Project Proposal
Team 9
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Project Name
RLED: REVOLUTIONIZED LEDs

Project Synopsis
Smartphone-controlled LED light strip allowing for intuitive user customization and interaction.

Project Description
This project is being undertaken to improve upon the standard LED light strips that you can purchase online. Most current LED light strips are rather boring as they only allow for a single color to be displayed across the strip at a time and do not offer much in terms of pattern customization or to be synced to a song. Beyond creating custom patterns to display on the LED light strip, this project will allow for patterns to be created, shared, and downloaded among users. The end result of the project should be an LED light strip that can be intuitively customized by the user via their smartphone. The most important concept of this project will be the sharing functionality such that users can see what other people have created with their own LED light strips and then be able to 'like' and download them to their own device to be used. In addition, an increase in the number of LEDs that are on a single 16-foot light strip from 150 to 300 will allow for greater customization of patterns and more elaborate displays.

Project Milestones
- **1st Semester**
  - All initial hardware purchased and assembled **10/16**
  - Implementation of the foundation of the iOS app **11/6**
  - Basic user interaction documentation **11/27**
  - Light strip and base app functional with default customizations implemented **11/27**
- **2nd Semester**
  - Allow users to implement their own customizations **3/1**
  - Incorporate with Smart Homes (HomeKit & Siri, Alexa) **3/20**
  - Basic user customization documentation **4/23**
  - Allow users to share their customizations **4/23**
- **Who Will Do What?**
  - Rob Chirpich: creation & implementation of microcontroller firmware
  - Qui Phan: creation & implementation of microcontroller firmware
  - Afnan Latif: front-end app design & implementation
  - Justin Khounsombath: front-end app design & implementation
  - Cameron Tomka: front-end app design & implementation

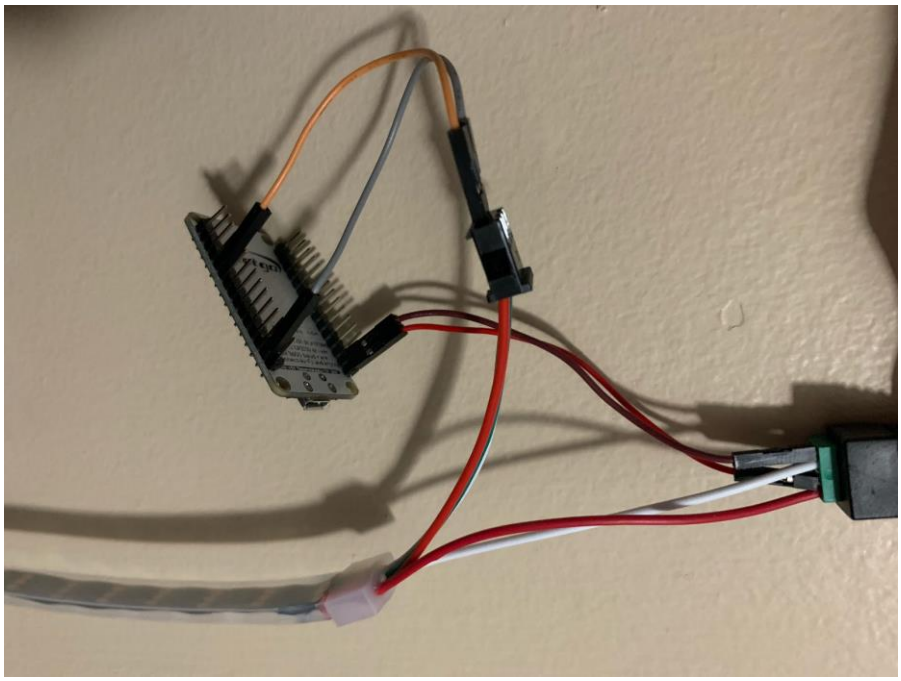
Project Budget
- **Initial Hardware:**
    - **Required immediately**
  - [$6.50 for 1] ESP8266 Microcontroller (https://www.amazon.com/gp/product/B010O1G1ES/ref=ppx_yo_dt_b_asin_title_o00_s00?ie=UTF8&psc=1)

    - [$29 for 1] WS2812B RGBW 16.4ft 300 LED Waterproof Strip (https://www.amazon.com/gp/product/B07BHK4LNQ/ref=ppx_yo_dt_b_asin_title_o00_s02?ie=UTF8&psc=1)
    - [$20 for 1] 5V 10A 50W AC Power Supply (https://www.amazon.com/gp/product/B07Q26YG61/ref=ppx_yo_dt_b_asin_title_o00_s01?ie=UTF8&psc=1)
- **Development Machine:**
    - [$20+] "Rent" a Mac from a service such as MacInCloud
        - Required as needed by developer
- **Apple App Store Fee:**
    - [$99 per year] Fee to host an app on the Apple App Store
        - Required late second semester
- **Amazon Web Services:**
    - [Free for 25 GB] Amazon DynamoDB storage (200 million requests per month)
        - Required second semester

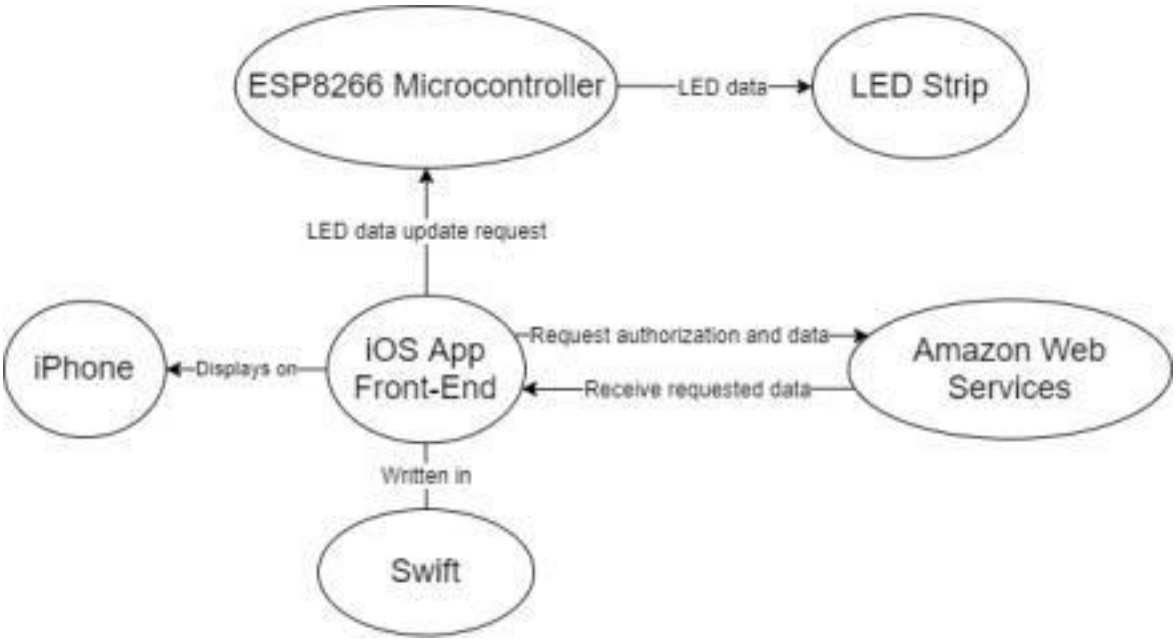
Preliminary Project Design

Revolutionized LEDs product is composed of two main components: the actual physical hardware and an iPhone-based application. The physical hardware is composed of three main pieces: the power supply, the microcontroller, and the LED light strip. In order for all of this hardware to work together smoothly, the components must be compatible with one another such that no electrical hazards will come about. Because of the features that we want to implement in our product, our choices for LED light strips were rather limited as we need RGBW, individually addressable LEDs, and also the strips require 60 LEDs per meter to allow for the greatest level of customization possible.

From these requirements, the best choice for an LED light strip came down to the WS2812B variety which meets all of our requirements, but has a few constraints of its own with respect to the power supply. The most important requirement from using LED light strips of the WS2812B variety is that they are only capable of handling 5 volts, thus extra care has to be used in picking out a viable power supply. However, the LED light strip also has a maximum required current for full functionality; with WS2812B strips, 18 Amps is the most that will be required to unlock peak brightness - this does not mean that the light strip will be unable to function with less amperage, but rather the LED strip will not achieve the highest level of brightness it possibly can. Ultimately, the decision on which power supply is best for any given situation can be left to the user, but for our current implementation of this product, we are using a 5 volt 10 amp power supply which is more than enough to satisfy most users as the level of brightness this current can produce is rather high already. The last piece of hardware that is required is a wi-fi enabled microcontroller which will be used to connect the LED light strip to the user's iPhone.

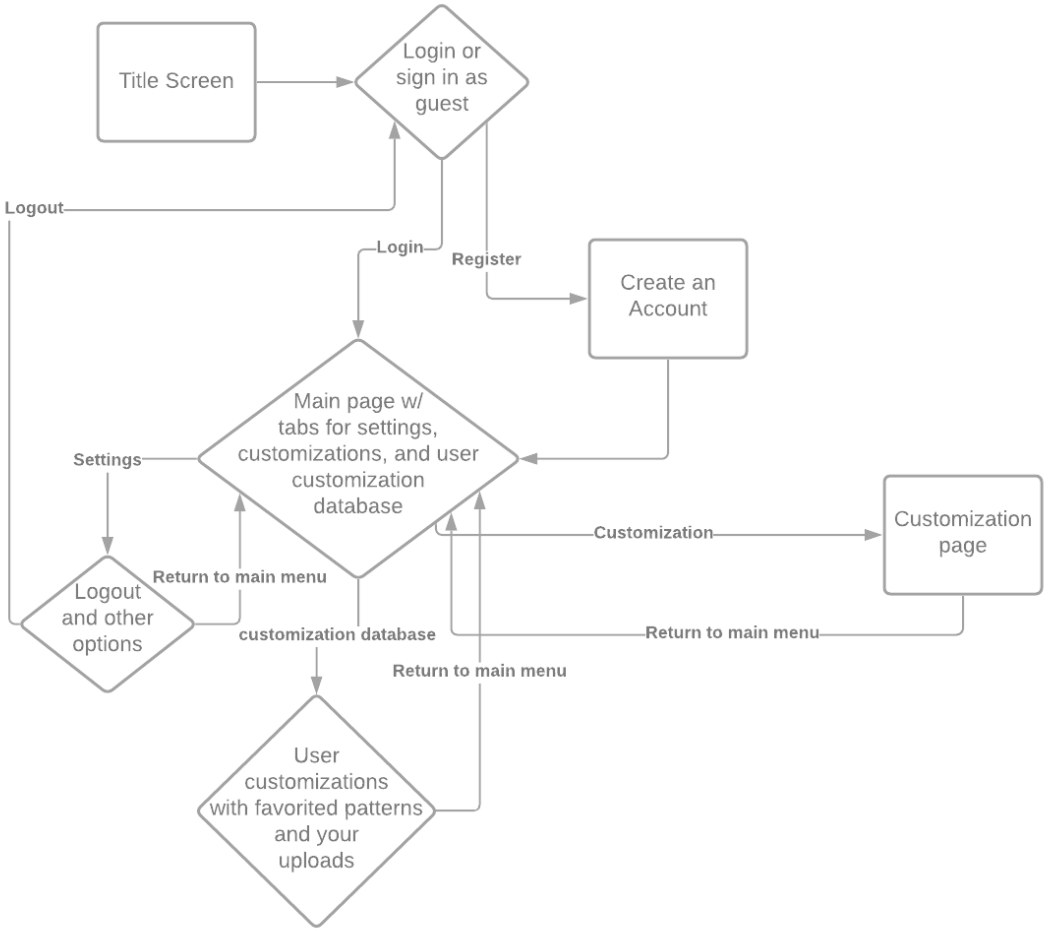


There were many possible choices, but for the current implementation the generic ESP8266 microcontroller is sufficient as this board is capable of handling 5 volts and also has the necessary onboard pins we require: ground, vin, and data - it also has others, which may be used down the line for more advanced features. Above is a photo of our current hardware implementation, excluding the power supply.



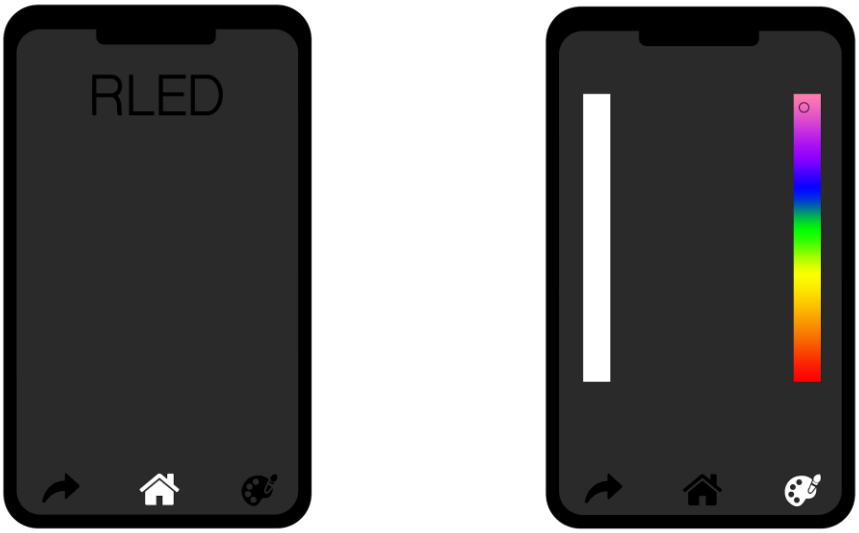
For the Front-End, we will develop the iOS app in the Swift language that is only available on an iPhone. The app will solicit data changes from the LED strip and send them to the ESP8266 microcontroller. The LED light strip is connected directly to the microcontroller so it will receive the LED data and execute the appropriate light pattern.

Since our app is going to have sharing capabilities for each user, we will utilize Amazon Web Services to store the user's credentials for authorization and user's saved light pattern data. When a user logs in with their ID and password, the iOS app sends a request to verify the given login information and then receive the user's profile, including the user's credentials as well as the user's light pattern data. In addition, Amazon Web Services will be used to store customized and personalized light patterns that any user can download and use with their own personal LED light strip.



For the iPhone-based application portion of this product, the goal is to have a visually appealing and intuitive user interface such that anyone can use it. Upon startup, the application will display our own applications title screen and from there the user can choose to login as an existing user, as a guest, or to register to create a new account. Once done with that, they are introduced to the main home page with tabs for home and settings, LED light strip pattern customization, and accessing and sharing custom user created light patterns that are stored in the cloud database. The data for custom user created LED light strip patterns will be stored on Amazon Web Services cloud servers such that it protects the credentials of the user, their

settings, and any other private information they wish to maintain some level of security with. With Amazon Web Services, we can request and send various bits of data to the servers on behalf of our users. The front end of the app, including the user LED light pattern customization, will be wirelessly connected to and sending information to an ESP8266 microcontroller which is directly connected to the WS2812B LED light strip. The apps front end will be written and designed almost solely in Swift and will be available on the iOS store, likely for free.



Above are our initial depictions of how the iPhone-based application will look as designed by the front-end members. The top left represents the initial home and settings page where users will

be able to log in to an existing account or to register and create an entirely new account. Once this is done, the functionality of the rest of the application will be unlocked. Once this functionality has been unlocked, the first step in connecting to the microcontroller to control the LED light strip and the patterns being displayed will be to 'Add' a new connection or device. In this case, we are adding a new LED light strip, so we will name it appropriately to distinguish it from other connected devices on the network. Next, the user will have to input their personal Wi-Fi network credentials so that the ESP8266 microcontroller will be functional on a wireless level and with the iPhone it was just connected to, but only as long as the iPhone is on the same wireless network as the microcontroller - this is very important!

After having connected the devices together physically and wirelessly, users will be able to modify various settings such as the number of LEDs that they wish to control on their LED light strip, the color schema of the LED light strip as well as the type of the LED light strip so that the proper patterns can be made available to each user as not all LED light strips are made equally. Once the settings have been updated, the user will be able to power on their own LED light strip and they will be dazzled and amazed at the bright LEDs shining back at them. From here, the user will most likely enter into the LED pattern customization section of the application where they will be free to create any sort of pattern they desire. They will be allowed to modify the speed at which the pattern is changing across the application, the brightness at which the LEDs on the light strip are displayed, and also the intensity of some various pre-loaded patterns that will be there to get the user started.

Ethical Issues:

- [Code of Ethics 1.2] Avoid harm
    - We need to ensure that the amount of power we are supplying to our LED strips and arduino is not going to cause any overheating or shorts. If we decide to mass produce our product for sale, the use of a third-party power supply could cause an overload and be a potential fire hazard. We would also need to be wary of patterns that could be hazardous to users with medical issues such as epilepsy.
- [Code of Ethics 2.9] Design programs that are robustly and usably secure
    - We are storing user data and need to ensure the security of it. Obviously we are not well-versed in concepts of cyber security so ensuring the safety of names, passwords, emails, and other data would be a task we would need to research in order to bolster privacy.

Intellectual Property Issues:

- Our issues with this project in regards to intellectual property will be determining how to get a patent for our 300 LED light strips and our app. For the hardware aspect, the best tool for us would be to create a patent for the way we construct our LED strip. However, issues with this would come up because the original LED strips we are buying are not created by us; rather, they are bought online and used in conjunction with other hardware.
- With more popularity, we could establish a trademark for our brand for things such as our logo, name, or symbols that are identified with our product. Our app can be claimed under copyright as well since it is an artistic and creative piece of software. Any and all custom patterns created by users will have no type of intellectual property license.

Change Log:

- **Project Milestones**
    - Some 1st and 2nd semester milestones were reworded for clarity.

    - Team member roles were assigned to each member to reflect the decisions that have been made to work on certain parts of the project. The roles were divided into the development of the application and then the creation and implementation of the firmware for the microcontroller.
- **Project Budget**
    - Our initial hardware changed to reflect the current hardware we are using, thus prices, names, and links to the WS2812B 300 LED 16.4ft strip, ESP8266 microcontroller, and 5V 10A 50W power supply were updated.
    - A development machine fee was added so that those members without Macs are able to complete their tasks.
    - The fee for uploading an app to Apple's App Store was included as this will become important during the second semester.
    - The cost for using Amazon Web Services for cloud storage was included.