PAINTING WITH LIGHT

by
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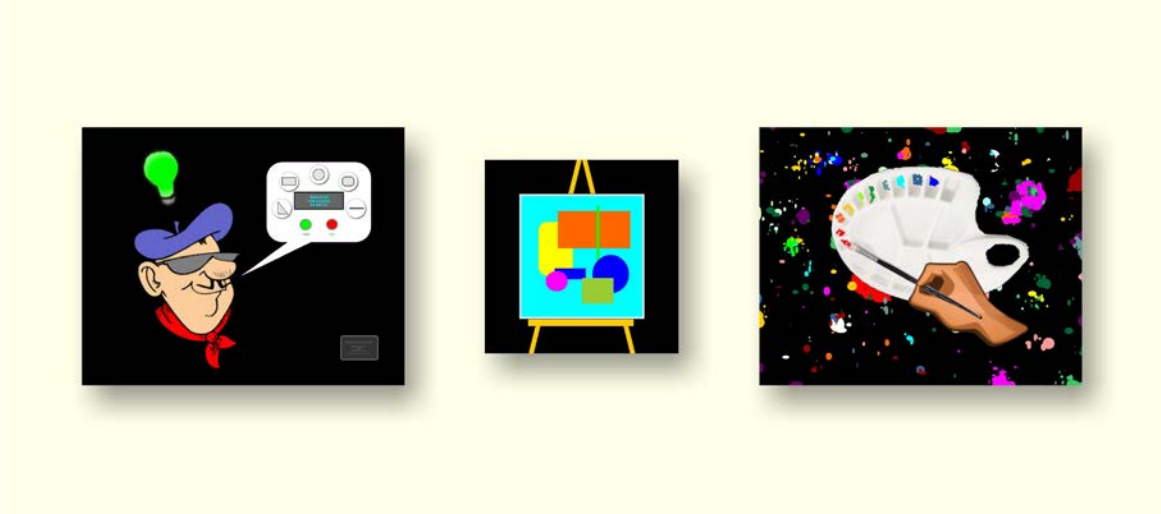
Concept

This is an automated art project that involves the viewer in selecting colors and shapes for a painting, sorts the selected colors on a painter's palette, and, lastly produces a painting on a 32 x 32 color LED matrix. It does, in reality, create a painting with light. The viewer makes the decisions on colors and shapes in a dialog with the artist via a control panel with a LCD display and various push buttons. The artist then sorts the "paint" colors in order on his color LED lit palette with his hand rotating a paintbrush. Finally, the artist produces a painting on a large LED matrix using the colors and shapes the viewer selected. He uses his Arduino "brain" to choose the size and placement of the selected shapes and whether they are drawn as an outline or filled with the color

Our project was constructed on two 16 x 20 inch artist's canvases and a 12 x 12 inch canvas painted black. Many other materials and dimensions might be used. Each canvas contains hidden electronics driven by Arduino Uno's and Mega's which communicate wirelessly. The "artist" panel generates RGB color values and shapes and transmits them to the "palette" panel. After the colors are sorted on the palette, the "painting" panel displays a cubist style artwork that is the combined result of the viewer's choices and program logic that injects randomness. No two paintings are ever likely to be the same, even if the viewer makes the same choices. We chose to display the painting for one minute and then wait for a viewer to start another one.

CAUTION: This is a complex and ambitious project. Both of the authors have years of experience in both electronics and programming, yet we encountered many technical problems and construction issues. The day our project was to make its debut, we inadvertently plugged the LED matrix to a power source with the wrong voltage and "fried" it. You MUST develop a very detailed set of plans and think through all the construction steps before beginning, and you are still likely to encounter problems. We strongly urge you to first make a prototype using easily modified cheap materials before embarking on construction of your final version.

A video of the project may be viewed HERE.



Parts needed

2 – Arduino Mega's
1 – Arduino Uno
3 - NRF24L01 RF modules (available from China)
3 - 10 µf capacitor
3 – 1000 mfd electrolytic capacitors to smooth Neopixel and LED voltages
1 - Servo (>90 degree turning radius)
3 - AA battery holders with appropriate connectors to power the Arduinos
NOTE: Other power sources may be substituted
3 – Regulated 5V power sources to power the Neopixels and the LED matrix separate from the Arduino power sources. The LED matrix can draw up to 2 amps.
1 - 16" x 20" Black Canvas
1 – 12" x 12" Black Canvas
1 - RGB LED
3 - 330 ohm resistors (for RGB Led)
2 – 470 ohm resistors (for Neopixel data line spike suppression)
1 - Adafruit Neopixel Jewel
1 – Adafruit 12 Neopixel Ring
1 – Adafruit 5 x 8 Neopixel Matrix for a rainbow backlit nameplate (optional)
1 - Adafruit NeoPixel Rainbow Strip, WS2812B
1 = Adafruit 32x32 RGB LED Matrix Panel - 6mm pitch
6 – 16 mm momentary pushbuttons (black)
1 – 16 mm momentary pushbutton (green)
1 – 16 mm momentary pushbuttons (red)
1 – 8 ohm speaker or piezo buzzer
1 - Painters plastic 12 well painter's palette

Paint Brushes, Acrylic paint, Hot Glue, Acrylic cement, Clear silicone cement

Male to Male wires, Male to Female wires

1 - Sheet black 0.118” acrylic plastic (large enough for laser cutting your black parts

1 - Sheet white 0.118” acrylic plastic (large enough for laser cutting your white parts

1 - Sheet clear 0.118” acrylic plastic (large enough for laser cutting your clear parts

Graphic printouts on full sheet Avery labels:

- 1 – Artist’s head
- 1 – Light bulb screw base
- 1 - Right hand

Thin white cloth and basswood strips if you choose to make a “canvas on easel” cover for the 7.5” x 7.5” LED matrix

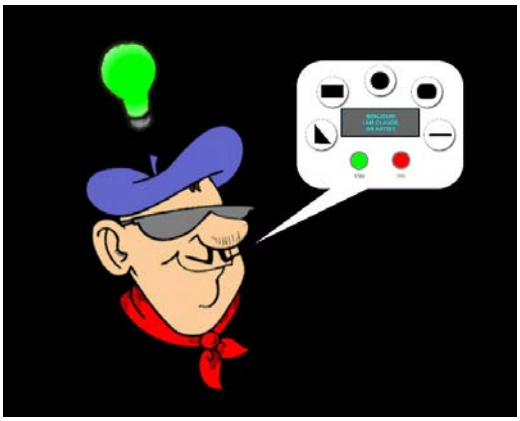
3/16" drill bit and drill, duct tape some, electrical tape

1 - Piece of wood around 3" x 4" x 1"

Construction

The Artist – Color and Shape Generator

The “artist” panel includes:



- a graphic representation of the artist’s head mounted on laser cut clear acrylic
- An interactive dialog control panel made from white acrylic shaped like a cartoon speech bubble. It contains an RGB backlit character LCD display, yes and no buttons and “shape” buttons.
- A light bulb constructed of 5 layers of laminated white acrylic as follows:
    - A back piece with holes for Neopixel wires to be glued to the color selection pushbuttons
    - 3 pieces with a large hole in them to accommodate the Neopixel jewel and ring
    - A top piece light will show through with a screw base graphic at the bottom

1. Stick all the graphics on the appropriate plastic parts and laminate the light bulb and shape button parts with acrylic cement (do not glue the top plate on the light bulb until the Neopixels have been installed ant tested).
2. Glue the artist’s head to the canvas.
3. Assemble the control panel as follows:
    a. Position the white speech bubble acrylic on the canvas and carefully cut out the canvas for two pushbuttons.
    b. Install the two buttons, placing a matching reinforcing plate over them on the back side of the canvas before installing the nuts
    c. Cur out the canvas in the holes for the remaining control buttons and install them.
    d. Cut out a hole for a prewired color LCD and glue it to the back reinforcing plate.
    e. Glue the laminated shapes to the buttons with a small amount of acrylic cement.
4. Install the light bulb.
    a. Glue a prewired Neopixel jewel and ring inside the light bulb. Route the wires through the holes in the back.
    b. Locate the position for the light bulb pushbutton and cutout a hole for it using a circular backing plate as a template.

c. Cut a small hole for the Neopixel wires and route them through that hole.
d. Mount the button using circular reinforcing plates and glue the bulb assembly to it with a small amount of acrylic cement.

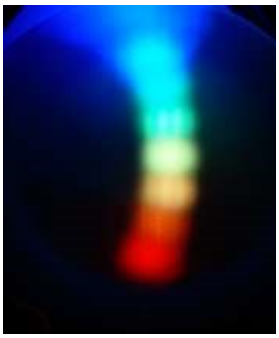
5. Attach an Arduino Mega, a large breadboard, a 5v Neopixel power source, a power source for the Mega and a loudspeaker to the back of the canvas with glue or Velcro strips.
6. Complete all the wiring.
7. Test everything before gluing on the light bulb front and attaching an optional name plate to complete the assembly.

Pin breakdown of "artist" panel Arduino Mega:

#define LightBulbPin 21 (jewel)
#define LightBulbPin2 22 (ring)
#define LightBulbButtonPin 39
#define tonePin 6
#define YesPin 37
#define NoPin 38
#define LinePin 32
#define CirclePin 34
#define RectanglePin 35
#define RoundRectanglePin 33
#define TrianglePin 36
#define WIFI_CEPin 9
#define WIFI_CSNPin 10
#define LCD_RS 7
#define LCD_ENABLE 8
#define LCD_D0 40
#define LCD_D1 41
#define LCD_D2 42
#define LCD_D3 43
#define LCD_D4 28
#define LCD_D5 29
#define LCD_D6 30
#define LCD_D7 31
#define LCD_Red 44
#define LCD_Green 45
#define LCD_Blue 46

The Artist's Palette – Color Sorter

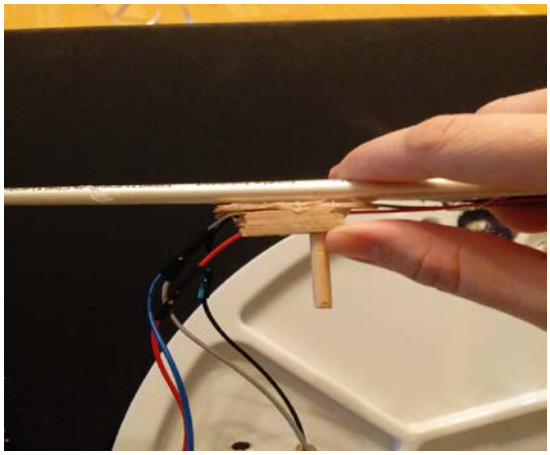
1. Drill holes in the palette paint wells.
2. Cut the Neeopixel strip to the number of LED's needed and attach long wires
3. Place each LED in the strip into new hole starting with the right most side. You will need to fold sections of the led strip flat to get all of the LED's to fit in the holes.
4. Use duct tape to tape down each led to the painter's palette.
5. Plug the led strip into the Arduino.
   Red wire goes to 5 volt. White goes to ground. Green goes to a digital output pin (2). Send colors to the LEDs 1 - 12. Place paper plate on top of LED's. Since the LED's are lit, you can see the outline that you need to cut.



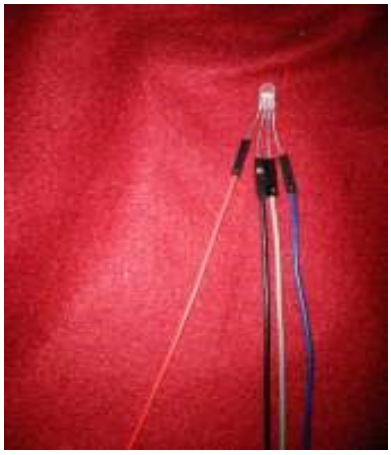
6. Place globs of clear silicone adhesive over the Neopixels in the palette wells to represent paint.

7. Using the paint brush, find a pivot point on the painters pallet where the middle of the paint brush can remain in place but the tip of the paint brush will be centered over the LEDs when rotating over them.

8. Mount the servo to a reinforcing brace behind the canvas with the shaft and dowel extension protruding through the front.



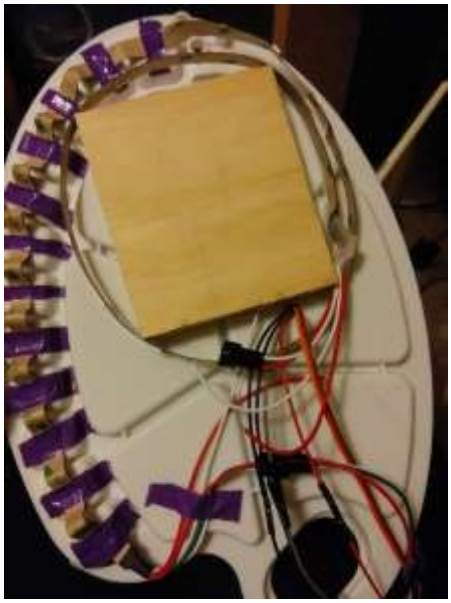
9. Attach the brush and to the dowel and route the wires around it so they won't bind when the servo rotates.

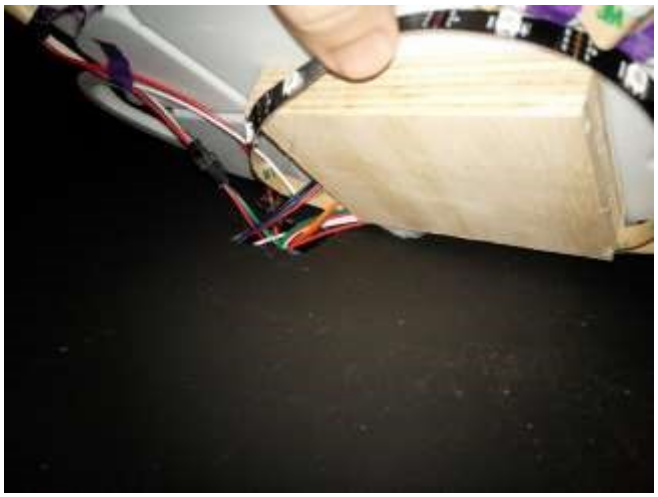


10. Carefully bend the acrylic hand part at the point where the hole for the paintbrush is located so that the fingers are bent slightly down where they join the hand. This will allow it to cover the servo shaft and wiring and can be accomplished by heating the plastic with a curling iron covered with a damp cloth.
11. Attach the hand graphic label to the hand.
12. Place hand on brush so that it is holding the brush and attach it to the brush with glue.

13. At this point, you should test your code to ensure that the servo, RGB led, and led strip are working properly.

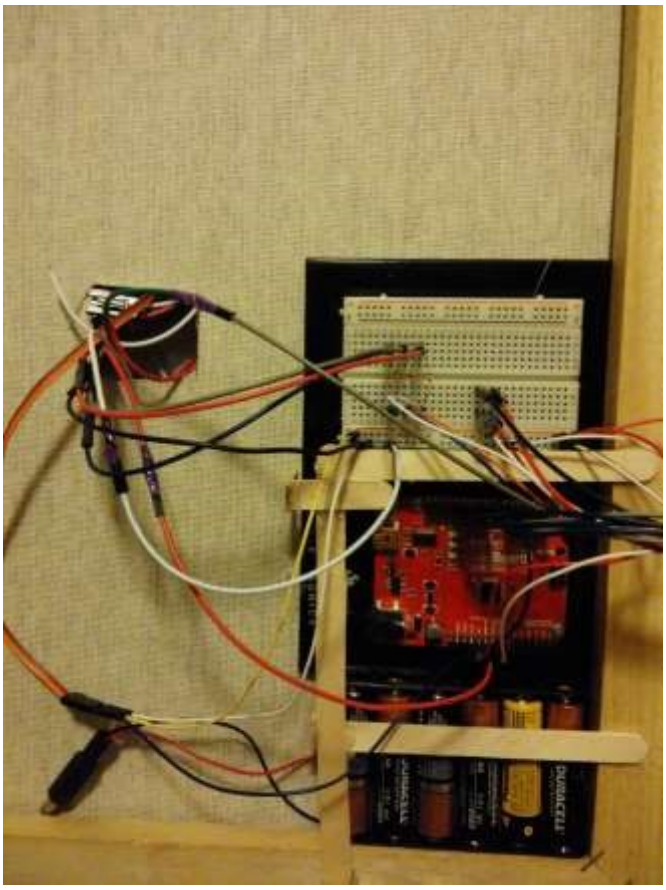
14. Take your canvas and determine how you want the painter's palette to be positioned on the board. Cut a small 1" x 1" hole in the canvas in the middle of where you want the painter's palette to be positioned.





15. Hot glue a standoff board to the palette and glue it to the canvas.

16. Using Popsicle sticks, hot glue a structure to hold the Arduino board and battery holder to the canvas.



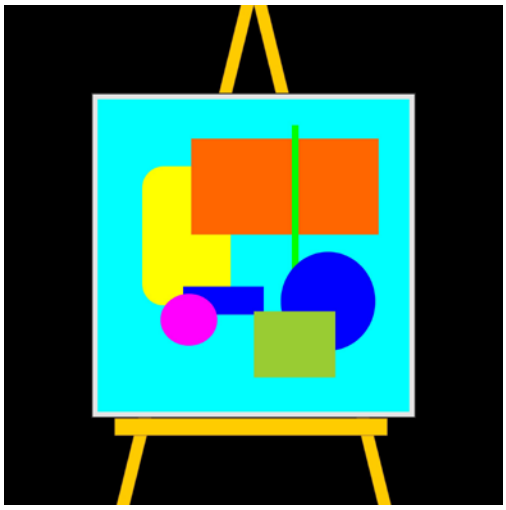
17. The last piece is to hook up the RF module to the Arduino board. We used pins 9-13. If the RF module doesn't work, you will probably need to use a 10 mfd capacitor.

    Pin breakdown of palette Arduino Uno:

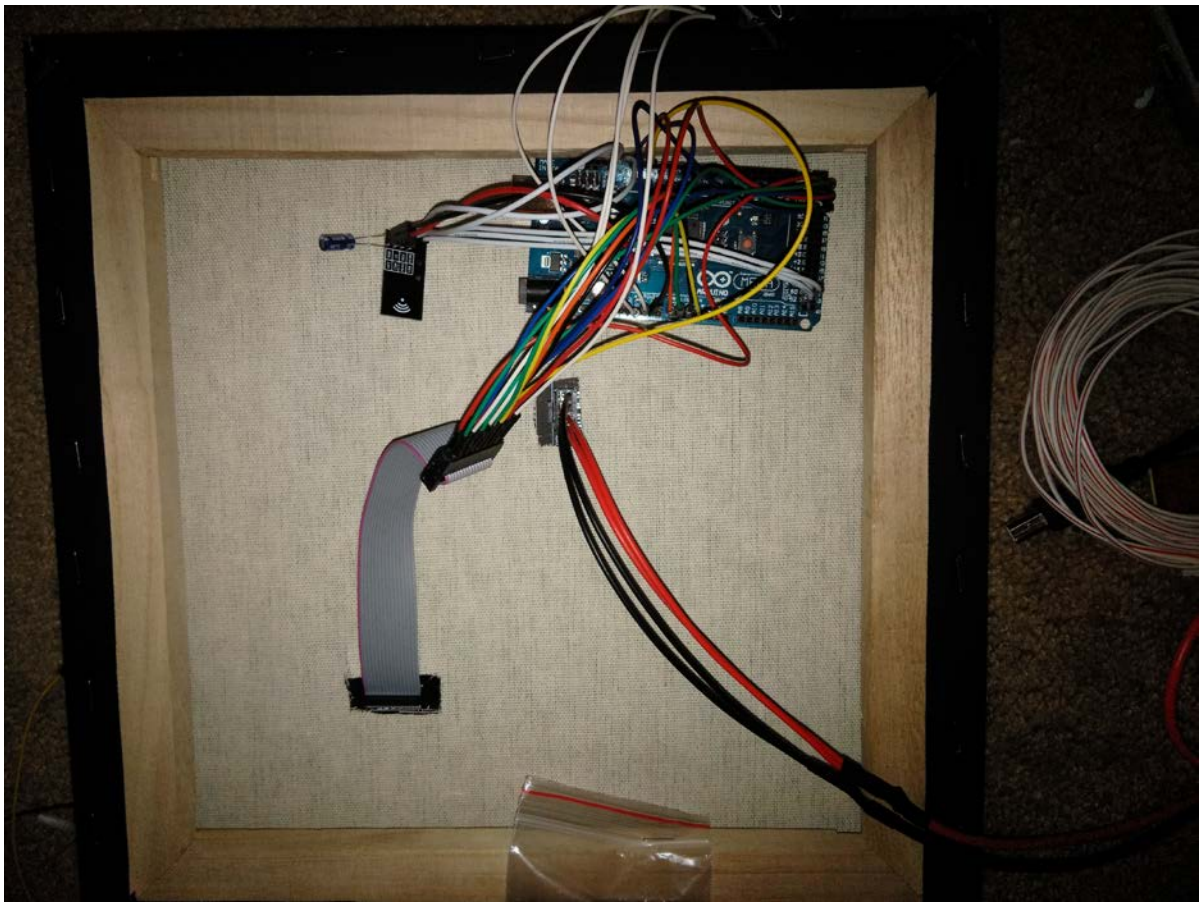
    2 - output to led strip
    3 - red leg of rgb led
    4 - green leg of rgb led
    5 - blue leg of rgb led
    6 - servo
    7 - empty
    8 - empty
    9 - CE (RF module)
    10 - CSN (RF module)
    11 - MOSI (RF module)
    12 - MISO (RF module)
    13 - SCK (RF module)

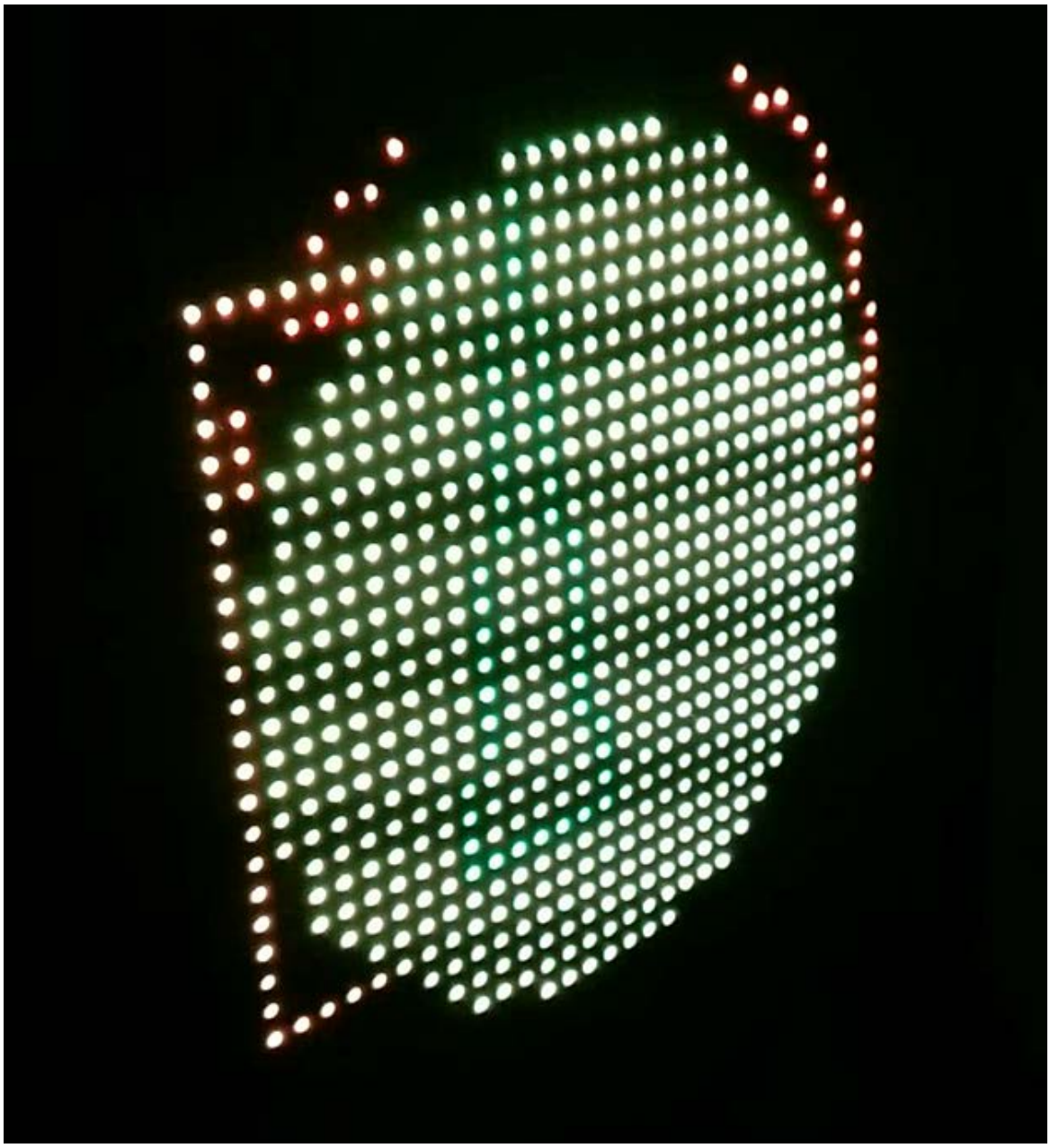
The Painting

The painting panel is deceptively simple. It incorporates the 32 x 32 RGB LED matrix glued to the front and an Arduino Mega, RF module and power supplies on the back of a 12” x 12” canvas. The key things to remember is that the matrix wiring must be as secure and short as possible and that the matrix MUST have an 5 volt independent power source capable of delivering 2 amps of well-regulated power.



You may wish to attach a “canvas on easel” cover made of thin white cloth over a wood or plastic strip frame, but the matrix looks impressive as is.





Programming

This is another opportunity to get creative. You can structure the flow of the artist's dialog with the viewer however you want and use your own algorithm for placing the shapes on the canvas.

You will need to include the manufacturer supplied libraries for the Neopixels, LED matrix and RF modules in your sketches. Test out your code with fake inputs and the serial monitor before trying it on the constructed panels. The artist and painting panels require too many ports for an Arduino Uno, so you will need to use Mega's or another Arduino variant with more ports than the Uno has.