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MQP Proposal

Introduction

Our group found itself with dozens of ideas of how we would be able to implement an interactive and entertaining, yet informative display. At first, not a single idea accomplished all of the criteria while still remaining feasible under the constraints that we were placed under, such as cost, power consumption, and completion time.

Eventually, we decided that a combination of several of our ideas would be the best possible way to achieve our goal. The following is a document that details several of our ideas, and how we plan to achieve them. In this plan, our final product will consist of a higher resolution LED display board that is much like a "ticker" that can be used to display scrolling words and symbols in many different colors as. Under this piece will be an interactive, yet more artistic display that reacts to motion in front of it. It will be another group of LED's, but in this case the array will have a more entertaining aspect to it, transforming the area into what can truly be called a "lounge." We present a detailed description of how we plan to implement the higher resolution board, as well as three options for the construction of the lower, motion sensing boards. Finally, we will analyze our research and choose the best possible solution.

High Resolution LED Display Board

The top part of the display we are proposing to build will be composed of about 60 8x8 RGB LED matrix displays. The model number of these 8x8 displays is BL-M23B881RGB-11. This portion will be set up 2 rows high, and about 30 columns long (final dimensions of this portion using 60 modules would be about 5 inches by 6 feet). In this section, we plan on displaying information which can scroll across the screen such as AK news, temperature readings, etc... The dimensions calculations are shown in the table below:

	8x8 Dim (inches)	8x8 Matrices	Size (inches)	Size (feet)
Rows	2.37	2	4.74	0.395
Columns	2.37	30	71.1	5.925
	Total Modules	60		

In considering the cost for this portion of our MQP, we have already purchased numerous circuitry elements to be used to drive individual modules. We estimate the cost per module to come to around

$20 to $25 not including the cost for circuit board fabrication. This cost includes the cost of the LED screen, and all electrical components we expect we will need to complete one module.

The table below shows an estimate of the cost per module for this portion of our MQP. Please note that the devices listed in this table are not to be considered final selections.

Part Type/Name	Part Number	Price Per Unit	Quantity per Module	Total Cost
8x8 RGB LED Matrix	**BL-M23B881RGB-11**	$8.09	1	$8.09
Microcontroller	**ATMEGA8515-16PU**	$2.42	1	$2.42
Current Source IC	**UDN2981A-T**	$1.85	1	$1.85
Current Sink IC	**ULN2803A**	$0.82	3	$2.47
Connector (male)	**???**	$1.00	2	$2.00
Connector (female)	**???**	$1.00	2	$2.00
NAND gate	**NC7500**	$0.06	1	$0.06
Logic Buffer (Serial Data)	**74HC3G34GD**	$0.22	1	$0.22
Power Supply Cap 100uF	**C3216X5R0J107MT**	$0.88	1	$0.88
330 ohm Resistor Array	**L091S331LF**	$0.15	1	$0.15
3.3 V regulator	**OKI-785R-3.3**	$3.60	1	$3.60
Circuit Board Fabrication		$10.00	1	$10.00
			Total	$33.73

We tested the LED display out in lab using a 300 ohm resistor and found that the display was easily bright enough to read when run at 3.3 V. After acquiring the electrical current used by each color, we were able to calculate how much power one display would require if every single LED on the matrix was on at the same time. This value came out to be about 2.15 watts. Multiply this value by the number of boards we plan on using in the finished product to get 133.4 watts total (for just the LEDs, all on at the same time). A more realistic estimate of the amount of power dissipated would be ~200 watts, just to be on the safe side.

This display will ultimately be run by some bigger microprocessor possibly capable of internet connectivity to pull data off of a server to be displayed on our LED screen. We may want to fit the main processing unit with a few sensors for ambient room temperature, air pressure, and maybe an ammeter and ADC to display the amount of current and power dissipated by the entire system. We plan on connecting the main microprocessor to two Demux chips in order to do a row and column select to pick an individual module to talk to in order to update it with what it should display.

Some cons and potential problems we may run into include the possibility of circuit capacitance limiting the data rate from the main processor to the individual modules. The amount of current required to run through one module to get to all the others is (with a 12V supply voltage) is 11 to 17 amps. In order to ensure this current can pass safely from one module to the next, the width of the connections on each circuit board will have to be wide enough to support this amount of current. We may also run into initial turn-on power consumption problems if each module is outfitted with its own power supply capacitor. Additionally, the ATMEGA8515 microprocessor we selected just barely has enough pins on it to interface to the LED screen and communicate with the main microprocessor. If we decide we need more pins on our microprocessor, we may need to select another microprocessor.

Peggy2 (from evilmadscience.com)

Dimensions

11.320 inch X 14.875 inch (circuit included)

Pros

- Fully programmable
- Versatile resolution, cost, and power consumption

Cons

- More time consuming
- Sensors need to be integrated

Power Consumption

<u>LEDs</u>

<u>Pixels</u>

1 Pixel @ 20mA
Red: 1.9V w/ Intensity of 500mCd
Green: 3.8V w/ Intensity of 2,500mCd
Blue: 2.7V w/ Intensity of 1,000mCd
White: 2.7V w/ Intensity of 5,000mCd

Note: Green and White have higher intensities which means that we can likely operate them at a lower current than 20mA

Max Power: 384W for 1/2 Pixel per square inch (2 LEDs per square inch)

Max Power: 192W for 1 LED per square inch (36 pixels per square foot)

Max Power: 95W for ½ LED per square inch (18 pixels per square foot)

Note: For each case the maximum power is determined with all LEDs in each pixel and all the pixels on, although a more accurate estimate would be about 1/3 of the mentioned values which would occur if all the green LEDs in the pixels were on.

RGB LEDs

1 RGB LED @ 20mA

Red: 1.9V w/ Intensity of 500mCd

Green: 3.1V w/ Intensity of 1000mCd

Blue: 3.0V w/ Intensity of 800mCd

Max Power: 553W for 1 LED per square inch

Max Power: 277W for 1/2 LEDs per square inch

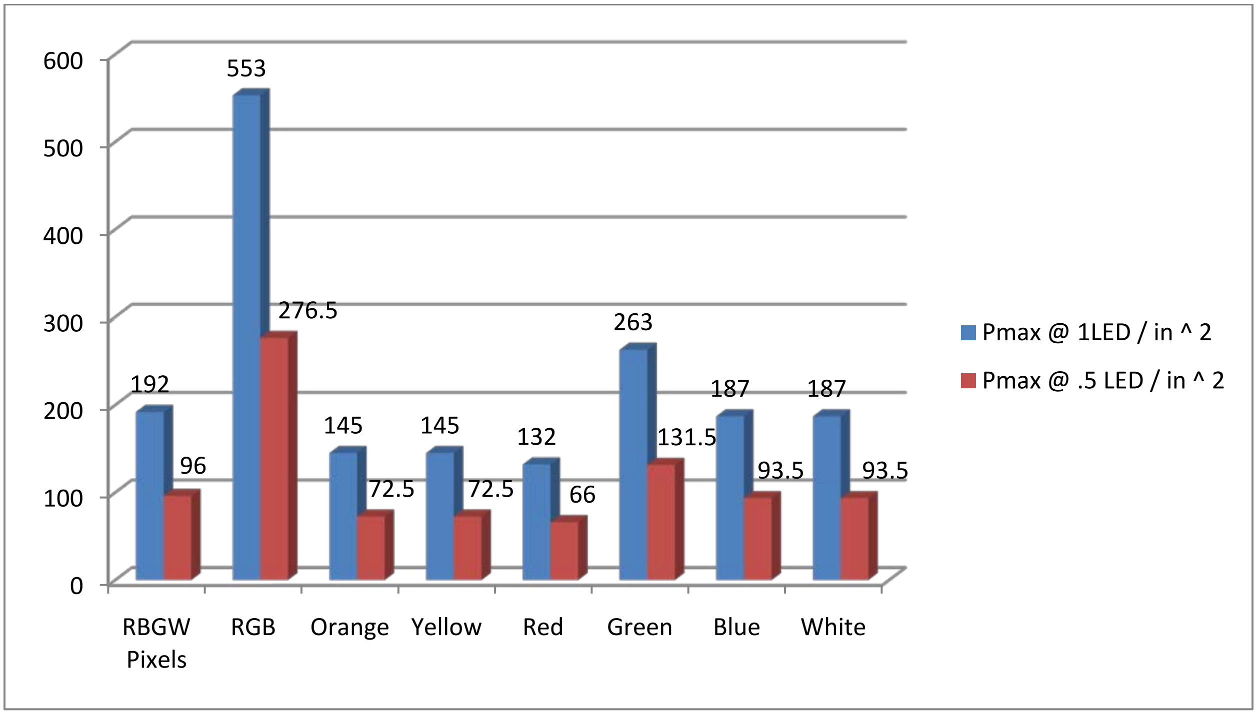
Max Power: 62W for 16 LEDs per square foot

Note: For each case the maximum power is determined with all LEDs on, although since this will not likely be the case a more accurate estimate would be roughly 1/2 of the mentioned values which would occur if all the green LEDs were on.

Alternative Single Color Display

1 LED @ 20mA
Orange: 2.1V w/ Intensity of 900mCd
Flickering Yellow: 2.1V w/ Intensity of 700mCd
Red: 1.9V w/ Intensity of 500mCd
Green: 3.8V w/ Intensity of 2,500mCd
Blue: 2.7V w/ Intensity of 1,000mCd
White: 2.7V w/ Intensity of 5,000mCd

Color	Voltage	Intensity	Pmax @ 1LED / in ^ 2	Pmax @ .5 LED / in ^ 2	Pmax @ 16 LED / ft
Orange	2.1	900	145.152	72.576	16.128
Yellow	2.1	700	145.152	72.576	16.128
Red	1.9	500	131.328	65.664	14.592
Green	3.8	2500	262.656	131.328	29.184
Blue	2.7	1000	186.624	93.312	20.736
White	2.7	5000	186.624	93.312	20.736



Maximum LED Power Consumption in Watts

Note: For the RGB and the RGBW Pixels, the power shown above is if all the LEDs are on. Actual maximum power for the RGB LED display will likely only be 263W/132W, since this is the power consumption of the green LED and only 1 LED will be on at a time. Also the pixel display will have a lower actual maximum power as well, for the same reason, of 66W/33W (For an all green display).

Sensors

~24 W, estimating from Interactive Display sensors

Cost

Circuit Board
95 for one panel (82 per 1 square foot)
1900 for full display (20 panels)

LEDs

Pixels (R-B-G-W)

1310 for entire display @ ½ Pixel per square inch (2 LEDs per square inch)
695 for entire display @ 1 LEDs per square inch (36 pixels per square foot)
282 for entire display @ ½ LEDs per square inch (18 pixels per square foot)

Note: Since the LEDs in this case are being made into pixels the resolution of the actual display will be ¼ that of the other displays with the same LED resolution.

RGB LEDs

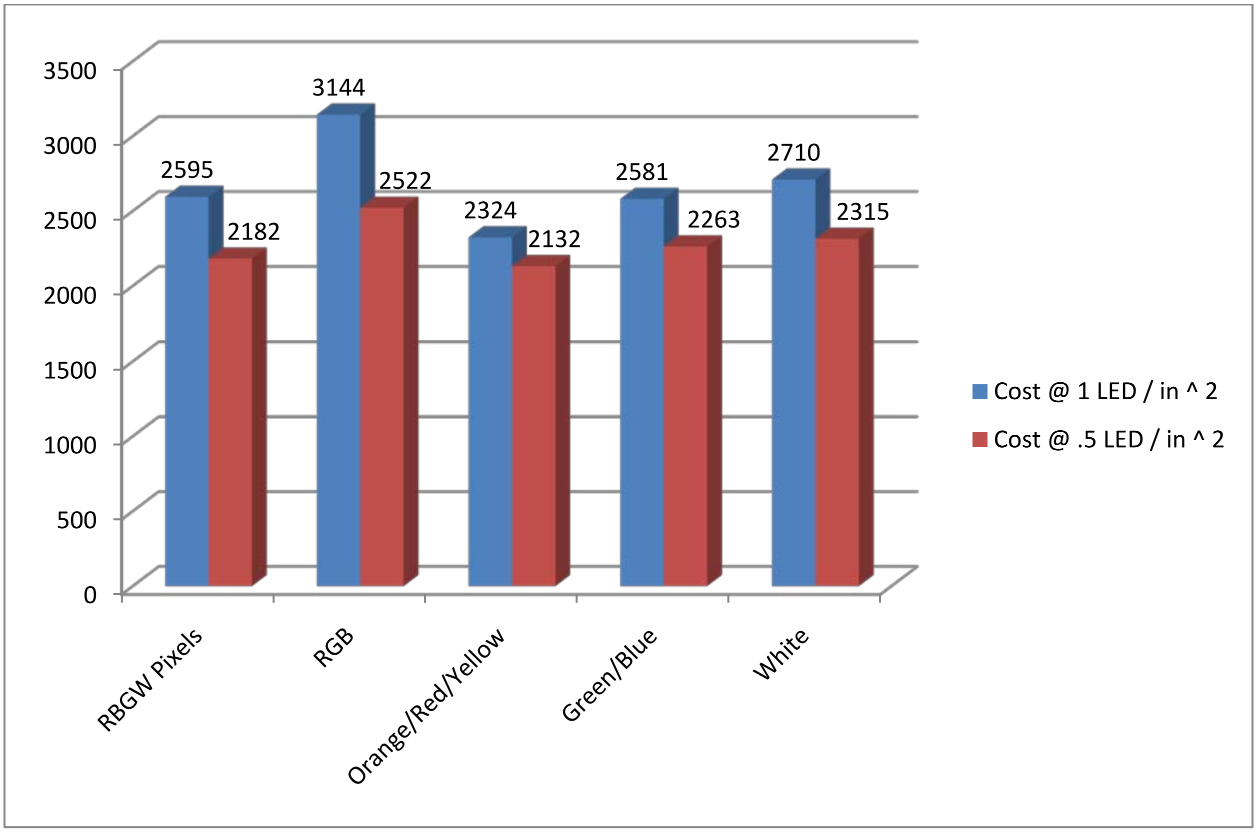
1244 for entire display @ 1 LEDs per square inch
622 for entire display @ 1/2 LEDs per square inch
173 for entire display @ 16 LEDs per square foot

Single Color Display

424 for entire display @ 1 LEDs per square inch (Red, Orange or Yellow)
681 for entire display @ 1 LEDs per square inch (Blue or Green)
810 for entire display @ 1 LEDs per square inch (White)
232 for entire display @ 1/2 LEDs per square inch (Red, Orange or Yellow)
363 for entire display @ 1/2 LEDs per square inch (Blue or Green)
415 for entire display @ 1/2 LEDs per square inch (White)
70 for entire display @ 16 LEDs per square foot (Red, Orange or Yellow)
100 for entire display @ 16 LEDs per square foot (Blue or Green)
116 for entire display @ 16 LEDs per square foot (White)

Note: This data was added as a fall back in case of budget constraints and also as a record of other color options that can be used in the pixel display alternatively to the Red/Green/Blue/White pixel color scheme described in this document.

Another Note: The cost of motion sensors has not been incorporated into this data, due to the fact that we do not have an accurate idea of the way we will be able to incorporate them into the display, or the full extent of which motion sensors will mesh best with the design of the Peggy 2.



Cost for Different Displays in Dollars

Comments

Being the most versatile option, the Peggy 2 display would also be the most time consuming in constructing. Its benefits are that it comes with microprocessors already and can be easily programmed once it has been constructed. It is also very versatile, and offers the most options in terms of power consumption, cost, and resolution. Sensors would need to be integrated, but they could be easily placed on the board as the full resolution of the Peggy 2 will not be used in any of the options described above (Full resolution is 625 LEDs per boards which is ~4 LEDs per square inch).

Interactive Panel (from evilmadscience.com)

Dimensions

12 inch X 12 inch (1 square foot)

Pros

- Inexpensive
- All analog; plug and play

Cons

- All Analog; very limited display options

Power Consumption

120W @ Full power for ½ LED per square inch
24W Steady State

Cost

85 for 1 square foot
2040 for Full display

Comments

This display would be the easiest to implement, as it only needs to be constructed and then it can be mounted. Would allow the project to focus more on the overhead banner, and would be an excellent alternative if time or money is a major constraint in the project. The downside of this approach is the completely analog construction which does not allow us to modify the reaction of the display, making this the least versatile option.

Sensacell Display **(M3016-16-RGB**)

Brief Overview:

“Sensacell is an interactive interface technology developed by the Sensacell Corporation. Described by the company as a “Modular Sensor Surface,” Sensacell was designed to provide a wide variety of large-scale interactive display applications.

A Sensacell surface functions as an interactive touchscreen display, but on a large-scale framework. Individual, tile-like modules—each containing LED lighting and capacitive sensors—are connected in an open-ended array. As the sensors can read through solid materials, Sensacell networks may be installed within common structural and architectural components, enhancing its configurative flexibility and durability.”

From a sales representative at Sensacell:

“The Sensacell modules are mechanically 'generic' in the sense that they can be made into floors, walls, counters etc. as long as they are mounted properly and protected from damage, dirt and water, etc.
The real strength of Sensacell is that the x-y-z 'switch field' can be used to trigger and control any number of devices like video effects boxes and sound sources. Sensacell speaks serial data so it can be made to communicate with MIDI or DMX devices/software.”

Pros

- Infinite software customizations are possible
- Easily implemented (motion sensors are part of each module)
- Power efficient

Cons

- Relatively expensive
- Relatively low resolution

Dimensions

11.811” x 11.811” x 0.625”

Power Consumption

0.4A Max ; 0.045 A nominal per module
24V supply voltage

230.4W Max Power ; 25.92W Nominal Power for entire 2'x12' array

Cost

M3016-16-RGB is $190/square foot ($2,044/square meter) + wiring and mechanical support
$190/ft^2 comes out to $4560 for a 2' x 12' array

LED/Sensor Information

7.5cm between LED's
RGB (16 million colors)
16 "sensing electrodes" per module sense motion up to 3"
16 LED's per 300mmx300mm panel (11.811" x 11.811" x 0.625")
Multi-touch capability

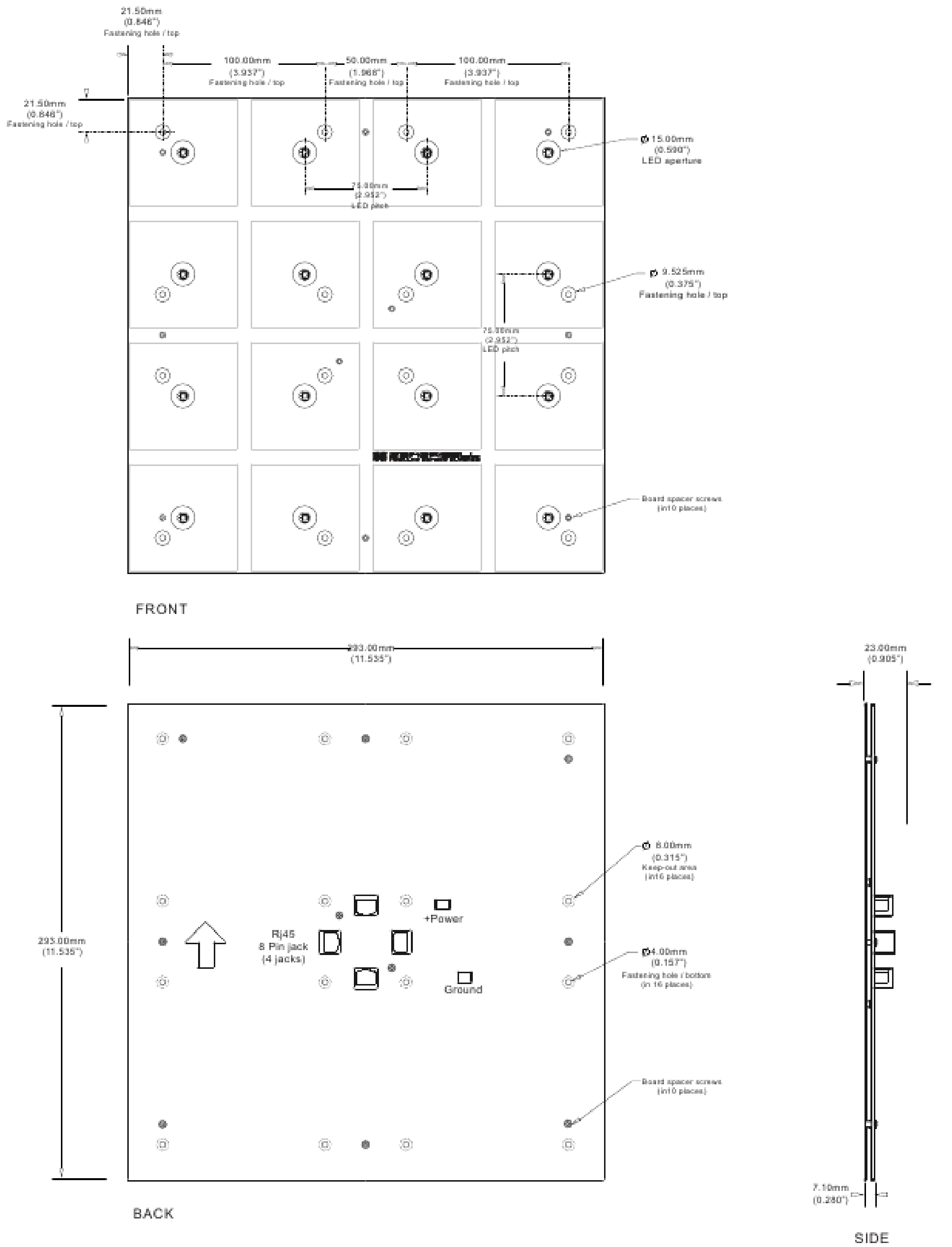
Comments

Sensa-Tools software (SensaSynth) included in our kit
$239 for an evaluation kit with a single module and software

Possibility of still displaying a message or logo as seen here:
http://video.google.com/videoplay?docid=939848804030060203

Higher resolutions are also available, as well as options that include video processing (for a much higher cost)

Dimensions



Schematic of Sensacell M3016-16-RGB model

Conclusion

The following figure gives a detailed analysis of the quality, convenience, and cost values of each option. We chose to weight capabilities and ease of implementation as the highest value criteria of our chart with 3 points. On the lower end, resolution got the least amount of value with 1 point. Power consumption and price both were given weights of two.

Competitive Comparison of Quality, Convenience, and Cost							
Value Analysis							
QUALITY	**Market Weight**	Sensacell		Peggy2		Interactive Display	
	Value Point	Value Point	Total	Value Point	Total	Value Point	Total
Resolution	1	1	1	3	3	2	2
Power Consumption	2	2	4	1	2	3	6
Capabilities	3	3	9	3	9	1	3
Total			**14**		**14**		**11**
CONVENIENCE	**Market Weight**	Sensacell		Peggy2		Interactive Display	
	Value Point	Value Point	Total	Value Point	Total	Value Point	Total
Ease of Implementation	3	3	9	2	6	2	6
Total			**9**		**6**		**6**
COST	**Market Weight**	Sensacell		Peggy2		Interactive Display	
	Value Point	Value Point	Total	Value Point	Total	Value Point	Total
Price	2	1	2	2	4	3	6
Total			**2**		**4**		**6**
Grand Total			***25***		***24***		***23***

Value Analysis

Based on this analysis, it appears that the implementation of an array of Sensacell panels is the most valuable option. This is under the condition of some very notable assumptions, however. We assumed that cost was not one of our most important concerns. If cost became an important constraint, we would have to change our analysis to reflect this. The same should be noted for power consumption, since that could possibly become another important constraint.