LED Matrix

Adrian Loera, Bleys C. Ranisate, Cody Beumer

Faculty Mentor: Dr. Puteri Megat Hamari

ECET Department, Minnesota State University, Mankato

BACKGROUND

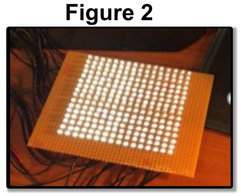
Our project's purpose was to import the functionality of modern day technology, in the form of an LED matrix (Figure 2), to the nostalgic design of the Etch-A-Sketch (Figure 1), a toy that was invented in the 1950's. Most of the design goals have been achieved, with the exception of a couple of the programs we intended to use.

Figure 1

Credit: Etch-A-Sketch

Existing Solutions Are Not High Quality

Figure 2



Credit: PennMed

Other independent designers have made a similar attempt with a good degree of success, but none of the designs we have seen are portable or aesthetically pleasing. We intended on adapting a similar version of these designs while solving these issues by making it not only portable but similar in appearance and feel to the Etch-A-Sketch.

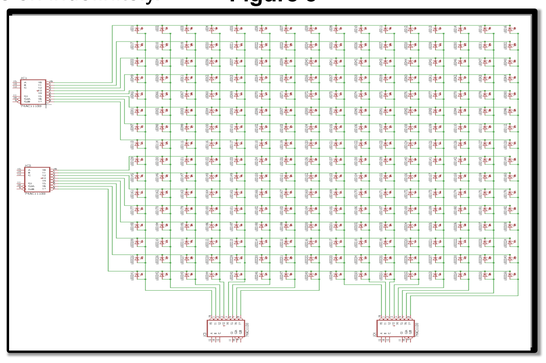
Goals to Meet for the Design

The plan is to create a device that will simulate the use of an etch a sketch that is pleasing to the eye, easy to use, cheap, safe and long lasting. Another good quality for the device would be to have affordable components that can easily be assembled en masse in a factory demographic.

PROPOSED SOLUTION

Our proposed solution involves connecting a Teensy 3.6 microcontroller to the inputs of four demultiplexers, two that have low output, and two that have high. The demultiplexers will then be connected to an array of LEDs (Figure 3) that have the positive and negative leads connected in parallel. This will allow for the user to select a specific coordinate in the matrix using rotary encoders that will then update an existing array of light positions. Our program will then turn the corresponding lights on indefinitely.

Figure 3

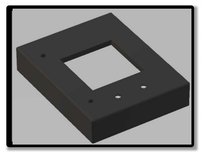


SYSTEM DESIGN

Rotary Encoders

Accept user input as counterclockwise or clockwise and then sends input to the microcontroller and registers left, right, up or down.

3D Case



To create the impression of the Etch-A-Sketch's original design, we have opted to create a 3D Print that is similar in appearance and knobs to go over the tops of the rotary encoders.

Delete Button

A toggle that the program would register in order to determine whether to add or to delete the location of the cursor. This allows for user to erase mistakes if they were made.

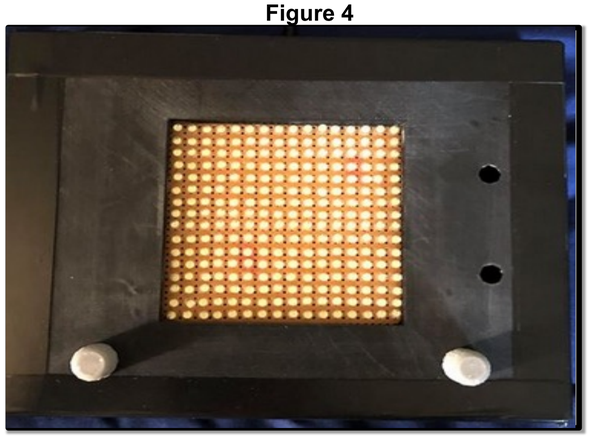
Information About LEDs

Each LED within the matrix behaves as a diode, meaning it only engages when current is passed from the positive side to the negative side. This makes it so we can only turn on the light that we are selecting at one given time.

Memory Button

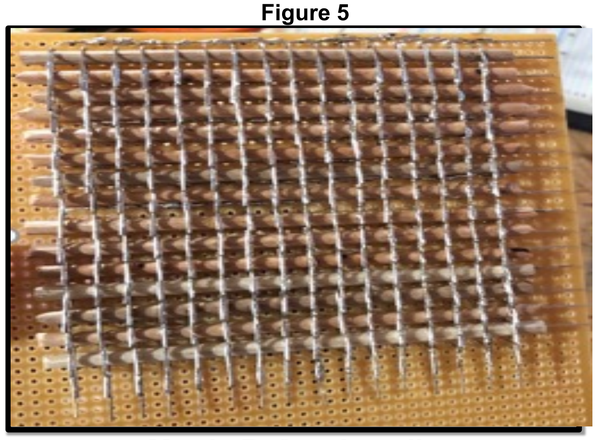
A button that would save the existing array into a permanent array stored within the microcontroller. This makes it so the user can save their progress and recall it the next time they turn the device on.

Figure 4



Matrix Installed In Frame

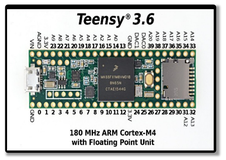
Figure 5



Matrix Before Installment

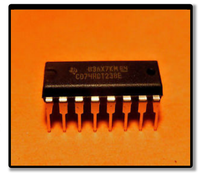
Teensy 3.6

The Teensy has the number of output pins required to send six inputs to four demultiplexers. Also takes on the user input from the rotary encoders and processes which direction the next location in the array should go.



74HCT238 & MC74HC238A-D Demux's

The two demux's on the left side of figure 3 send positive voltage to the given input from the microcontroller. Then to create current the two demux's on the bottom send a negative output to the negative lead of the LEDs. This will create current and toggle selected light.



3D Print Information

The print was created by a company run by one of Adrian's friends called Cubic^3, which handles custom 3D prints for designs brought in by users.

Loop Array Information

The program is set to infinitely loop through and turn on one LED at a time. Only one can be turned on at a given time. The matrix will then turn on the next light in the array. The delay between is so small that the human eye can no longer detect that the previous light has been turned off, creating the impression that the whole array is on all the time.

Required Power

In order to keep the device portable, there is a requirement of two AAA batteries. Otherwise there is a port that can connect the device to a computer and receive power through there. 3.3V is all that is required to power the device, but 5V is recommended.

FUTURE DIRECTION

- Explore more coding options to improve the functionality of design.
- Add a protective screen to the top so users can't touch the LEDs.
- Create a sleeker and smaller version of prototype.
- Fix bugs that existed within the code that hindered usage.
- Modify the design so color can be implemented within the array.
- Update memory feature to save more than one image.
- Add feature so user can move cursor without modifiying the array.

REFERENCES

74HCT238 and MC74HC238A Datasheet
Teensy 3.6 and Standards from Adafruit.com
M. Hamari, ECET, 2017~2018

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CONTACT INFORMATION

Feel free to contact us at bleys.ranisate@mnsu.edu, Adrian.loera@mnsu.edu and cody.beumer@mnsu.edu with any questions or comments.