acrylic Panel 12" x 12" - 0.1" / 2.6mm thick
A nice whoppin' slab of some lovely black acrylic to add some extra diffusion to your LED Matrix project. This material is 2.6mm (0.1") thick and is made of special cast...
https://www.adafruit.com/product/4594
Adafruit NeoPixel NeoMatrix 8x8 - 64 RGB LED Pixel Matrix
Put on your sunglasses before wiring up this LED matrix - 64 eye-blistering RGB LEDs adorn the NeoMatrix for a blast of configurable color. Arranged in an 8x8 matrix, each pixel is...
https://www.adafruit.com/product/1487

FeatherWing Proto - Prototyping Add-on For All Feather Boards
A Feather board without ambition is a Feather board without FeatherWings! This is the FeatherWing Proto - a prototyping add-on for all Feather boards. Using our...
https://www.adafruit.com/product/2884

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<tr>
<th>Item</th>
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<td>12-pin and 16-pin Female Headers</td>
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<td>1 x 10-Wire Ribbon Cable</td>
<td>28AWG Silicone Cover Stranded Core</td>
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<tr>
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<tr>
<td>1 x M2.5 Hardware Kit</td>
<td>Black Nylon Screw and Stand-off Set</td>
<td><a href="https://www.adafruit.com/product/3299">https://www.adafruit.com/product/3299</a></td>
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1 x **USB Cable**

Fully Reversible Pink/Purple USB A to micro B Cable - 1m

https://www.adafruit.com/product/4111

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**Circuit Diagram**

The diagram below provides a visual reference for wiring of the components. This diagram was created using the software package [Fritzing](https://www.fritzing.org/).

**Adafruit Library for Fritzing**

Use Adafruit's Fritzing parts library to create circuit diagrams for your projects. Download the library or just grab individual parts. Get the library and parts from [GitHub - Adafruit Fritzing Parts](https://github.com/adafruit/Fritzing-Parts).
Wired Connections

The Feather M4 Express is installed on top of the Proto FeatherWing using Headers. The NeoMatrix is wired to the Proto FeatherWing so that the Feather can be easily swapped.

- 5V from NeoMatrix to 3V on Proto FeatherWing
- GND from NeoMatrix to GND on Proto FeatherWing
- DIN from NeoMatrix to Pin #6 on Proto FeatherWing
- Switch to EN and GND on Proto FeatherWing

Powering

The Adafruit board can be powered via USB or JST using a 3.7v lipo battery. In this project, a 1200mAh lipo battery is used. The lipo battery is rechargeable via the USB port on the board. The switch is wired to the enable and ground pins on the board.
3D Printing

Parts List
STL files for 3D printing are oriented to print "as-is" on FDM style machines. Parts are designed to 3D print without any support material. Original design source may be downloaded using the links below.

File names
- cover.stl
- pcb-mount.stl
- neomatrix-grid.stl
- acrylic.stl

Fusion 3D Share Link
Download CAD files from Prusa Printers
Download CAD files from Thingiverse

CAD assembly
The Proto FeatherWing is secured to the pcb-mount with M2.5 hardware screws (standoffs are optional). The Feather M4 snaps into the female headers on the Proto FeatherWing. The NeoMatrix is fitted into the built-in standoffs in the pcb-mount. The neomatrix-grid is fitted over the NeoMatrix PCB. The piece of acrylic is placed inside the cover. The cover is fitted over the neomatrix-grid and snap fits onto the edges of the pcb-mount.
Slicing Parts
No supports are required. Slice with setting for PLA material.

The parts were sliced using CURA using the slice settings below.

- PLA filament 220c extruder
- 0.2 layer height
- 10% gyroid infill
- 60mm/s print speed
- 60c heated bed

Design Source Files
The project assembly was designed in Fusion 360. This can be downloaded in different formats like STEP, STL and more. Electronic components like Adafruit’s board, displays, connectors and more can be downloaded from the Adafruit CAD parts GitHub Repo.

CircuitPython on Feather M4 Express

CircuitPython is a derivative of MicroPython designed to simplify experimentation and education on low-cost microcontrollers. It makes it easier than ever to get prototyping by requiring no upfront desktop software downloads. Simply copy and edit files on the CIRCUITPY drive to iterate.

The following instructions will show you how to install CircuitPython. If you’ve already installed CircuitPython but are looking to update it or reinstall it, the same steps work for that as well!

Set up CircuitPython Quick Start!

Follow this quick step-by-step for super-fast Python power :)
Download the latest version of CircuitPython for this board via CircuitPython.org

Click the link above and download the latest UF2 file.

Download and save it to your desktop (or wherever is handy).

Plug your Feather M4 into your computer using a known-good USB cable.

A lot of people end up using charge-only USB cables and it is very frustrating! So make sure you have a USB cable you know is good for data sync.

Double-click the Reset button next to the USB connector on your board, and you will see the NeoPixel RGB LED turn green. If it turns red, check the USB cable, try another USB port, etc. Note: The little red LED next to the USB connector will pulse red. That's ok!

If double-clicking doesn't work the first time, try again. Sometimes it can take a few tries to get the rhythm right!
You will see a new disk drive appear called FEATHERBOOT.

Drag the adafruit_circuitpython_etc.uf2 file to FEATHERBOOT.

The LED will flash. Then, the FEATHERBOOT drive will disappear and a new disk drive called CIRCUITPY will appear.

That's it, you're done! :)

Further Information

For more detailed info on installing CircuitPython, check out Installing CircuitPython().
This project uses the LED animation rainbow example code from the CircuitPython LED Animation guide. The code is modified slightly to accommodate the additional pixels used in the sign.

The Mu Python Editor
Mu is a simple Python editor that works with Adafruit CircuitPython hardware. It's written in Python and works on Windows, MacOS, Linux and Raspberry Pi. The serial console is built right in, so you get immediate feedback from your board's serial output! While you can use any text editor with your code, Mu makes it super simple. Instructions for Mu are available here.

Installing or upgrading CircuitPython
You should ensure you have CircuitPython 5.0 or greater on your board. Plug your board in with a known good data + power cable (not the cheesy USB cable that comes with USB power packs, they are power only). You should see a new flash drive pop up.

If the drive is CIRCUITPY, then open the boot_out.txt file to ensure the version number is 5.0 or greater.
Installing Project Files

To use with CircuitPython, you need to first install a few libraries, into the lib folder on your CIRCUITPY drive. Then you need to update code.py with the example script.

Thankfully, we can do this in one go. In the example below, click the Download Project Bundle button below to download the necessary libraries and the code.py file in a zip file. Extract the contents of the zip file, open the directory examples/ and then click on the directory that matches the version of CircuitPython you're using and copy the contents of that directory to your CIRCUITPY drive.

Your CIRCUITPY drive should now look similar to the following image:

```
# SPDX-FileCopyrightText: 2021 Kattni Rembor for Adafruit Industries
# SPDX-License-Identifier: MIT

This example shows usage of the PixelMap helper to easily treat a single strip as a horizontal or vertical grid for animation purposes.

For NeoPixel FeatherWing. Update pixel_pin and pixel_num to match your wiring if using a different form of NeoPixels. Note that if you are using a number of pixels other than 32, you will need to alter the PixelMap values as well for this example to work.

This example does not work on SAMD21 (M0) boards.

```
pixels = neopixel.NeoPixel(pixel_pin, pixel_num, brightness=0.5, auto_write=False)
pixel_wing_vertical = helper.PixelMap.vertical_lines(  
    pixels, 8, 4, helper.horizontal_strip_gridmap(8, alternating=False)  
)
pixel_wing_horizontal = helper.PixelMap.horizontal_lines(  
    pixels, 8, 4, helper.horizontal_strip_gridmap(8, alternating=False)  
)
comet_h = Comet(  
    pixel_wing_horizontal, speed=0.1, color=PURPLE, tail_length=3, bounce=True  
)
comet_v = Comet(pixel_wing_vertical, speed=0.1, color=AMBER, tail_length=6,  
    bounce=True)  
chase_h = Chase(pixel_wing_horizontal, speed=0.1, size=3, spacing=6, color=JADE)  
rainbow_chase_v = RainbowChase(  
    pixel_wing_vertical, speed=0.1, size=3, spacing=2, step=8  
)
rainbow_comet_v = RainbowComet(  
    pixel_wing_vertical, speed=0.1, tail_length=7, bounce=True  
)
rainbow_v = Rainbow(pixel_wing_vertical, speed=0.1, period=2)  
rainbow_chase_h = RainbowChase(pixel_wing_horizontal, speed=0.1, size=3, spacing=3)

animations = AnimationSequence(  
    rainbow_v,  
    comet_h,  
    rainbow_comet_v,  
    chase_h,  
    rainbow_chase_v,  
    comet_v,  
    rainbow_chase_h,  
    advance_interval=5,  
)

while True:  
    animations.animate()
Upload Code

Ensure the file is named code.py and drop it onto the CIRCUITPY drive main (root) directory that appears when your Feather is plugged into your computer via a known good USB data cable. The code will run properly when all of the files have been uploaded including libraries.

Customizing LED Animations

Take a moment to walk through the LED animation library for CircuitPython learn guide. The guide covers the how to create animations with horizontal and vertical grids.

Learn Guide: CircuitPython LED Animations – Pixel Mapping
Acrylic Cutting

Acrylic Template
A piece of stock can be from the 12 x 12in sheet can using a table saw or a scoring tool (plastic cutting knife). Our stock was cut to 114x114m to accommodate the size of the Bantamtools CNC spoilboard. Use the SVG file to CNC mill or laser cut the piece. Optionally print the template for reference.

Download Acrylic Template PDF
Download Acrylic Outline SVG file

Desktop CNC
Cutting the Black LED acrylic was done using the Bantam Tools Desktop CNC (). This guide covers using Fusion 360 and bantam tools software to cut the acrylic.

Tool Library
Download the tool library from the Bantam Tools website to use in Fusion 360. Install the library by using the Tool Library in the manufacture workspace. Select Local in the side bar and click the Import libraries icon. Navigate and choose the bantam tools Fusion 360 tool library. Use the 1/8in flat end mill to cut the piece of acrylic.

Fusion 360 Tool Library – Bantam Tools CNC
2D Contour
In Fusion 360 manufacture workspace, create a New Setup and set stock mode as relative size box. Add a 2mm to the stock side offset. Use the 2D contour operation to cut the shape out the material. Under the Tool tab, select the 1/8in flat end mill from the imported tools under Local library. Under the geometry tab, in the contour selection area, click on the lower edge of the model. Under the Passes tab, enable Multiple Depths and add 0.1mm to Maximum Roughing. Use the recommended settings () for cutting acrylic with a 1/8in flat end mill. Right click on the setup in the browser select post process. Use the othermill as the processor and name your gcode file accordingly.

Tool: 1/8" flat end mill
Feed rate: 59 in/min (1500 mm/min)
Plunge rate: 1.81 in/min (46 mm/min)
Spindle speed: 16,400 RPM
Max pass depth: 0.005" (0.13 mm)

Download GCode file
Otherplan
Use the open files button and navigate to the exported gcode file from Fusion 360. Set the material to Generic using the dropdown. Enter the dimensions of your stock acrylic in the material size dropdown. Set the X and Y to 0mm and add a 0.2mm to the Z to accommodate for the double-sided tape used to secure the stock to the spoil board. Offset the placement of the gcode file by 2mm in the X and Y. Set the Z to 0.2mm for stock to leave behind. Select the 1/8in flat end mill. Click start milling button when the stock is secured and the 1/8in end mill is installed and probed.

Wiring

Feather Headers
The Proto FeatherWing is setup with 12-pin and 16-pin female headers. The Feather M4 Express will have a male strip of headers, 12-pin and 16-pin respectively.

Wiring Switch
The slide switch is wired up to a piece of ribbon cable with two connections going to the middle pin and either side. The wire was peeled off from a roll of 10-wire ribbon cable. The cable length is approximately 5cm (2in) in length.
Wiring JST Cable
A male (socket plug) 3-pin JST-PH cable is setup to connect to the Proto FeatherWing. This wire was peeled from a roll of 10-wire ribbon cable. The cable length is roughly 8cm (3in) in length.

Wiring Proto FeatherWing
The slide switch and 3-pin JST cable is soldered to the bottom of the Proto FeatherWing PCB.

Switch Wired
The slide switch is wired to the EN and GND pins on the Proto FeatherWing. The wires are soldered from the bottom of the PCB. Reference the pin labels on the top of the PCB.
3-Pin JST-PH Cable
The 3-pin JST-PH cable is wired to 3V, GND and D6 pins on the Proto FeatherWing. The wires are soldered from the bottom of the PCB. Reference the pin labels on the top of the PCB.

Wired Proto FeatherWing
Double check the wiring is correct.

Wiring NeoMatrix
A 3-pin JST (female socket) cable is wired to the 5V, GND and DIN pins on the NeoMatrix PCB. The red wire is connected to the 5V pin, black to the GND pin and white to the DIN pin on the NeoMatrix. The wires are approximately 5cm (2in) in length.
Wired NeoMatrix
Double check the wiring is correct. Pieces of heat shrink tubing can be used to keep the wires bundled together.

Test Circuit
With the code and libraries uploaded to the Feather, the circuit should power on. Install the Feather on top of the Proto Feather Wing. Plug in the battery to the Feather. Connect the two JST cables together. Use the slide switch to power the circuit on.

Assembly

Hardware for Proto FeatherWing
The Proto FeatherWing is secured to the PCB mount using screws and hex nuts. Use the following hardware.

4x M2.5 x 8mm screws
4x M2.5 hex nuts
Install FeatherWing
Place the FeatherWing over the four tabs with the mounting holes lined up. Reference the photo for correct placement. While holding in place, insert M2.5 x 8mm screws into mounting holes on the FeatherWing PCB.

Secure FeatherWing PCB
Install and fasten the M2.5 hex nuts to threads of the screws to secure the FeatherWing to the PCB mount. The FeatherWing was mounted with the USB port close to the edge. Double check the placement of the PCB with the Feather M4 installed on top of the Proto FeatherWing.
Standoffs (Optional for Battery Power)
For battery power, standoffs will provide clearance for fitting a battery in between the Proto FeatherWing and NeoMatrix PCB. Use eight M.25 x 6mm long screws and 10mm tall M2.5 standoffs to secure the FeatherWing to the mounting tabs on the case.
Install Switch
The slide switch is inserted at an angle into the built in holder. The actuator pokes through the little hole on the side of the mount. The body of the slide switch will stay in place when the NeoMatrix PCB installed. It essentially holds the switch in place preventing it from coming out the top.
Install NeoMatrix

The NeoMatrix PCB is fitted into the pcb mount with the mounting holes lined up with the built-in standoffs. Orient the PCB so the mounting holes are lined up. Reference the photos for correct placement. Place the NeoMatrix PCB over the standoffs and press down so the pegs are fitted into the mounting holes.

Installed NeoMatrix

The built-in standoffs provide approximately 4mm of clearance. This in turn makes the PCB mount thick (11.5mm) but overall a design decision that accommodates for wiring and connectors.
Install Grid
The grid is designed to fit over the NeoMatrix PCB. The walls in the grid feature cut outs specifically sized for the on-board 0805 capacitors on the NeoMatrix PCB. Orient the grid so the cutouts are lined up with the caps on the PCB. Place the grid over the PCB and press the grid into the PCB mount.

Install Acrylic
The piece of acrylic is press fitted into the cover with the matte side facing down and the glossy side facing up. The lip around the bottom surface keeps the acrylic from falling out.
Install Cover
The cover fits over the grid and PCB mount. Orient the cover so the cutout is lined up with the switch on the PCB mount. Snap fits on the edges grasp onto the nubs on the side of the PCB mount.

Connect NeoMatrix to FeatherWing
Connect the JST cable from the NeoMatrix and Proto FeatherWing together.

USB Power
Connect a USB cable to the USB port on the Feather. Use a computer's USB port or USB 5V wall adapter to power the Feather. Optionally use a battery.
Final Build
And there you have it! Enjoy your new square pixel display and create something awesome with it!