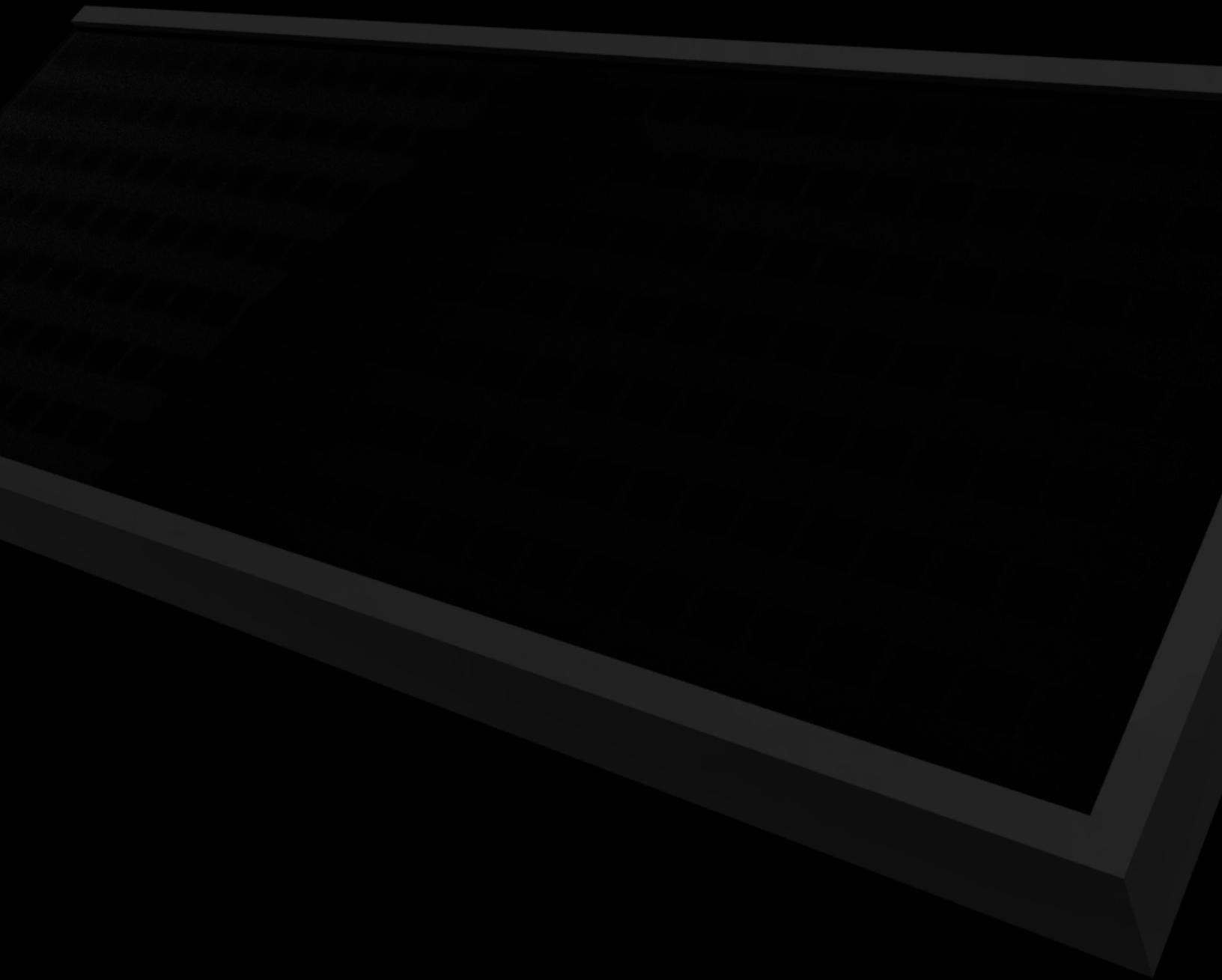


AURA DESIGNS PRESENTS...

S.C.N.B SCORE CLOCK NAME BOARD

TEAM MEMBERS: SHAFIN MOHAMMAD AND AASHIR HUSAIN



Who We Are

We are AURA Designs: an engineering firm that specializes in creating innovative and practical design solutions for our clients. The cooperation between our clients and engineers is pivotal to the creation of synergy in our team. Through clever use of machinery and design, we strive to find environmentally sound solutions to the problems of our valued clients.

About Our Logo

We chose AURA Designs to represent our entire company as it stands for the emission of light from an internal source. This is similar to that of which we stand for. AURA encourages people to keep thinking, creating, building and repairing their technology. For this reason we put our users first encouraging them to enter STEM and STEM related fields.



Problem Statement

Our goal is to create a functional and efficient alternative to changing the names on the score clock present in the gymnasium. The score clock should be re-mountable and modular so that it can be easily placed on top of the names present. It should preferably have white lettering with space for 5 or more letters. The power must be acquired from the score clock itself, ideally from the light bulb receptacle. The price point given for this project was around \$100.



**"If people like you,
they'll listen to you,
but if they trust you,
they'll do business
with you."**

- Zig Ziglar

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RESEARCH AND INVESTIGATE

Our Competitors

Due to the constraints laid out by our client, we had to work carefully so as to accommodate all of the basic requirements, we started by researching what competitors had to offer.

Most products on the market similar to ours had high price points and mediocre features. An example product featured on the right showcases a LED display that is similar in size to our requirements. It features a dense pixel grid with RGB color support. Text is displayed through a USB and there overall modularity is non-existent.

After viewing other similar options we created the basis for our product. Making sure to include all of our clients requirements we also planned included some extra features onto our goals list.

Basic Specifications:

The score clock should be re-mountable and modular

Must have wireless text input

Should have white lettering with space for 5+ letters

The price point is ~\$100

The power must be acquired from the score clock, preferably a DIY receptacle, from a standard light bulb

Any name should be able to be produced and seen from across the gym

Safety precautions: overheating, include fan/watercooling

Extra Planned Features:

RGB Color support

Modularity

Slim profile with thin bezels

EXTRACTING INFORMATION



Title: 8"x 26" Full Color Video P5 HD LED Sign Programmable Scrolling Message Display

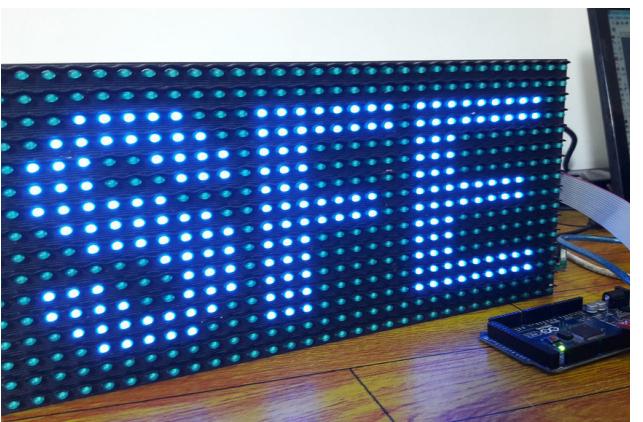
Price: \$218

Key Features: Signal cable interface is USB, Housing material is Aluminum alloy, Waterproof IP20

After viewing other options available to the client we made sure to enhance our product by going above and beyond the expectation. To start we ensure that blue-tooth was a must. Most models no matter the price did not include this feature. Second we made sure to use RGB LEDs for upgradeability down the line. Finally we made sure to make our product modular, this way if anything were to break the product could easily be fixed by the user.

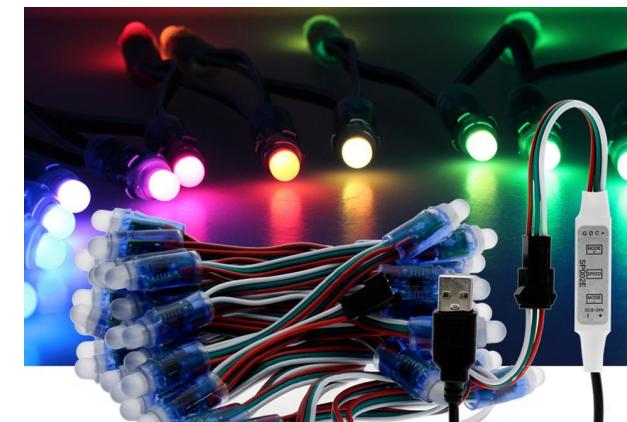
SCREEN TECHNOLOGY

Our first step in tackling this problem was to find a cost efficient way to display our clients messages. To do so we researched the best possible screen technologies on the market and sorted them based of their key features:



DMD PANELS

DMD panels are huge dot matrix's that contain high density LEDs, they are usually single colored but their circuit design makes them easy to use. However they come in squares of predetermined lengths and at high prices.



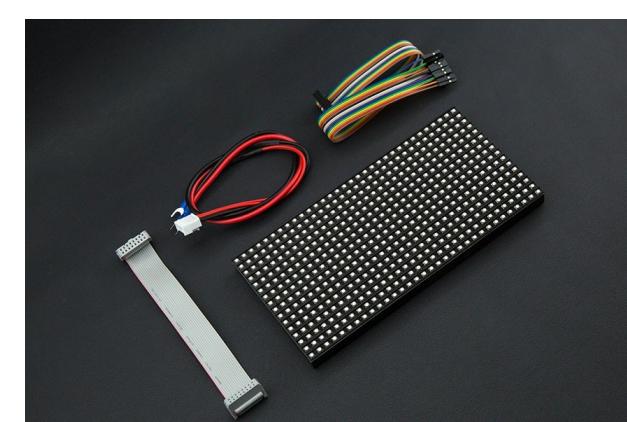
INDIVIDUAL LEDS

The most labor intensive of the technologies, individual LEDs poked through a large grid to create a matrix is the cheapest solution to creating a large scale custom led panel.



DIY LED STRIP PANEL

Uses individually programmable LEDs to create a custom sized matrix. They are a cheap and reliable way to create cheap displays. However they do require a large amount of time to strip and solder together.



LED PANEL

The easiest option, purchase a custom sized led panel from a professional source. The cleanest and easiest option of the bunch.

USER INPUT METHODS



Some possible ways to change the text displayed wireless include, using a blue tooth module, connecting to the Internet and or using a wireless keyboard. Of the three our team decided to use blue-tooth as it is the easiest to use for the consumer. Almost everyone has access to it on their smart phone making it the perfect host for text data transfer.

Modularity



A key factor we include in all of our products is modularity, this means that we encourage the user to repair their own products and help out the environment. After researching ways to make the S.C.N.B modular we discovered the simplest option would be to divide the whole project into layers. Sheets that the user can slide in and out of a shell casing.

POWER INPUT



As the client has challenged us to use the pre-existing light socket for power, a key challenge in this project will be to convert 220V of power into 5V of power so that the Led Strip can be safely powered without burning out. In doing so we will have to design a custom DIY Light socket receptacle adapter.

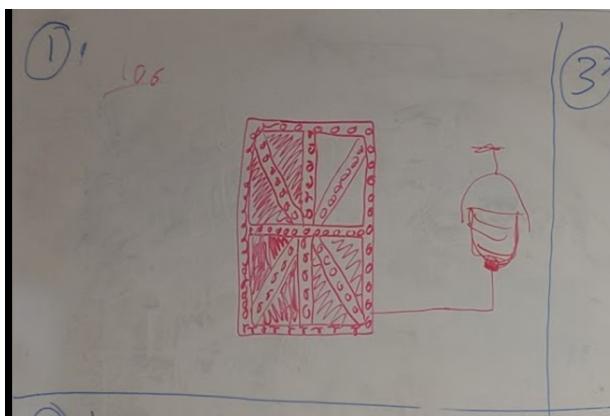
Re-mountable



A key factor we include in all of our products is modularity, this means that we encourage the user to repair their own products and help out the environment. After researching ways to make the S.C.N.B modular we discovered the simplest option would be to divide the whole project into layers. Sheets that the user can slide in and out of a shell casing.

INITIAL SOLUTIONS

Using our knowledge of the clients basic requirements and our own knowledge and understanding of the digital led display market, we created 6 unique and creative designs to solve the problem at hand.

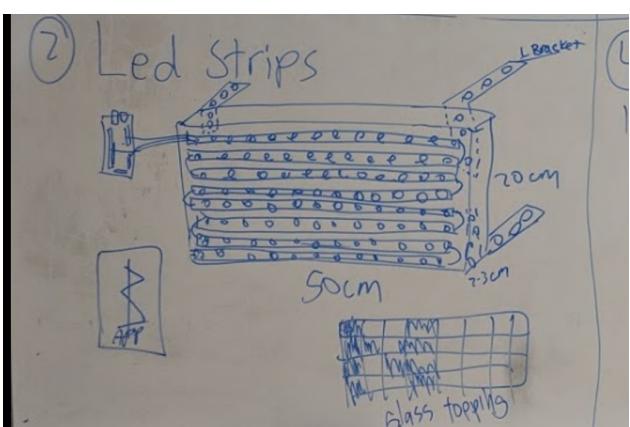


1. Calc Display

A series of segmented calculator like displays, like the ones already on the score clocks, used to showcase the team names. Body is encompassed in a wooden case.

Pros: Cheap, Reduce wasted LEDs, Matches score clock format

Cons: Single color, Ugly letters, Lots of work

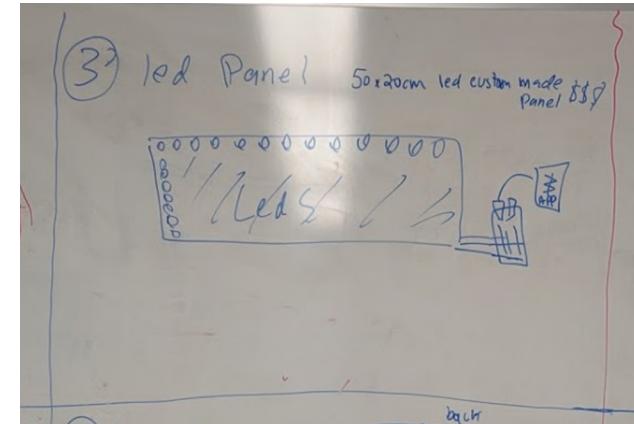


2. Frosted Name Panel

Rows of led strips placed behind a sheet of frosted glass, Provides unique aesthetic not used by other manufacturers,

Pros: Diffuses harsh bright light for better viewing, RGB, Fairly cheap

Cons: Needs lots of calculations, Intricate parts like the grid

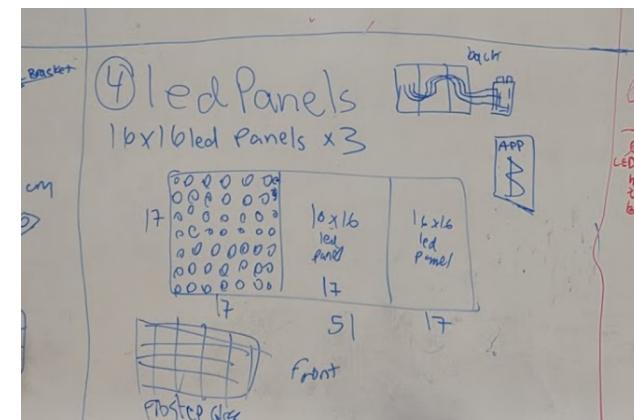


3. Money Muncher

Purchase a large RGB led panel and use it to display text through a BT application.

Pros: Very easy, Best finish, RGB

Cons: Very expensive, easier to purchase final product

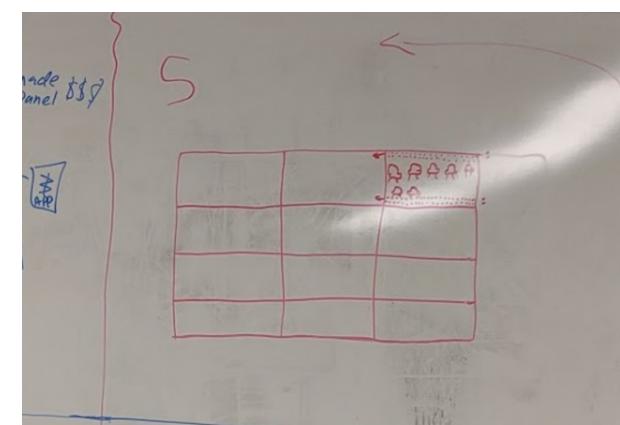


4. Matrix Display

Series of large DMD panels connected to make 1 large Matrix. Placed on wooden board and controlled with BT.

Pros: Fairly easy to make, High PPI

Cons: Expensive, Single color

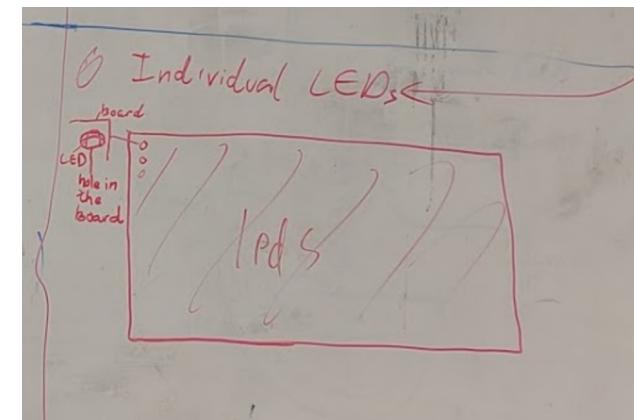


5. Segmented Display

Segmented breadboards containing individual LEDs. Essentially like creating DMD boards with LEDs.

Pros: Very cheap, RGB or Single Color, easier to repair

Cons: Lots of work, Hard to program



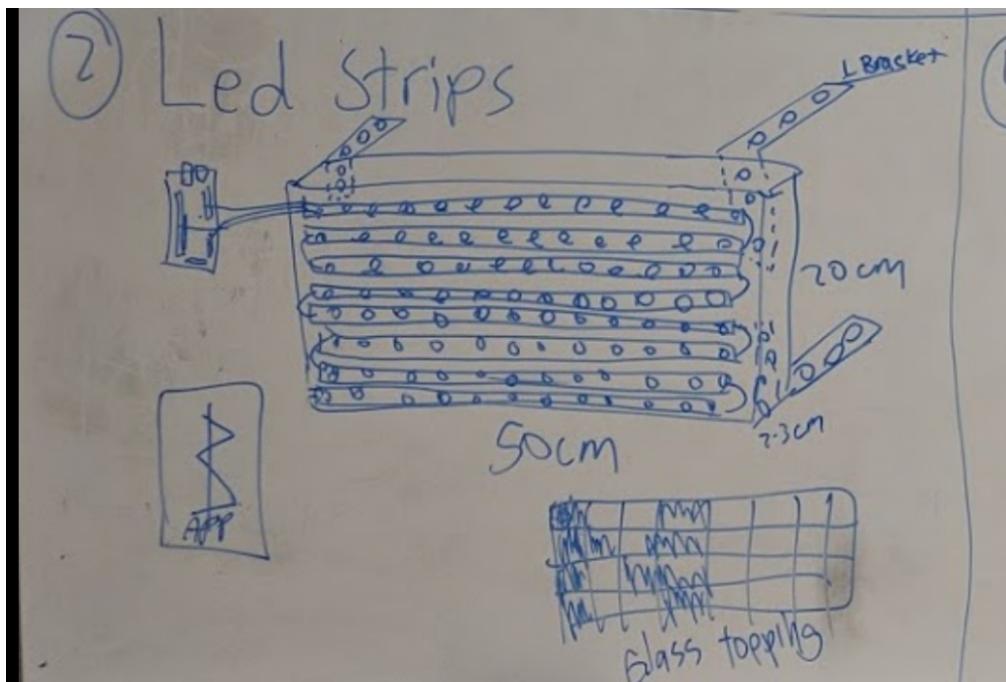
6. Labor Intensive

Series of individually programmed LEDs connecting in a large grid made from wood with pre-drilled holes.

Pros: Very cheap, RGB or Single Color

Cons: Lots of work, Hard to repair

FINAL SOLUTION



Our group chose design 2 because of its versatile display aspect ratio, individual interchangeable LEDs, low cost to work ratio and frosted glass. We incorporated the custom aspect ratio of design 6 into design 2. Having a simple 1:1 aspect ratio on the led board would simply not give us the best use of space on the board. For this reason our group decided on a custom aspect ratio, this ensures that our letters are as big as they can possibly be without seeming distorted. Aside from this the RGB led strips are easy to work with and cost efficient. It works by positioning a series of individually programmable led strips evenly on a slate of wood. A 3D printed grid will be placed around each of the LEDs to help define the light emitted by the bright LEDs. The frosted glass will be positioned on the very front to diffuse the light and help hide the leds placed behind. The single sided frosted glass also helps the LEDs provide a brighter glow which can be seen from anywhere in the gymnasium. Finally the glass adds an aesthetic aspect to the final product giving it a unique look as many of the LED display panels currently on the market do not have this feature.

DIAGRAMS OF FINAL SOLUTION

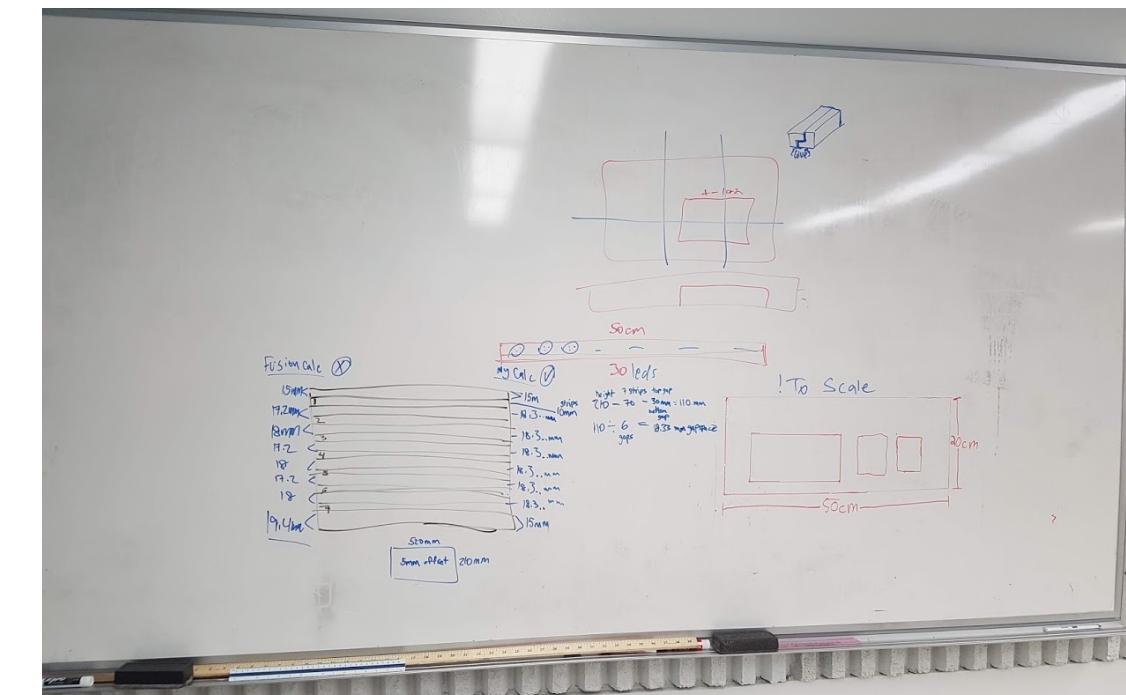
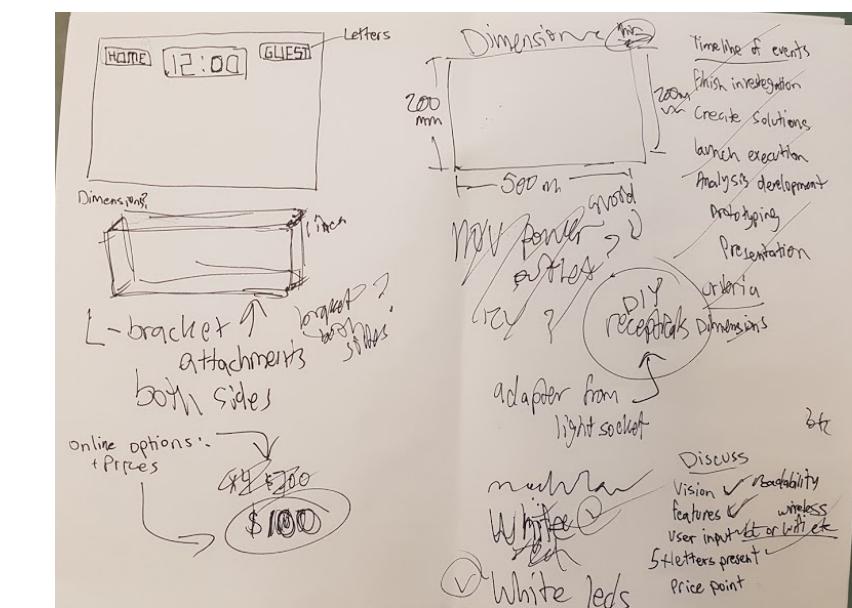
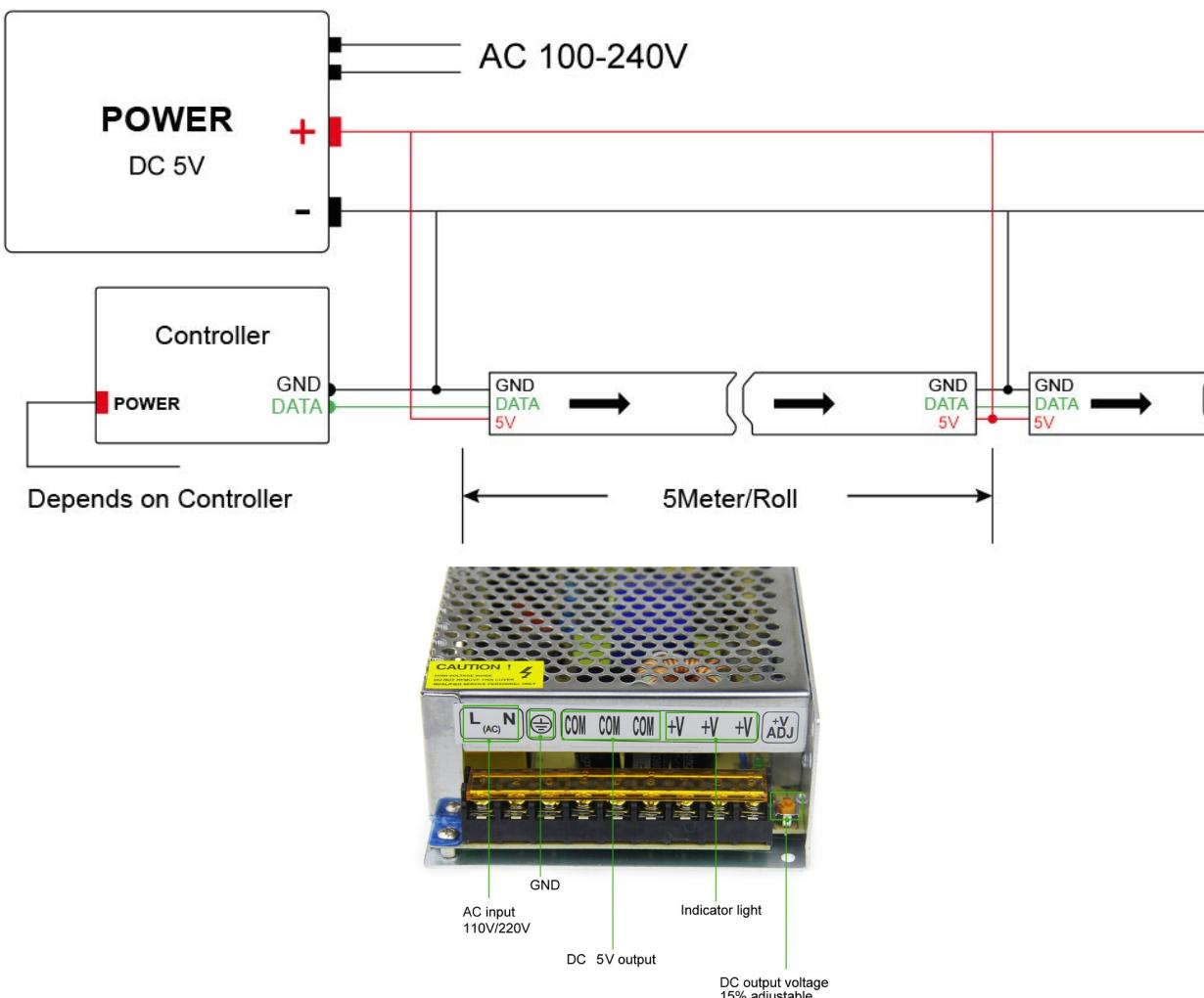


Diagram showing calculations for the aspect ratio between each and every single led pixel. Case dimensions and LED plate drawn as best to scale as possible.



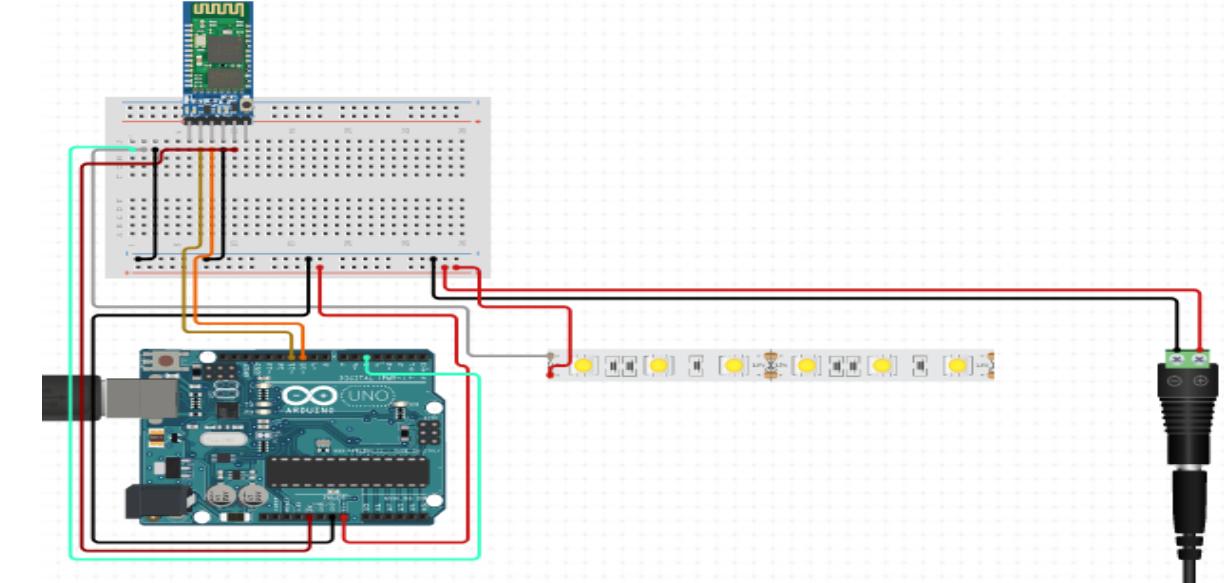
Notes after meeting with our client, figuring out the basis for our project and ensuring that the basic requirements are met before further including extra features.

DEVELOPMENT WORK



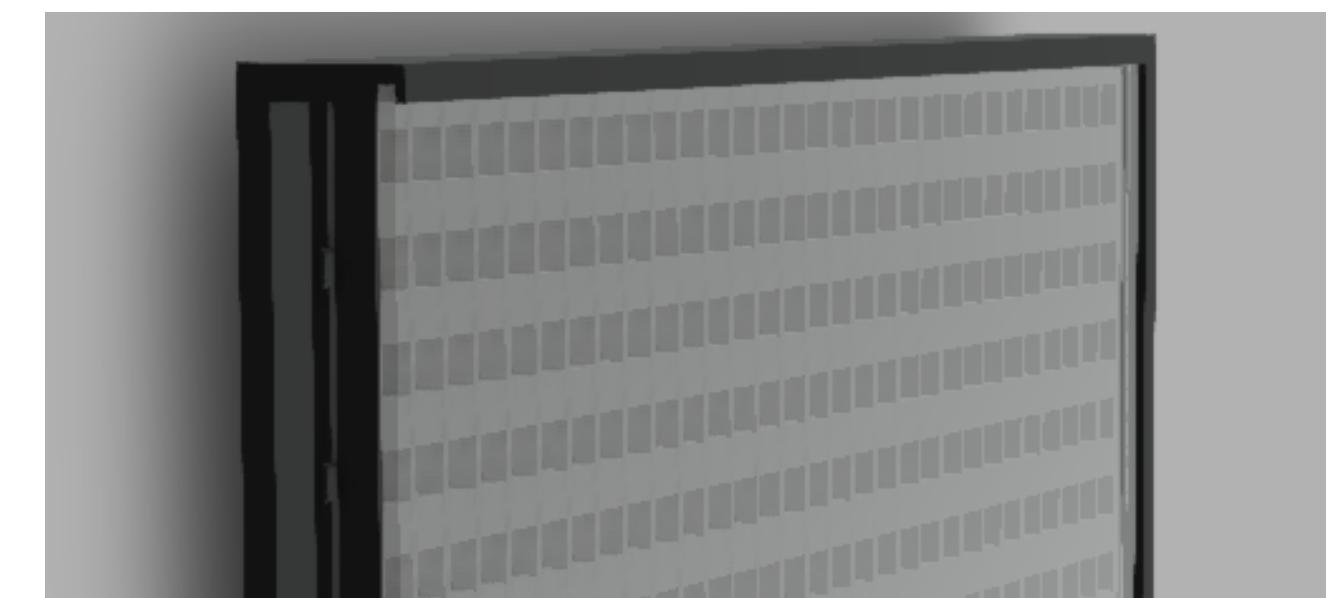
Electrical Schematic

As can be seen the overall circuit for the SCNB is fairly simple and straight forward. You connect the same pins to each other, 5V to 5V, ground to ground, DATA to DATA. The overall power supply unit outputs 5V at 20amps and is enough to power all 210 leds.



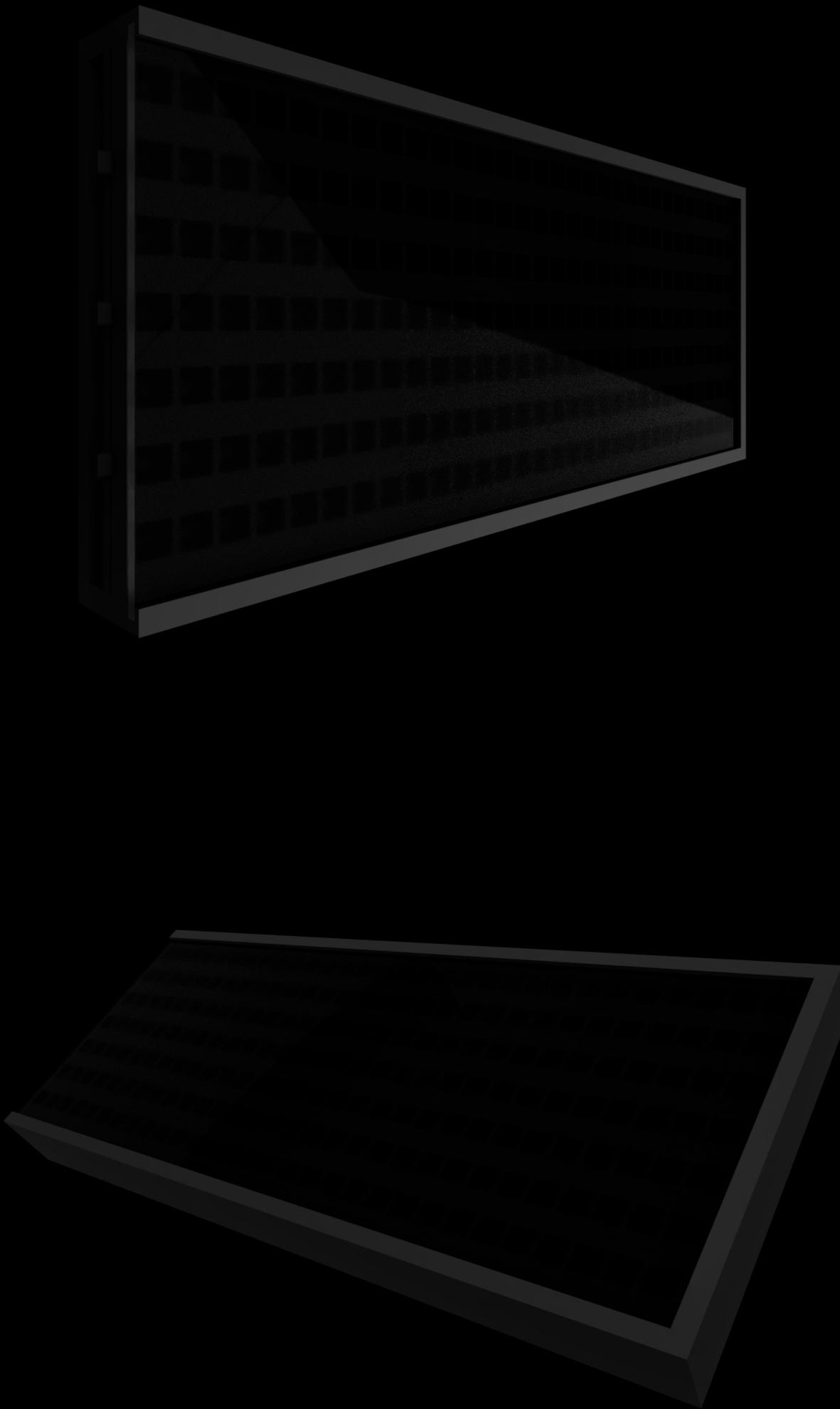
Circuit Design

Just like the electronics we kept the circuit simple. The only thing being powered directly from the arduino is the bluetooth module. Making sure to connect the RX pin to 11 and TX to 10 all that's left is the ground and 5V. The led strip requires a single data connection which is provided by pin 6 and over all the led strip can be powered directly from the power supply.



CAD Model

The CAD Model is well organized and broken down into different parts and components. Each sheet is its own separate component allowing you to slide them in and out of the shell casing. All of the parts have their own material and appearance which is matching to that in real life. All of the dimensions are accurate and using user controlled parameters the client can change the size of and density of the led strip and grid. Overall this simple CAD model has a lot on the inside which is cleverly concealed by the use of organization.



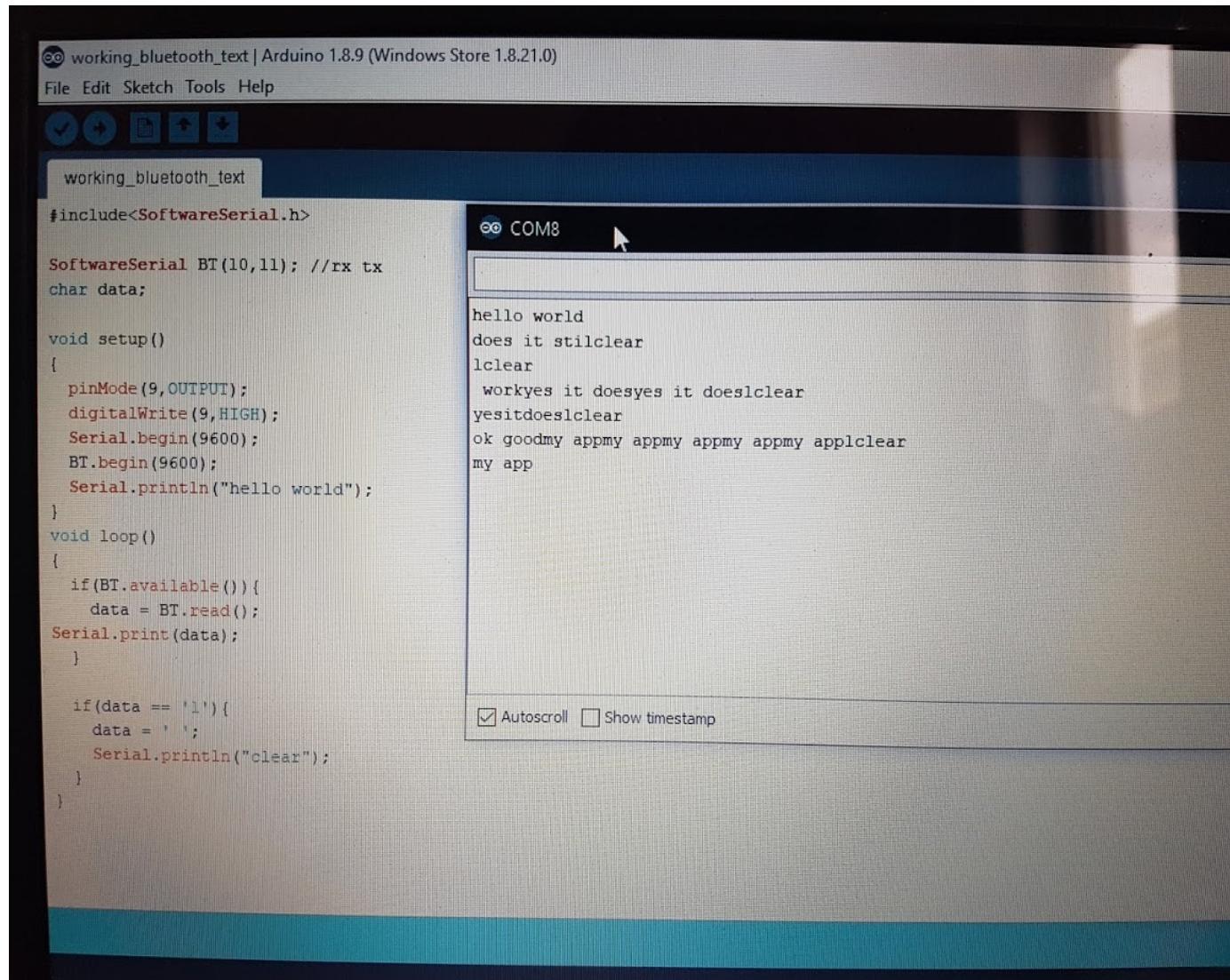
PRECISE CALCULATIONS

Our first prototype for an LED display only costs, \$124.12. While this may seem like a lot of money at first glance, it really is not. Due to time constraints laid out by our clients and stakeholders we had limited access to the supplies we could receive. Due to shipping costs and product availability our cost was a little higher than intended. This design will only improve as time progresses. To start if we were to wait longer to receive our products the display cost could easily shrink.

AURA Designs		
Score Clock Receipt Harms, Kyle Donald		
Bill of Materials		
WS2812B Addressable RGB LED Strip 5m	001	49.99
3D Printing PLA Filiment	002	7.79
Arduino Uno R3 Project Set	003	3.31
DC5V 20A 100W Power Supply	004	24.88
HC-05 Wireless Bluetooth	005	10.99
4 x L Mounting Brackets	006	5.64
2 x Black Spray Paint	007	1.96
Frosted Acrylic Panel	008	10.55
Electrical Tape - Black	009	0.99
Light Bulb	010	0.99
Subtotal		117.09
Tax	6.000%	7.03
Total		124.12
Change Due		0.00
Payment Method: Visa		
Card Number: 4296 **** * * * *		
Date: 6/12/2019		Thank You. Please Come Again!

PROTOTYPE CONSTRUCTION

A glimpse of our construction phase. To start off with we have the heart of our project, the code, the computer chip that controls all the LEDs and displays your message.



The screenshot shows the Arduino IDE interface with the sketch named "working_bluetooth_text". The code uses SoftwareSerial to communicate with a Bluetooth module. It initializes pins, sets up serial communication at 9600 bps, and begins a loop where it reads data from the BT module and prints it to the Serial monitor. If the received character is 'l', it prints "clear". The Serial monitor window shows the output of the code, including some test messages and the word "clear".

```
#include<SoftwareSerial.h>

SoftwareSerial BT(10,11); //rx tx
char data;

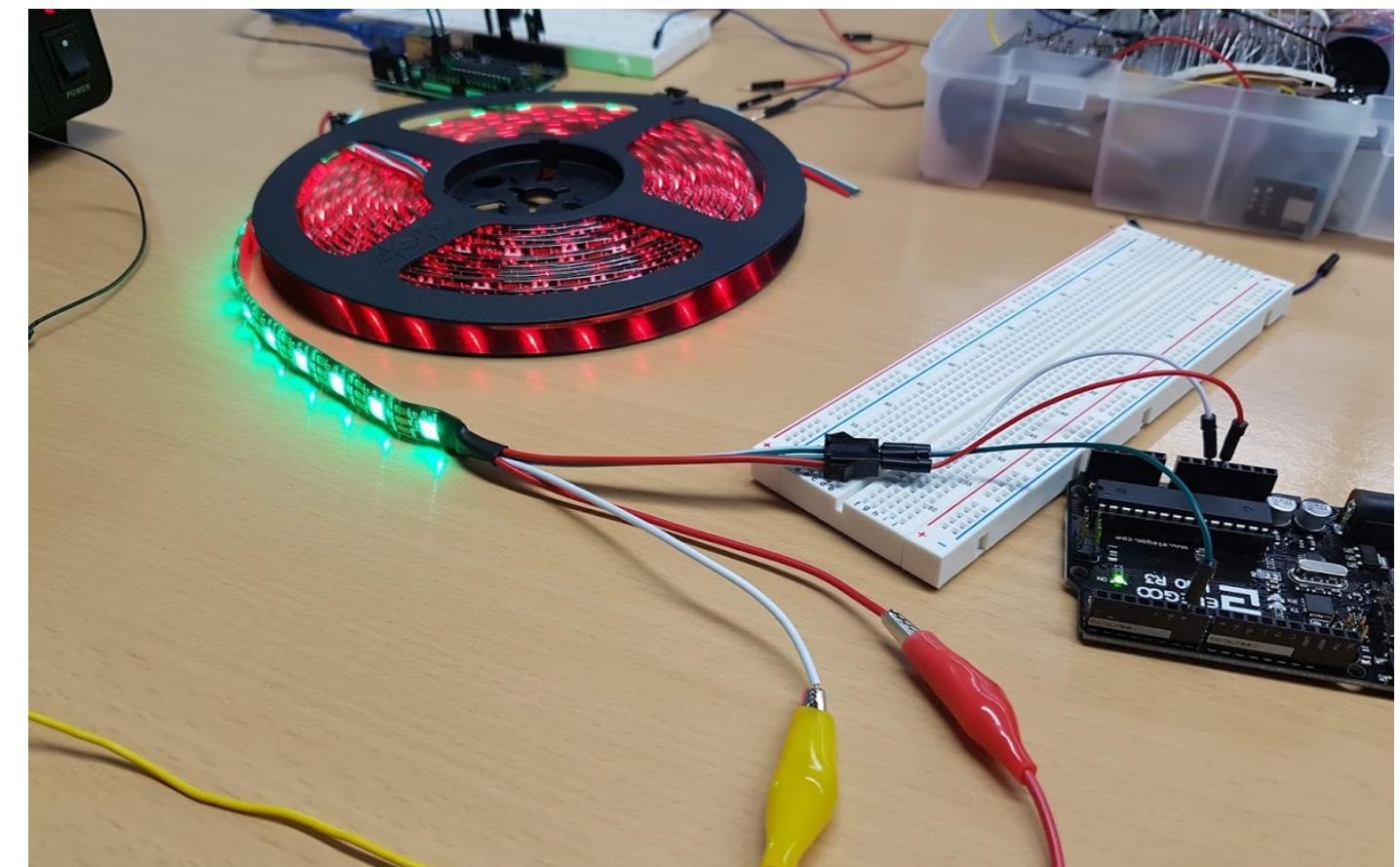
void setup()
{
  pinMode(9,OUTPUT);
  digitalWrite(9,HIGH);
  Serial.begin(9600);
  BT.begin(9600);
  Serial.println("hello world");
}

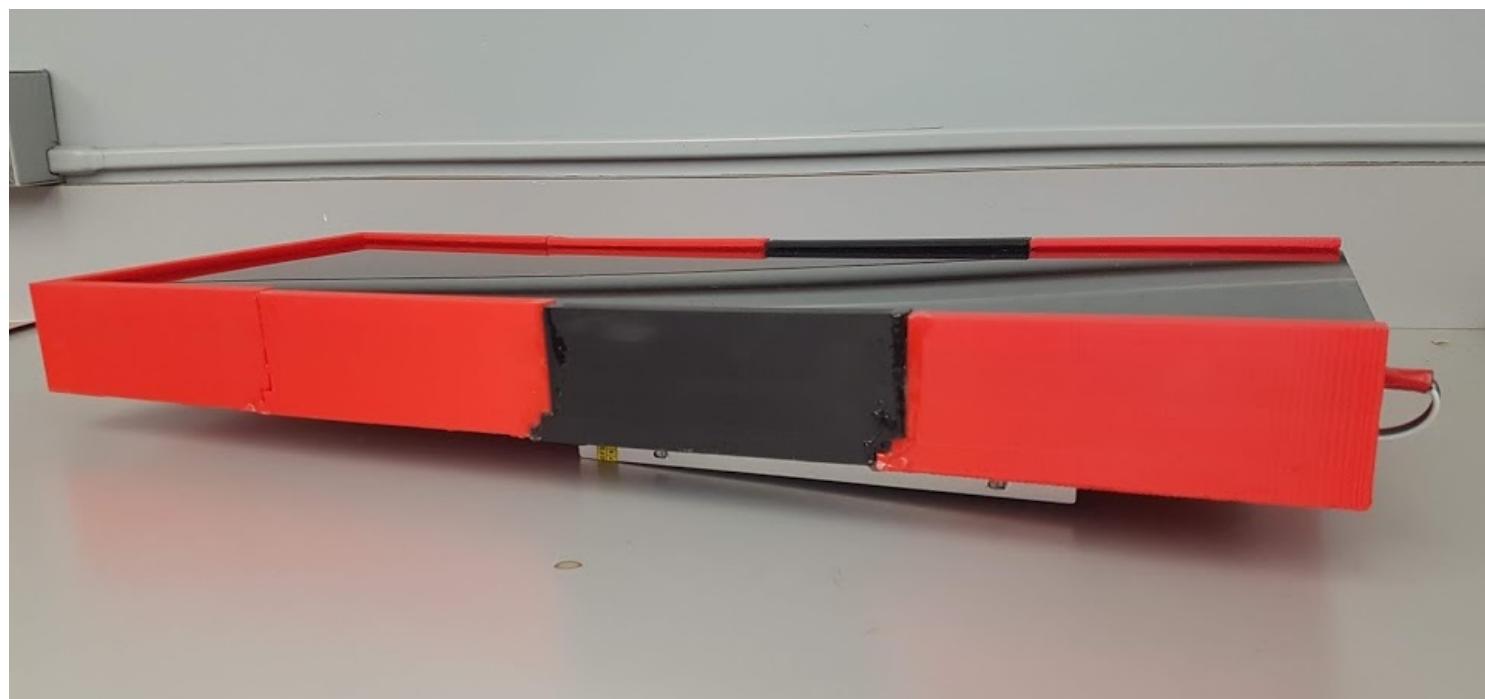
void loop()
{
  if(BT.available()){
    data = BT.read();
    Serial.print(data);
  }

  if(data == 'l'){
    data = ' ';
    Serial.println("clear");
  }
}
```



Next we have the LED strip. For this project we decided to use high quality WS2812B LEDs as they are individually programmable and provide with RGB color. They don't use a lot of power to run and have a generally low price.





Next we have the shell, the casing for our product. A low profile easy to use case with grooves on each end to slide different parts and components in and out of. We used this design to ensure the user has complete control over their product and know what is inside as well as how everything works together.



This is the LED plate, using our precise calculations to determine the best aspect resolution for the application of this display. With that information we placed and connected seven 50cm long led strips to create an intricate matrix of LEDs.

AURA LED Display

⋮



Connection Status

Disconnected

"AURA"

Enter Team Name

Please press clear before
entering in another team name.

Clear Display Text



How it Works

Type in your team name and hit
the button. Aura will display the
text on its display via bluetooth.

Finally, to aid the user, we created our own app using a web application called MIT APP INVENTOR. The app uses top down design to guide the user through different steps to help them display their message on the big screen.

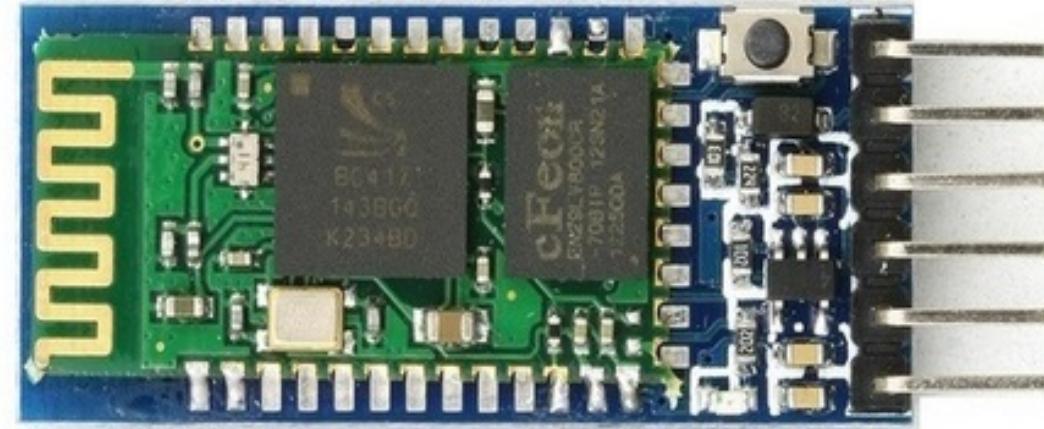
OBSERVATIONS AND MODIFICATIONS

As time progresses people begin to want new things. At AURA designs we listen and adapt.



Design Changes

To improve the overall quality of the final product we made some big changes to our score clock name board. To start we changed the entire material it was built out of. Instead of using wood as intended, we chose to 3D print the shell enclosure instead. This decreased a lot of unnecessary weight allowing us to make room for other more important parts. Another design feature we changes was the removal of the grid. After testing out a foam grid insert we came to conclude that the difference between having a grid and not having a grid was minute and unneeded.



Testing Process

During the testing process we faced multiple challenges with the bluetooth module. There are a lot of complications that come when using this tiny module. To start the HC-05 BT Module was not working as intended out of the box. To fix this we researched the most common problems with BT modules and how to fix them. In the end we reset the BT module using the AT command mode and changed a few settings while we were at it.

```
Serial port 'COM3' already in use. Try quitting any programs that may be using it.  
Binary sketch size: 4960 bytes (of a 258048 byte maximum)  
processing.app.SerialException: Serial port 'COM3' already in use. Try quitting any programs that may be using it.  
    at processing.app.Serial.<init>(Serial.java:144)  
    at processing.app.Serial.<init>(Serial.java:76)  
    at processing.app.debug.Uploader.flushSerialBuffer(Uploader.java:75)  
    at processing.app.debug.ArvduudeUploader.uploadViaBootloader(ArvduudeUploader.java:88)  
    at processing.app.debug.ArvduudeUploader.uploadUsingPreferences(ArvduudeUploader.java:66)  
    at processing.app.Sketch.upload(Sketch.java:1664)  
    at processing.app.Sketch.exportApplet(Sketch.java:1624)  
    at processing.app.Sketch.exportApplet(Sketch.java:1578)  
    at processing.app.Editor$DefaultExportHandler.run(Editor.java:2314)  
    at java.lang.Thread.run(Thread.java:619)  
  
processing.app.debug.RunnerException: Serial port 'COM3' already in use. Try quitting any programs that may be using it.  
    at processing.app.debug.Uploader.flushSerialBuffer(Uploader.java:99)  
    at processing.app.debug.ArvduudeUploader.uploadViaBootloader(ArvduudeUploader.java:88)  
    at processing.app.debug.ArvduudeUploader.uploadUsingPreferences(ArvduudeUploader.java:66)  
    at processing.app.Sketch.upload(Sketch.java:1664)  
    at processing.app.Sketch.exportApplet(Sketch.java:1624)  
    at processing.app.Sketch.exportApplet(Sketch.java:1578)  
    at processing.app.Editor$DefaultExportHandler.run(Editor.java:2314)  
    at java.lang.Thread.run(Thread.java:619)
```

Problems Encountered

On the other hand the code was the most challenging part of the score clock name board. Since the BT module sends data at different BAUD RATES it was important to make sure that what we were using was compatible with all the devices around. After playing around with some numbers and changing some variable settings in the code it was ready. Until the only thing being displayed was the last character of each string. To solve this issue we created a new variable that stored iterations of your text inside and displayed it once every iteration was complete. This ensures that your message is displayed properly each and every single time you use AURA's S.C.N.B.

AREAS FOR IMPROVEMENTS

To ensure our product remains the best we have planned out the future of its development. Here are 6 things we would do to improve AURA S.C.N.B.



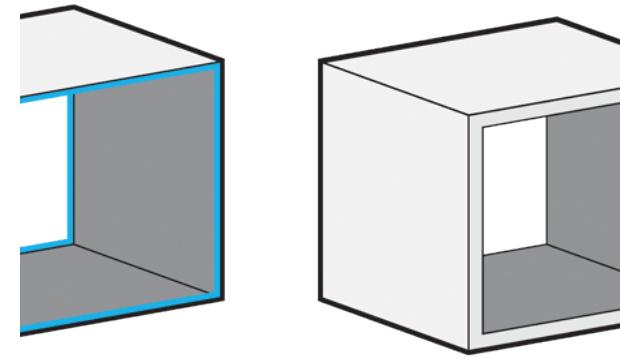
thin [θɪn]

thick [θɪk]



1. Make It Thinner

As many of you don't already know, our score clock name board is pretty thick. This is because at the time our constraints and ideas required us to have space allocated to a large 220V power supply and grid. Removing these parts could reduce the thickness by over 50%.



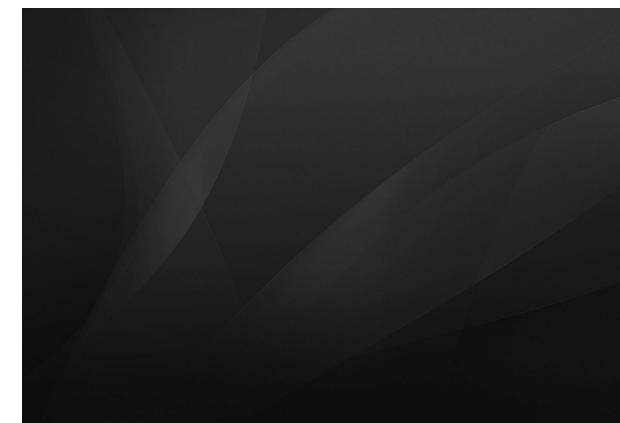
3. SINGLE BODY SHELL

Instead of having multiple parts combined to make one, we can increase the structural integrity of the whole score board by printing it as one piece. Although to do this we would need to gain access to a larger 3D printer.



4. HIGHER PPI

Using 144 leds/m allow for more letters to be placed on the same amount of space. Not only this but it also allows for greater visibility and higher brightness.



5. GLOSSY BLACK

To continue the trend of aesthetics, covering the rough 3D printed plastic in something else with a glossy finish would increase the design of the score board. Additionally a glossy black finish would give the display a stealthy and futuristic bezel less look.



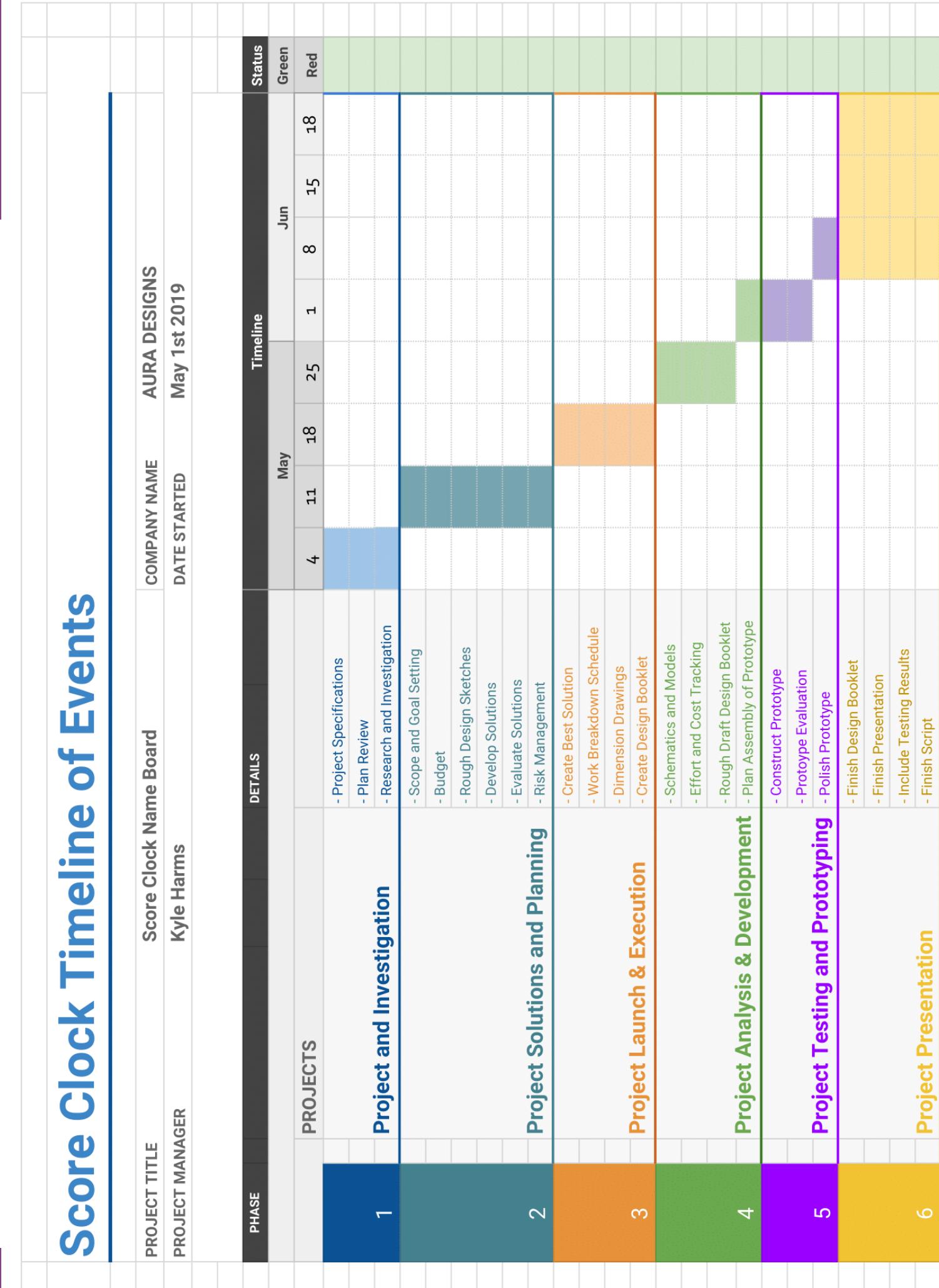
6. IMPROVE APP

As of right now, the app is fairly simple accomplishing the bare minimum. We can include so many other features for example color change, brightness toggles and option to scroll text. And this is just the tip of the iceberg.

PROJECT TIME LINE OF EVENTS

At AURA Designs our head engineers are always hard at work, completing works for their clients. Our engineers take time outside of their work shifts to work on assigned project. For this project, they received ~30 hours of work time (plus an extra hours recorded in their design journals) to design, and construct a fully functional score clock name board based of the requirements given by the client. The engineers working on this project are Shafin Mohammad and Aashir Husain. While these two were hard at work measuring and developing the foundation of the project they were also building, modeling and powering this task. The tight schedules and determination is in the end what allowed them too finish this prototype on time. In the end the brains and foundation came together from just two engineers, to create a very elegant score clock name board for their valued client.

Score Clock Timeline of Events



Head Engineers:
Shafin Mohammad and Aashir Husain

Special thanks to our client:
Mr. Peterson

Big thanks to project supervisor:
Kyle Harms

