Our project is to design a flexible LED display. The display will consist of a 16x16 matrix of matrix of programmable RGB LEDs. This matrix will be controlled by a smartphone application. In addition, we will have run-time control for our product. This means a user can quickly switch to a preset display with the press of a button.

The major parts we are using are:

RGB LED: WS2812
Battery: 3.7 V - 4.2 V 5000 mAh
Microcontroller: Designed around ATmega328
Bluetooth: Version 2.1
Flexible PCB: Copper Clad Laminate LF9220R

For the project, there are two main components to the product: the matrix, and the phone application. The following is a description of both components.

LED Matrix

Dimensions: 7inx7in
Number of LEDs: 256 RBG LEDs
Weight: 3 - 5 lbs.
Operating Voltage of LEDs: 3.5 V
Operating Current of LEDs: **
Operating Voltage of Microcontroller: 7 V
Operating Current of Microcontroller: 40 mA

Phone Application

Figures 1 and 2 are sample images of the user interface. The user can control the colors or enter text to be displayed. It communicates via bluetooth to the microcontroller, which in turn commands the matrix.

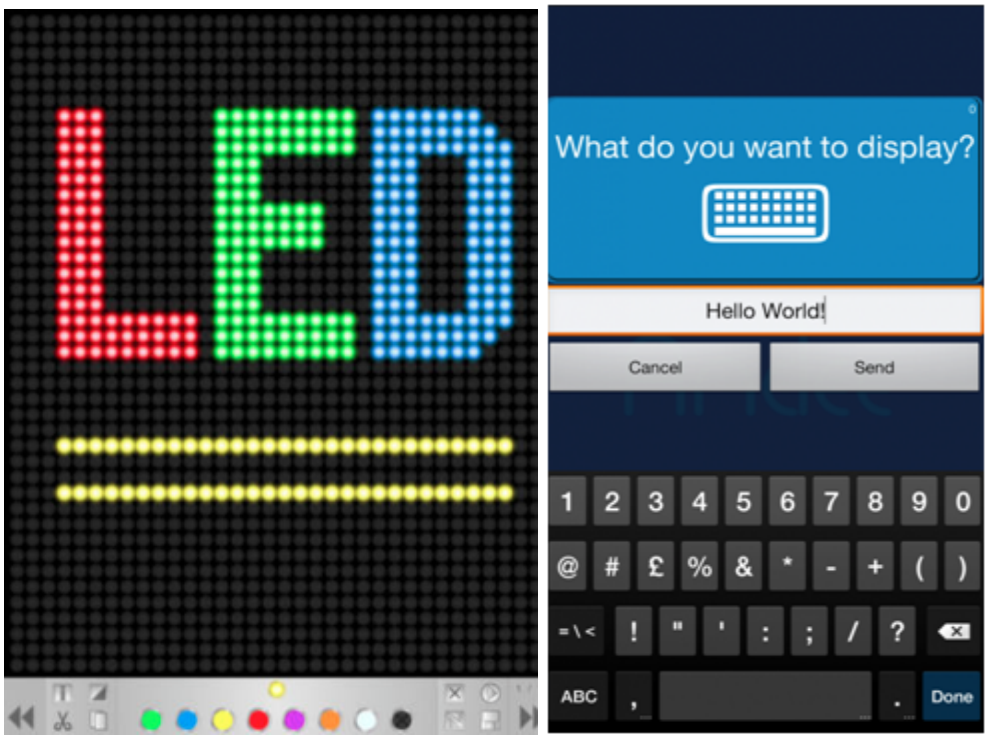


Figure 1 and 2: Sample UI

We began this project with the goal of helping improving visibility in under lit situations. We envision our product as a source for night time workers, bikers, and so on. This is an important goal to achieve because of many gruesome statistics. For example, 60% of all fatal biker accidents happen during night, 50% of a bicycle accidents occur during night, 96% of all biker/bicycle accidents results in hospitalization and more than 86,000 injuries occur during nighttime construction (Blau, Liza).

Keeping these statistics in mind, we set out to make a product that could be useful and effective in many settings. Through our research, we patterned our product to instill confidence in night time travelers and workers in regards to their safety.

On the other hand, we understand that similar devices have been made and sold worldwide. However, our product has the unique feature of having run-time and smartphone application control. The most distinct feature we have is that the LED matrix will be flexible. This makes our product comfortable for use in various conditions. Figure 3 shows the best approximation of our product.

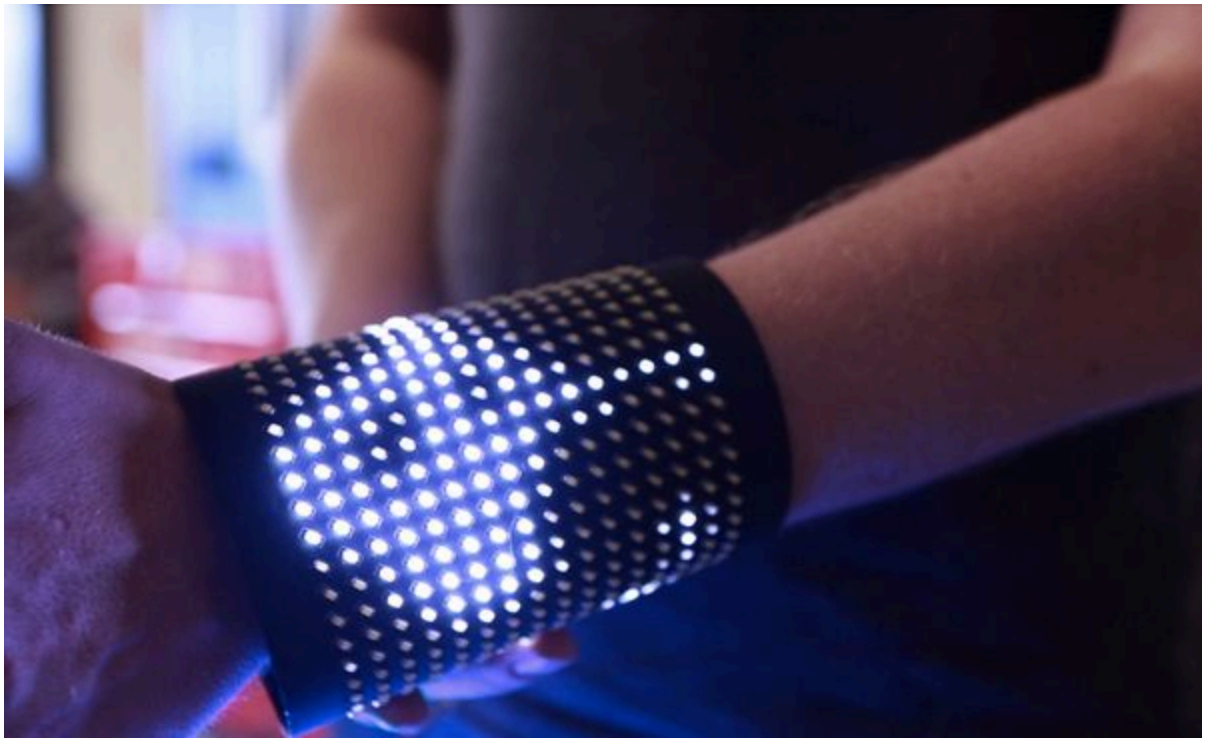


Figure 3: Similar to our design

As a team, we have the qualities necessary to make our vision into a real product. Individually, we have the following backgrounds to contribute to this project.

Vignesh: He is a senior electrical engineering student with strong knowledge in hardware implementation. He has gained this knowledge through working as a researcher for Washington State University. His research primarily dealt with studying power consumption of many technical components and finding a circuit design to limit their usage. Therefore, he has the knowledge necessary to find the best solution to powering our product.

Aaron: He is a senior electrical engineer with a focus in a embedded system design. He has experience with working with many microcontrollers and FPGAs during his time as an electrical engineer. He has completed many project that involve working with different high and low level languages. Presently, he is working as an intern at Altera.

Pratiek: He is a senior electrical engineering student with a concentration in programming. He has become extremely comfortable working with various microcontrollers. He led many teams to successful project presentations in engineering disciplines. Currently, he works as a tutor for core engineering classes.

Travis: He is a senior electrical engineering student with a focus in hardware design. He has shown the characteristics needed to succeed in this role by succeeding in various core classes. Currently, he is working as an intern at Maxim as a test engineer. His experiences at a large scale corporations will translate well to our LED matrix design.

Since joining as a team, we have tremendous progress on our project. The following two figures are Gantt charts of planned progress for the coming months.

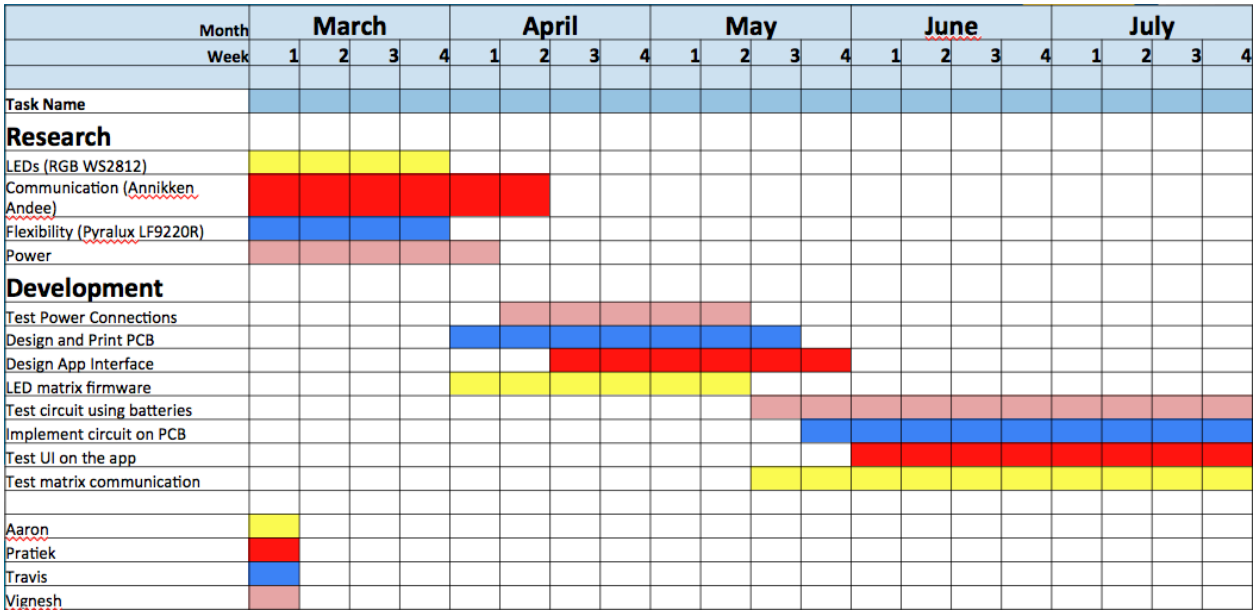


Figure 4: Schedule for next two months

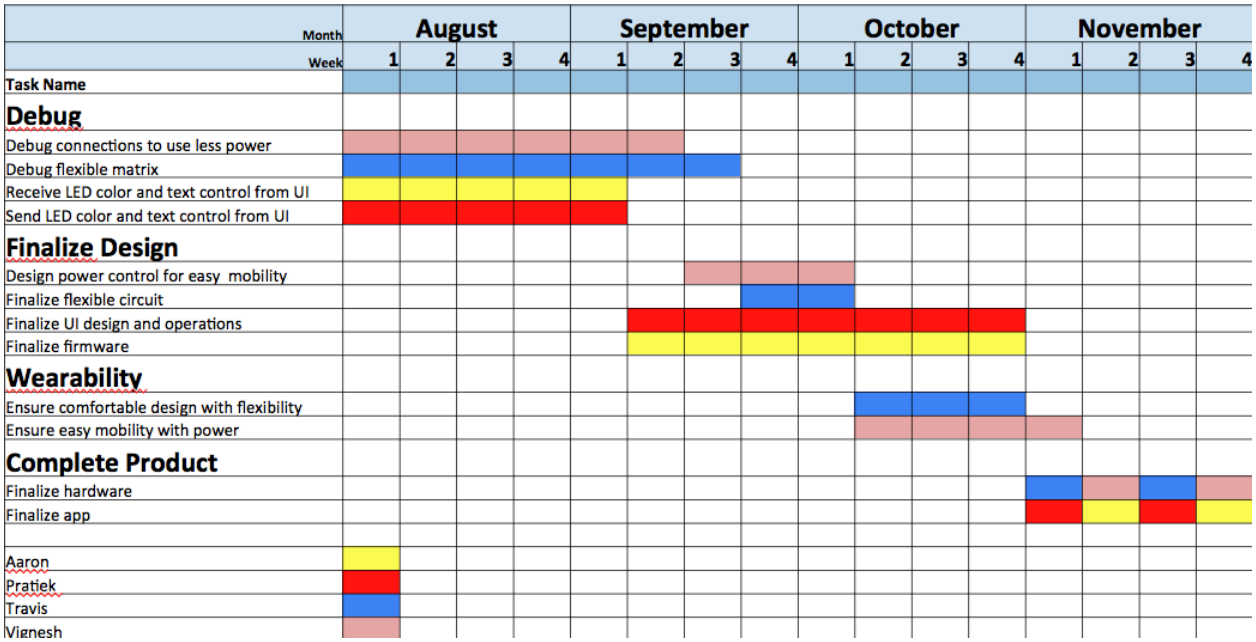


Figure 5: Schedule until the end of the year

Over the past couple months, we have proven that we are the right team to do this project. Even if prior knowledge is disregarded, our work as a team so far has exceeded even our own expectations.

Hardware

We were debating between using programmable RGB LEDs and single color LEDs. We chose the programmable RGB LEDs because the schematic became more manageable and it provided a variety of colors. Figure 6 shows our schematic for final product.

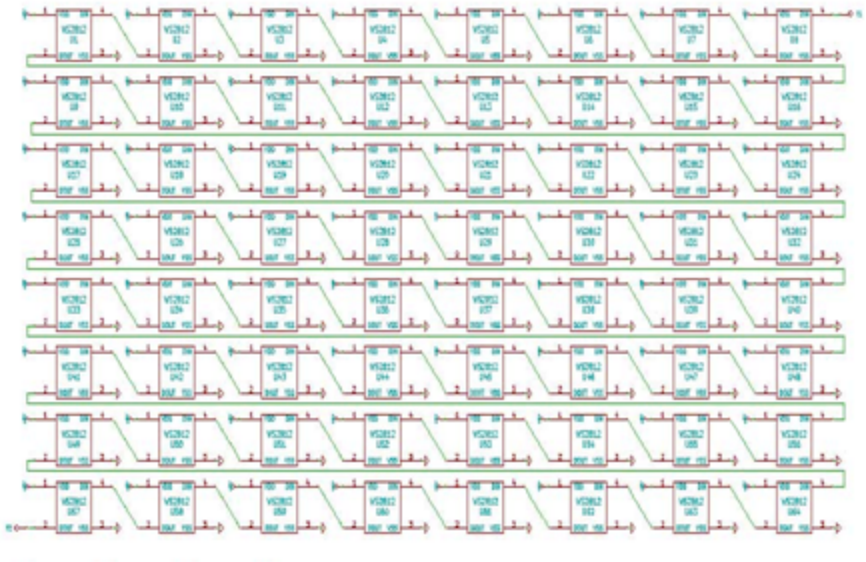


Figure 6: Schematic for matrix

The WS2812, the programmable RGB LEDs, has a driver built into each piece. Therefore, each receives its input from the previous LED, which gives us the advantage of not having to addressing each LED using a matrix of wires.

We have also chosen to use copper clad LF9220R PCB. This is a flexible PCB that provides us with a feature that our competitors do not have.

The last hardware component is power. The rechargeable batteries have to power both the matrix and the microcontroller. Therefore, there at two different operating conditions that have to be considered. The microcontroller requires 7 V and 40 mA. While the matrix requires 3.5 V and a maximum of 15 A. These values are calculated for 256 LEDs that are working at full capacity. To fill these needs, we are using 3.7 V to 4.2 V with 5000 mAh rechargeable battery. A single cell of this battery will provide power for our entire system for 20 min, so by using four batteries we will provide power for a sufficient time.

Software

For this portion of our project, we have written to control the WS2812. Our code can control the color, the brightness, and the pattern that the displayed image changes for cascaded LEDs. Our major task for the next months are to program the smartphone application to control the matrix via bluetooth.
The flowchart below shows the basics of the code we have done.

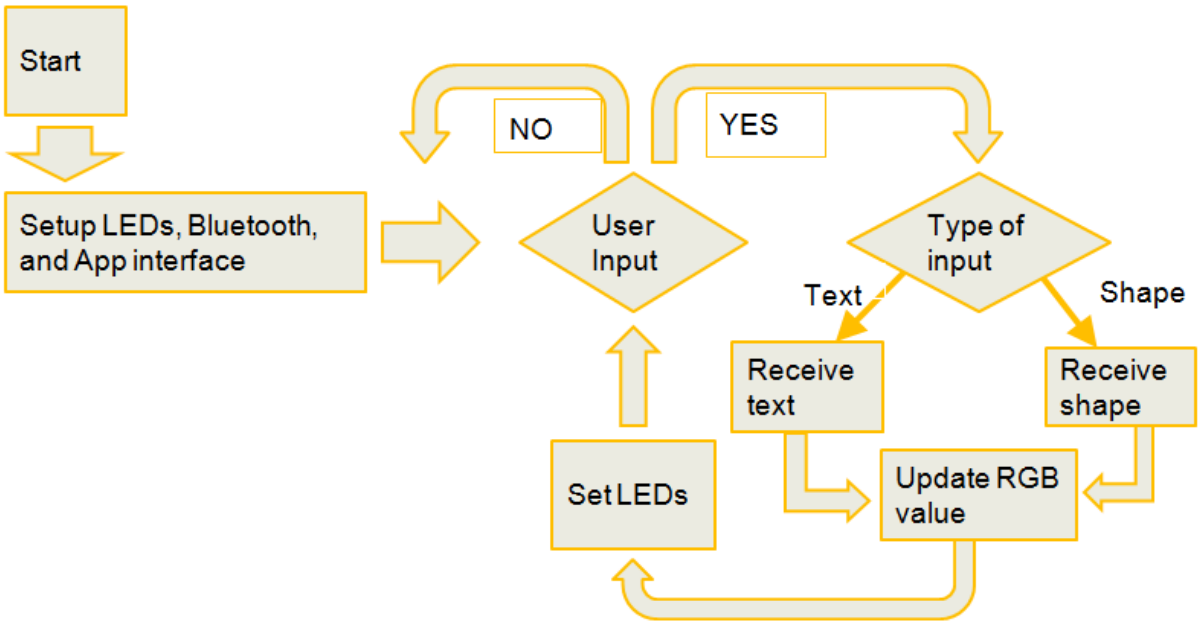


Figure 7: Flowchart of firmware

The following block diagram consists of our entire system in basic terms.

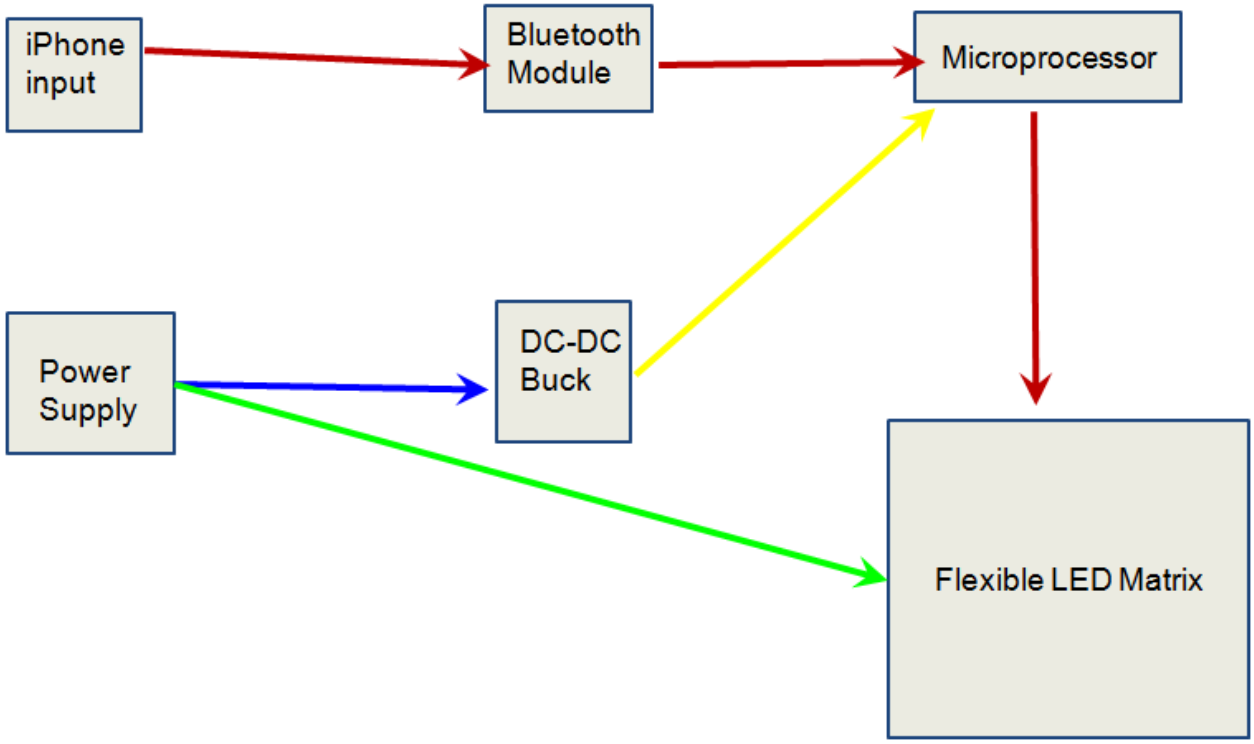


Figure 8: Block diagram of system

By considering our progress thus far, we have begun thinking about where our funding will come from. At the moment, we have depended on the resources of our advisor, Dr. Ping Hsu. However, for the coming months, we foresee major expenses such as flexible PCB production, LED purchases and so on. Therefore, we will again have to rely on Dr. Hsu's industrial connections for funding. He has given us confidence that if we meet his standards, then we will receive his help for funding.

Works Cited:

Blau, Liza. "Bike Safety at Night." *Road Biking*. LIVESTRONG.COM, 23 Oct. 2013. Web. 05 May 2014. <http://www.livestrong.com/article/153786-bike-safety-at-night/>.