DOE Final Interim Report

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CSC-450/650
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1. Client info

1.1 Who is the client? (Unchanged)

Client Information:

Our client is (cascading down):

United States Department of Energy (DOE)
Office of Energy Efficiency and Renewable Energy (EERE)
Building Energy Research & Development
Building Technology Office

For succinctness, the client is referred to as "the client" or "DOE" in the rest of this document.

DOE Contacts:

Dr. Wyatt Merrill
Company: Department of Energy Building Technologies Office
Website: https://www.energy.gov/eere/buildings/building-technologies-office

1.2 What do they want? (Product Vision) (Unchanged)

A searchable database of spectral power distributions (SPD) from commercial LEDs that has the ability to derive lighting qualities (TM30, CRI, color temperature, etc.) directly from the SPD and the ability to export the data unlike private sector firms and general energy companies or databases technology firms who might charge too much for such a product. The product should undergo user testing to ensure import/export capabilities as well as correct and accurate SPD calculations.

1.3 Example personas and user stories: (Unchanged)

Example personas and user stories that are used to derive product features:

- **Government energy organizations**

Persona and Scenario: Bob, age 34, works for the Building Technologies office at the Department of Energy in Washington D.C and has a background in Chemistry. His team has been tasked with working with thousands of lines of SPD lighting data values and their goal is to find the Gambot of the light (RG) and Fidelity (RF) metrics as well as an SPD graph displaying

the color spectrum based on the inputted data values. Bob has the experience with deriving and collecting the data but is unfamiliar with the techniques used to find TM-30 metrics based on those values.. Bob and his team do not have an experienced background in calculating these TM-30 metrics and are a bit unfamiliar in inputting the wavelength and intensity values into equations to correctly calculate the metrics they are looking for. Bob and his team are aiming to just be able to take their file's worth of data, input it into a calculator, and receive the outputted metrics they desire.

User Story: As a Chemist I want to be able to plug in collected data to the software and be able to clearly and easily obtain accurate calculated SPD data metrics displayed on my screen.

- **Lighting manufacturers**

Persona and Scenario: Brian, age 45, is a lead manufacturing project manager at General Electric and oversees hundreds of different products that General Electric manufactures from LED retrofit lighting kits to incandescent garage bulbs to simple halogen floodlights. Brian in his earlier college years received a degree in physics along with mastering in electrical engineering and his early work experience included various engineering and manufacturing jobs of similar lighting products to what he currently oversees today. Brian is the first point of contact when asked about the specific metrics, data and progress in development about the General Electric products being manufactured. Brian hopes to update his current system of keeping all of this product information either on paper or on his company computer so that the information can be more easily accessible as opposed to going through him every time for it. With SpectraSearch, Brian wants to be able to utilise an upload feature so that he can input various TM-30 SPD metrics about GEs products, manufacturing information and product names into the easily accessible database so that both him and his clients can access this information with a simple search.

User Story: As a manufacturer project manager I want the ability to upload lighting product information for my company so it can be easily accessed for later use.

- **Electrical engineers/scientists**

Persona and Scenario: Alice, age 29, is a Senior Electrical Engineer working at a large lighting company and finds her main work with deriving lighting qualities from the lighting products she works with. Alice has had ample experience working in various labs running experiments pertaining to both deriving Fidelity and Gambot of light metrics and studying the effects on the human eye versus the effect of the light on a plant. She continuously runs tests to compare the SPD spectrums across many lighting qualities that she works with. While having much experience in working with these metrics and calculations Alice wants to be able to use her work and put it on a platform for the data to be more readily available. Using SpectraSearch Alice hopes to run her tests and calculations through the software and also run those comparisons between the effect of color and light on the human eye versus a plant or the eye of an animal.

User Story: As an electrical engineer I hope to take my studies and data and input it on the SpectraSearch software and use the output metrics to study the varying values between different mediums.

- **Light Bulb companies/company employees**

Persona and Scenario: Zack, age 26, is a data analytics specialist working in the lighting products department at FEIT electric. Zack graduated from American university with a statistics and information technology degree and has had various opportunities with accounting and law firms to collect and create insightful data recommendations. Now with a full time opportunity at his current company FEIT electric, he works mainly to supply the company with data based on their lighting products. Zack mainly works with engineering and manipulating data with his Python and R competencies but is not knowledgeable about the lighting data he currently works with. His recent project assigned to him is to gather specific lighting metrics about FEIT electric's LED lighting products. Without this information readily available to him Zack is looking for a software product or database where he can easily access the uncommon LED bulb lighting metrics that he needs to supply his company with relevant information for his project. Zack can utilize the SpectraSearch searchable database to access all of the relevant information about the lighting products he needs with a simple search.

User Story: As a data analytics specialist, I want to be able to easily access information I am not knowledgeable about from a readily available database containing said specific lighting metrics and be able to use this data for my company..

2. Progression

2.1 What does the client require from our team? (Changed)

Upon the meetings that were conducted with the client the requests were as follows: An accurate (SPD) calculator to calculate certain lighting metrics and advanced light mechanics, Update the function standard into the TM30 protocol (IES Technical Memorandum), Clean the application and shaping the performance of it, Include Things like (Gambot of the light (RG) and Fidelity (RF)) into the calculator, Clean the field with in the upload page and finally there is a need to shape the website to meet accurate numbers when modeling and graphing. The challenging in that part is trying to figure out **How can we take the SPD and calculate these things that are part of the TM30 protocol in an accurate manner** since the client does not know how to calculate these things himself, nor is an industry standard calculator available prior to us exist, so we have to learn it in order for us to transmit it to an application software standard for him. Apart from this goal the client, for finishing off the semester, wants us to build up the database with the newly available data as much as we can since with the equation setbacks in mind.

2.2 Where are we now? (Our current progress) (Changed)

At this point we have moved away from working with the equations because the team found there was not going to be enough time to keep combatting this problem as we keep hitting walls that do not allow us to move forward with this functionality. Following attempted contact with

the curator . Alternatively, the team has been working toward integrating filtering functionality with the data the database already contains instead of filtering the data with the previously discussed excel functionalities. For some guidance on these issues the team contacted previous team members on their strategies toward integrating the equations. The current progress as of now entails many front end updates that include new features for better user experience and better data categorization. New features include: cleaner categorization of SPD data when using the search function, clean presentation of filtered data with tables to present requested data points and also worked to add numerous data points to overall build up the database with many more SPD values. Other improvements were many bug fixes to the application including: lag with the search bar only presenting one result at a time, bugs relating to the sign up function on the login page not allowing the user to sign up, upload bugs that did not allow full functionality of the data upload feature and data exporting issues that led to incorrect data being exported.

2.3 What is the client's end goal with us? (Changed)

Following the setbacks of the main priorities previously discussed, the end goal has now shifted to aim for a build up of the database to be much larger in scale and be able to combine SPD data currently in the database with new data provided by the client. It was requested to also finish any current front end enhancements to improve the usability and possibly build up the product and database to be a substantial product to be continued for future teams.

2.3.1 Brief Summary Of The Meetings With The Client

Meeting 1 (Wednesday Sep 9th, 2020)
Establish initial contact with the client, introduce the group and have the client present their needs and goals for the product. Helped the team establish roles and create goals for the team to complete for the next milestones.

Meeting 2(Monday Sep 28th, 2020):
Going off our clients previous requests and explaining the current state of the product including showcasing how the application works and going through new tasks and updates from them. Deliverables: 20 page PDF help manual of how to install/run the application.

Meeting 3(Monday Oct 26, 2020):
The CSV upload function was presented to the client. The team was provided with further information on the equations pertaining to TM-30 calculations. Due to an issue with GitHub the client was not able to access the current version of the software. The client left us with a new request, asking us to include a filter function in order to give a better user experience in navigating through the information within the database.

Updated Meeting 4(Monday Nov 30, 2020):
Client requested that we include more data of different lighting sources into our database to make the application more practical for everyday use, this would also scale up the database to be more suitable to include real world data. He advised us to contact Dr. Ohno one more time in

order to gain more knowledge on the SPD equations if time permits. The client was able to provide us with a new data of 1,500 different light sources for further examination and learning purposes. Right after that we managed to update the SQL database with that new information gained.

3. Milestone

3.1 Timeline:

Sprints 1 and 2 (Start September 3rd)
Sprint 1:(Ends September 29)
- **Sprint 1 Scrum 1 (Sep 12, 2020)**
- **Sprint 1 Scrum 2 (Sep 19, 2020)**

Sprint 2:(**Ends October 10th**)
- **Sprint 2 Scrum 1 (Sep 26, 2020)**
- **Sprint 2 Scrum 2 (Oct 03, 2020)**

Presentation 1 (Oct 06, 2020)
Interim Report 1 & Survey report 2 (Oct 08, 2020)
Sprint 3 and 4 (Start October 10th)
Sprint 3:(Ends October 24th)
- **Sprint 3 Scrum 1 (Oct 10, 2020)**
- **Sprint 3 Scrum 2 (Oct 17, 2020)**

Sprint 4:(Ends November 6)
- **Sprint 4 Scrum 1 (Oct 24, 2020)**
- **Sprint 4 Scrum 2 (Oct 31, 2020)**

Presentation 2 (Nov 03, 2020)
Interim Report 2 & Survey report 3 (Nov 06, 2020)
Sprint 5 (Start November 6th)
Sprint 5:(Ends November 28th)
- **Sprint 5 Scrum 1 (Nov 07, 2020)**
- **Team assessment report (Nov 13, 2020)**
- **Sprint 5 Scrum 2 (Nov 14, 2020)**
- **Sprint 5 Scrum 3 (Nov 21, 2020**)

Additional Feature Time (Nov 28, 2020 - Dec 05, 2020)
Additional Feature Time:(Ends December 5th)
- **Additional Feature Time Scrum 1 (Nov 28, 2020)**
- **Additional Feature Time Scrum 2 (Dec 05, 2020)**

Final Reports & Survey report 4 (Dec 08, 2020)

(Milestones denoted here are based on when we are meeting with the client for updates or and they are meeting the end of sprints)

Sprint 1 Sep 29th:

First testing meeting with client: Fixed bugs and functionality issues to have a presentable, testable product ready to show the client. The main purpose of a meeting at this point in time was to show our client how the product currently works and receive client input on the current system. Technical progress by this point included: bringing the calculator to testing functionality (not 100 percent accurate), fix the functionality of the login page to allow users to log in and

access the database information, and fix bugs with the upload page. Input we received from the client were points including changing the current metrics that are given when putting data into the calculator to the updated TM-30 metrics, specifically Fidelity and Gambot of Light, and the second major input from the client was adding the capabilities to just upload a CSV file to the calculator page and have the program run calculations based off that instead of having to manipulate the data manually to run in the calculator. These updates are to be made by the next meeting

Sprint 2, Oct 10 and 3, Oct 24; October 26th meeting with client:
After numerous recommendations from clients, our main goals for October and the next Client update are a fully functional Upload feature and Corrected TM-30 standard metrics that the product will output. The metrics should be a simple fix on the front end: simply changing and deleting irrelevant metrics in the output table from the calculator and adding in the new ones requested by the client. The main challenge we will face here is becoming familiar with the equations we are working with and how we are going to integrate them into the code, certainly an unexpected event we are currently facing. We have been able to make good progress on updating both the upload page and adding a file upload function on the calculator page, but are still facing technical issues to get those running, by the october 26th milestone both of the issues will need to be fixed.

Sprint 4 Nov 6:
Following the presentation 2 and end of sprint 4 the team has still not been able to fully integrate the updated TM-30 metrics which was a priority during this sprint. Major updates leading up to this milestone that were completed were the full functionality of the CSV upload feature as well as fixing front end bugs with the overall upload page that were pointed out by the client. The calculation page now has the functionality of being able to take in a CSV file through an upload button tool and pull in the SPD data from that file and calculate the metrics from that data. Some progress has been made toward implementing the new Gamut and Fidelity index equations but the problems the team has faced on this issue is a lack of knowledge in fully understanding all of the many components that are a part of these calculations. The team has not been able to integrate the equations but were provided with helpful resources like an SPD calculation spreadsheet that will help the team break down the equations into more understandable parts. The goal going forward is to break down all of these equation components and try and integrate placeholders in our code for each variable and even try to implement spreadsheet technology in the web app that will pull in the SPD data from the web app and calculate them through the spreadsheet.

Team assessment milestone Nov 13:
By this point it is looking like the team will not be where we want to be in terms of having all of the features completed described in previous milestones. Previously mentioned were various features like spectral data output and how it might appear to different mediums like the human eye or plants, database and user interface enhancements. The team's main setback has been with integrating the fully functional TM-30 equations; these have been a process we have taken more time on than we thought. Our team's assessment by this point is we now have two main priorities: work to fully understand these equations and get some functionality into our product and also try and work on a search categorization feature. With the

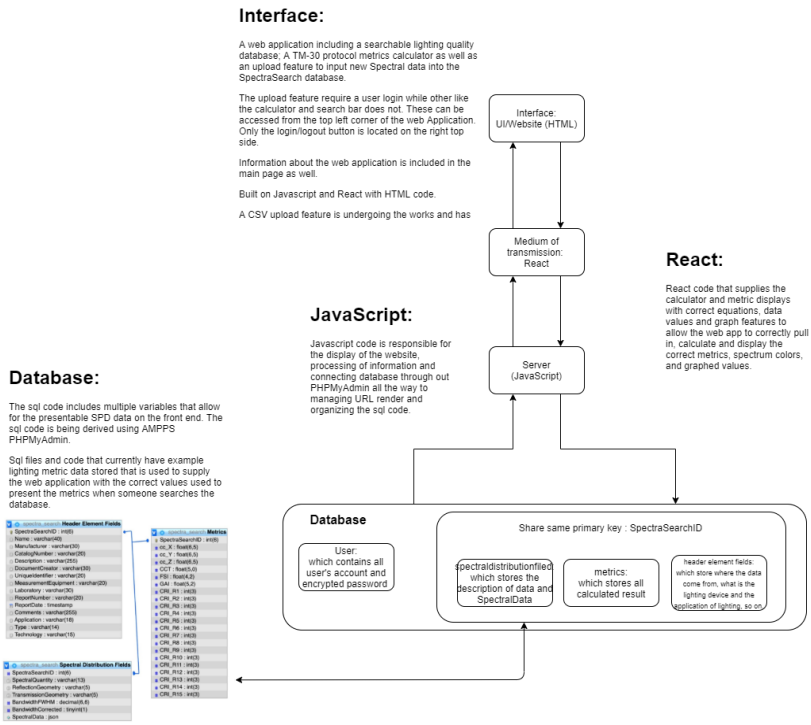
magnitude of work that needs to be put toward the new TM-30 equations any additional features the team previously thought could be added need to be either postponed or scrapped for now with respect to how much time the team has left at this point. Now the focus is getting feasible front end features added, such as a categorization search feature and updated interface changes for a better appearance; the new main priority at this point is still to put forth work on these equations to either prepare future groups to continue this work or have some functionality completed before shifting full focus to other major product aspects. Following sprints and milestones will still have goals in place to implement data verification (data checker), work toward categorization and data filtering and mass feature debugging on the web app but the team is realizing the equation work is more of a setback then we previously thought.

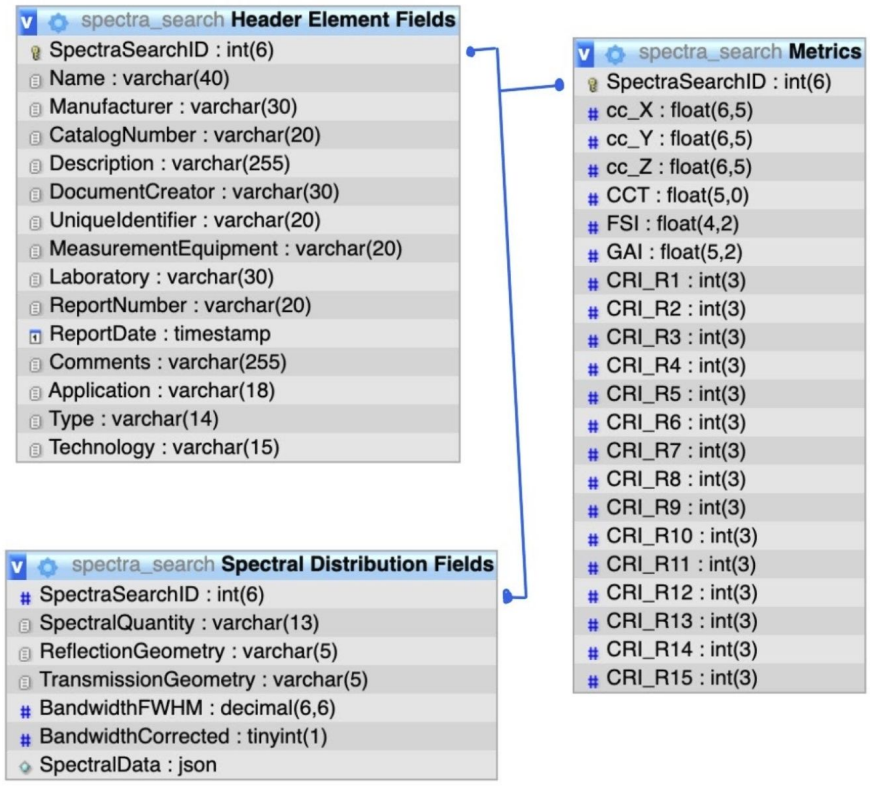
Sprint 5 Nov 28:
By this point at the end of the semester, the team will have taken the clients final input following the October 26th meeting and have done their best to add as many advancements as time allows by that point. The web application should be able to take in some spectral data (Wavelength & Intensity), and output all metrics accurately and present it in an organized manner. This entails having all the variables pertaining to fidelity and gamut of the TM-30 protocol worked out to ensure the accuracy of the metrics outputted. We should be done debugging the main product feature: Calculator, upload, login, data output, exportation, database search, the requested medium comparisons and open source capabilities should have been achieved. The front end should be free of bugs and the back end database should include many more features than what had been initially coded in by the previous teams. The webpage at this point will be able to check the integrity of the data inputted and tell the user if the data is written in an unwanted format or that the website cannot handle. The database should also have a much easier upload capabilities that is error free.

Final Milestone December 5th:
This will be the team final milestone to complete any previous additional features and to have it at a stage where it's ready for use and reliable. In addition the product will be ready to be presented for the final presentation. If main features are not fully completed/functional the team will make sure to provide clear instructions to the following teams on how to continue the product work.

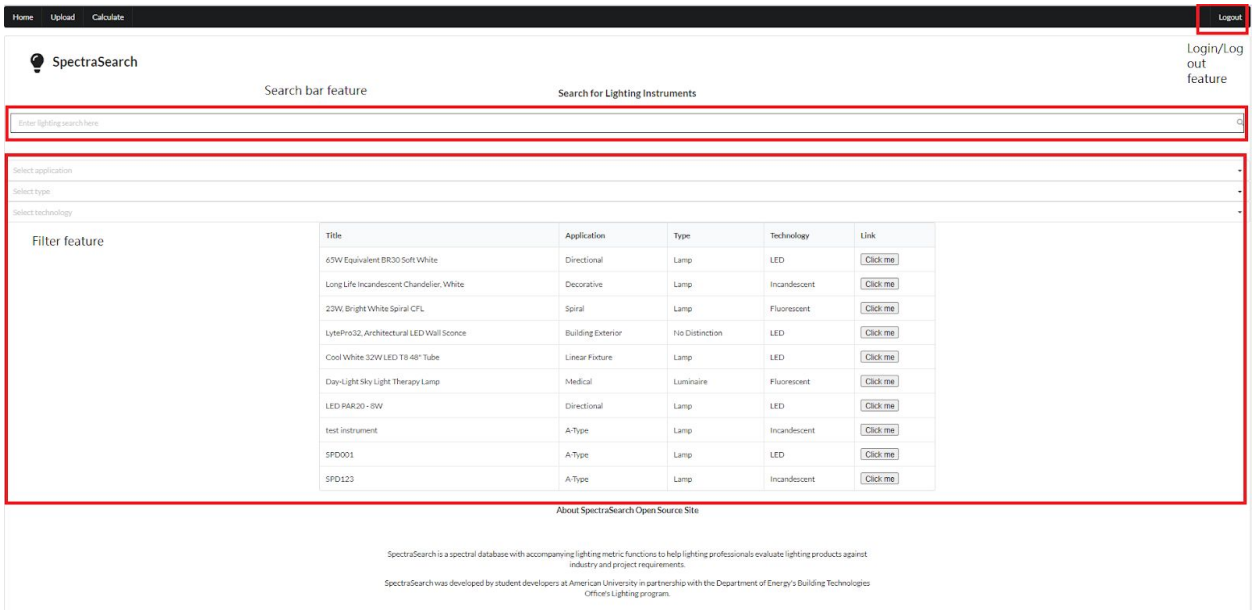
4. System

4.1 System architecture:





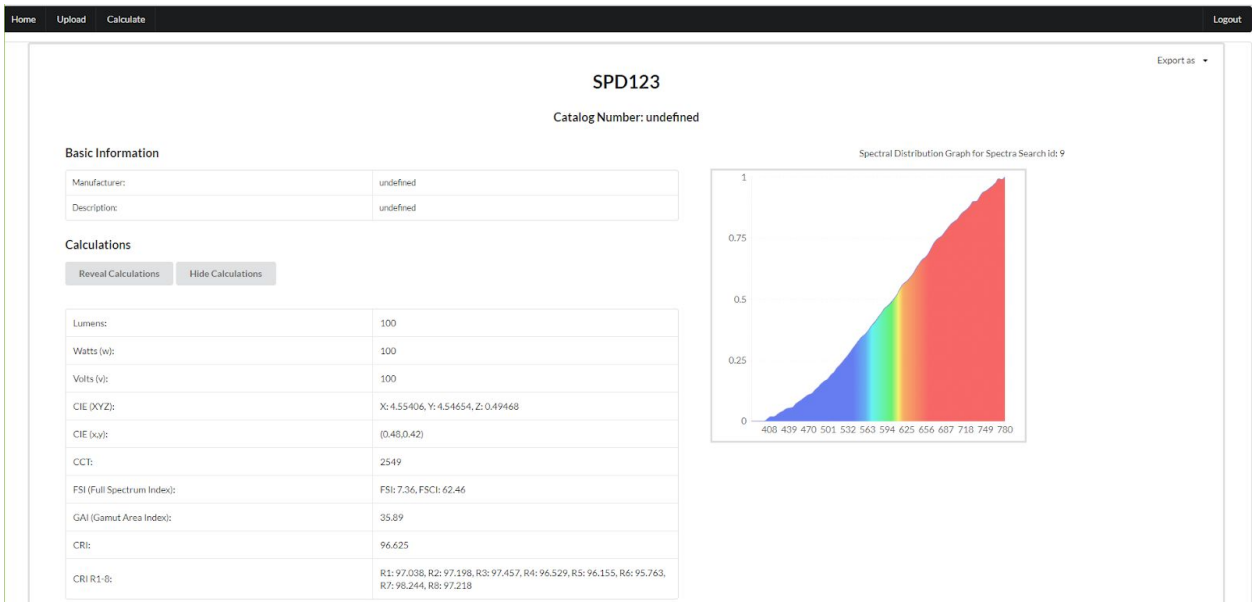
4.2 Feature description: (Changed)



The main features of the application in this page (starting from the left to right are):
The home button which will direct you to the main page. The upload button which will direct to the upload page and will take you to where the open community and the users of the website can upload information regarding the lighting instrument and contribute to the website data. Then we have the calculate button which will take you to a calculator that will showcase an interactive graph upon entering the needed information to reflect better understanding of the data provided. Finally we have the login page that will allow the user to login so that they are able to upload information as needed in the upload page and also have the ability to logout as needed. In addition the page includes a search bar to search for different instruments which will interact with the text and a table reflects the data which is filtered by the elements which are chosen in layed down.

The page also has a simple about us section to introduce the application and the goal of it.

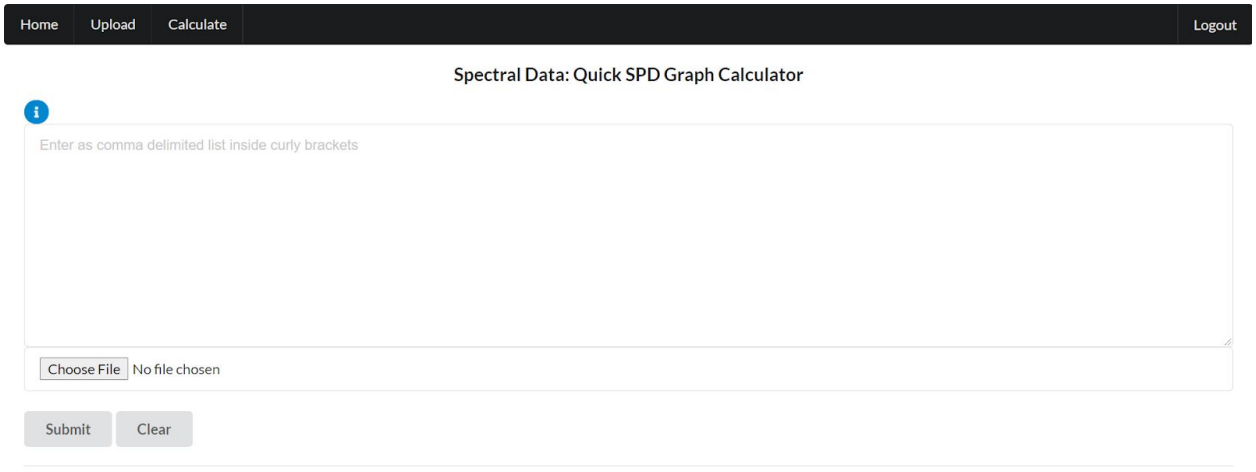
Upon choosing a result from the search bar, information regarding the instrument will pop up:

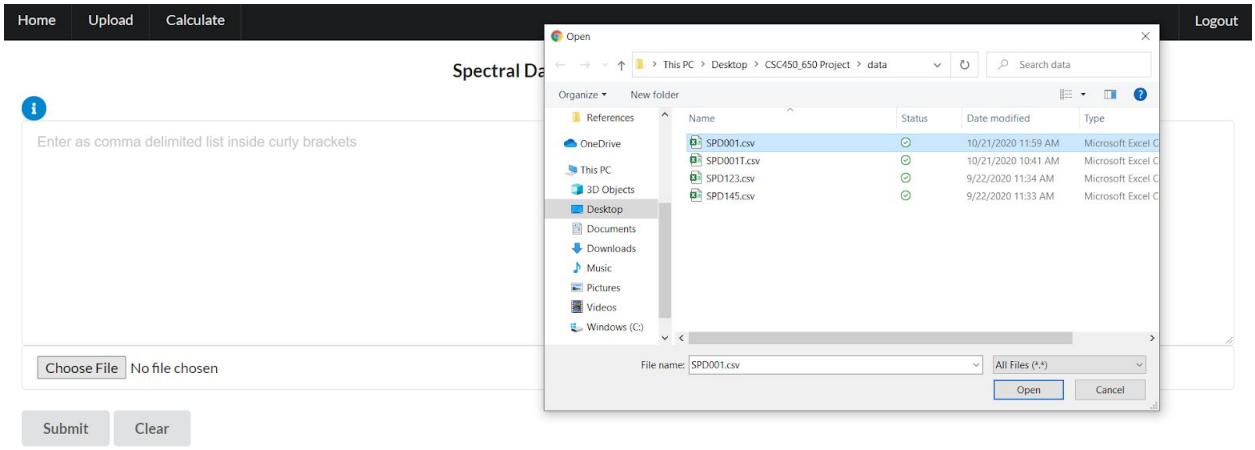


The page containing information about the given and needed light instrument will be showcased. The information shown include: Basic Information (Manufacturer & Description), Calculations (Lumens, Watts, Volts, CIE, CCT, FSI, GAI, CRI & CRI R1-8) & the interactive Graph.

There is still a need to work on the security as the application is not considered to be within the highest standard of security but is the minimum required to have a functional base “foundation”.

Then we have the Calculate page: (Changed)

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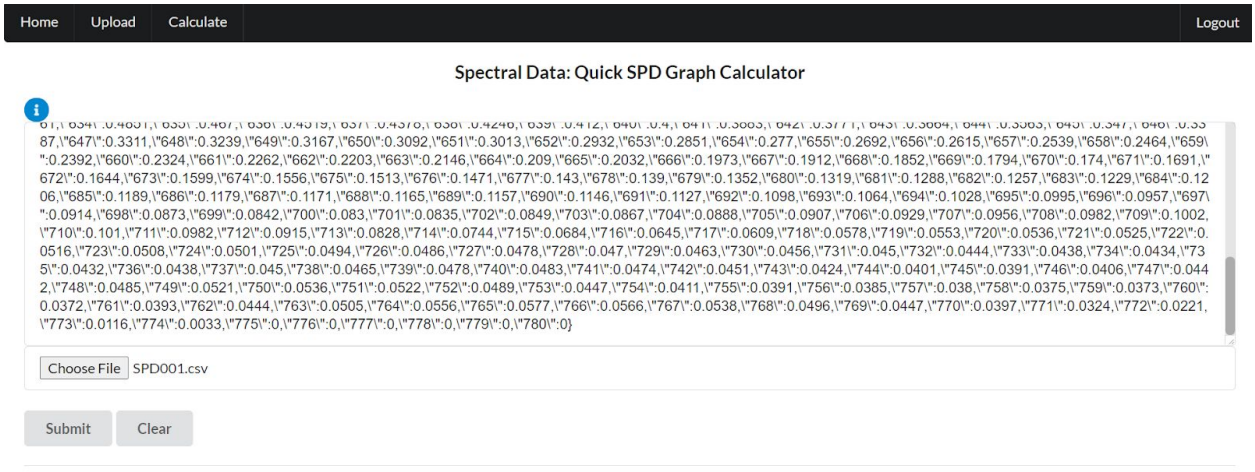
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Spectral Data: Quick SPD Graph Calculator
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SPD001.csv
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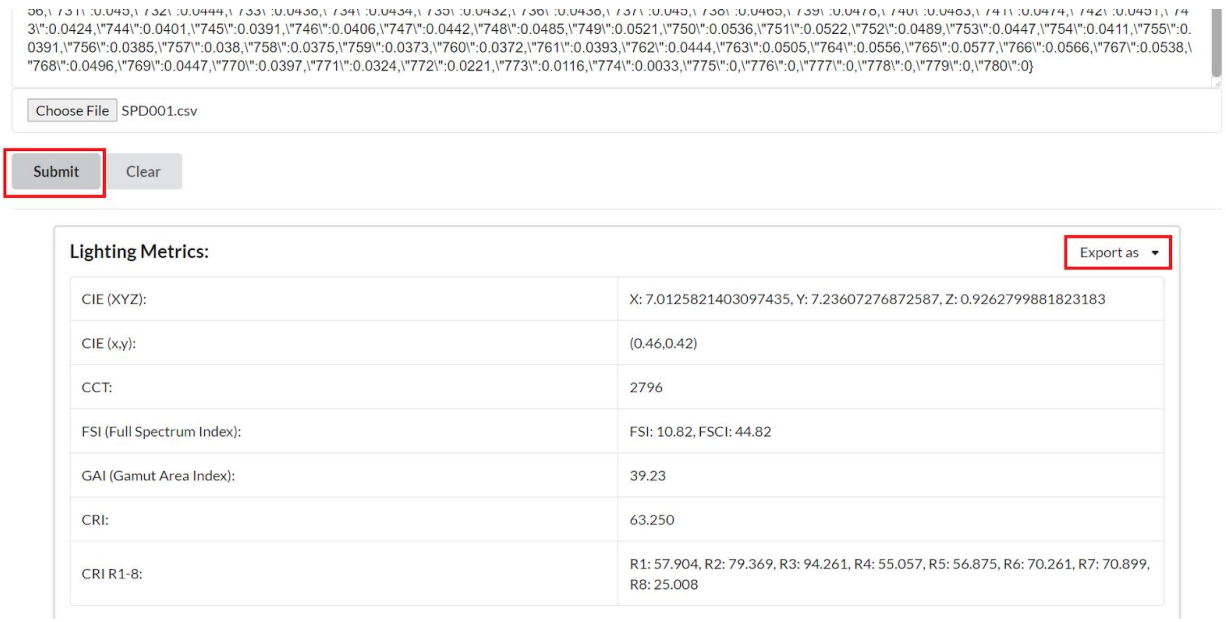
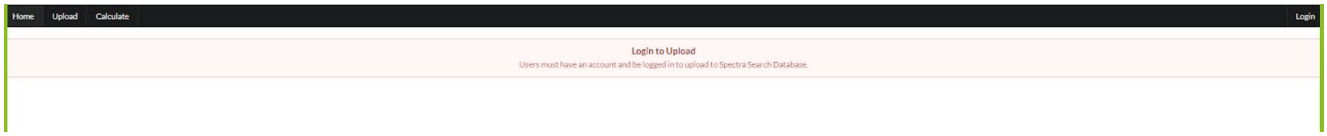


This page allows the user to have a reflection drawn of how the data is and the graph of it. The application will take data points from the user and reflect a graph that is aimed to show the spectral distribution of power lights. The application will process all of that automatically and as needed. It will calculate the lightning metrics automatically as well. There are two features that have been implemented: (Updated In addition to the figure above)

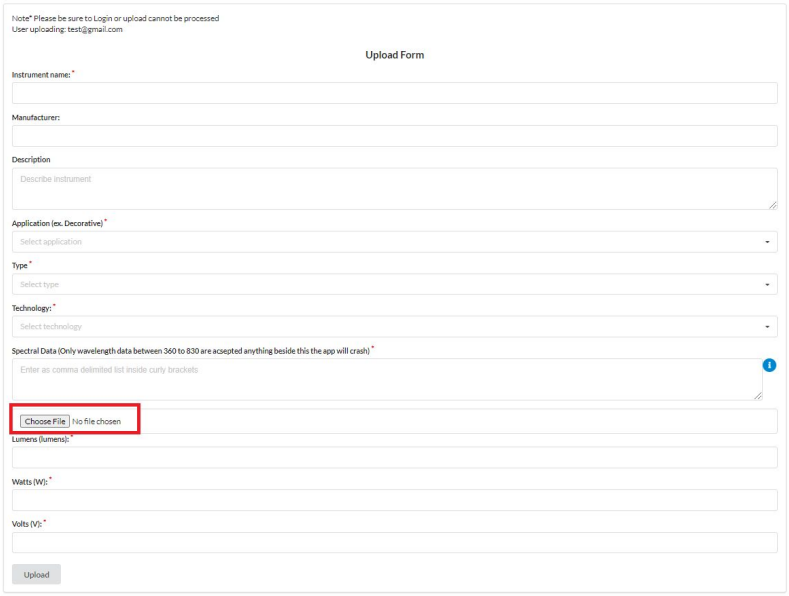
1- The upload feature has been implemented which allows the user to upload a CSV file that will be fed into the values box to provide the needed output of the calculation and graphs.

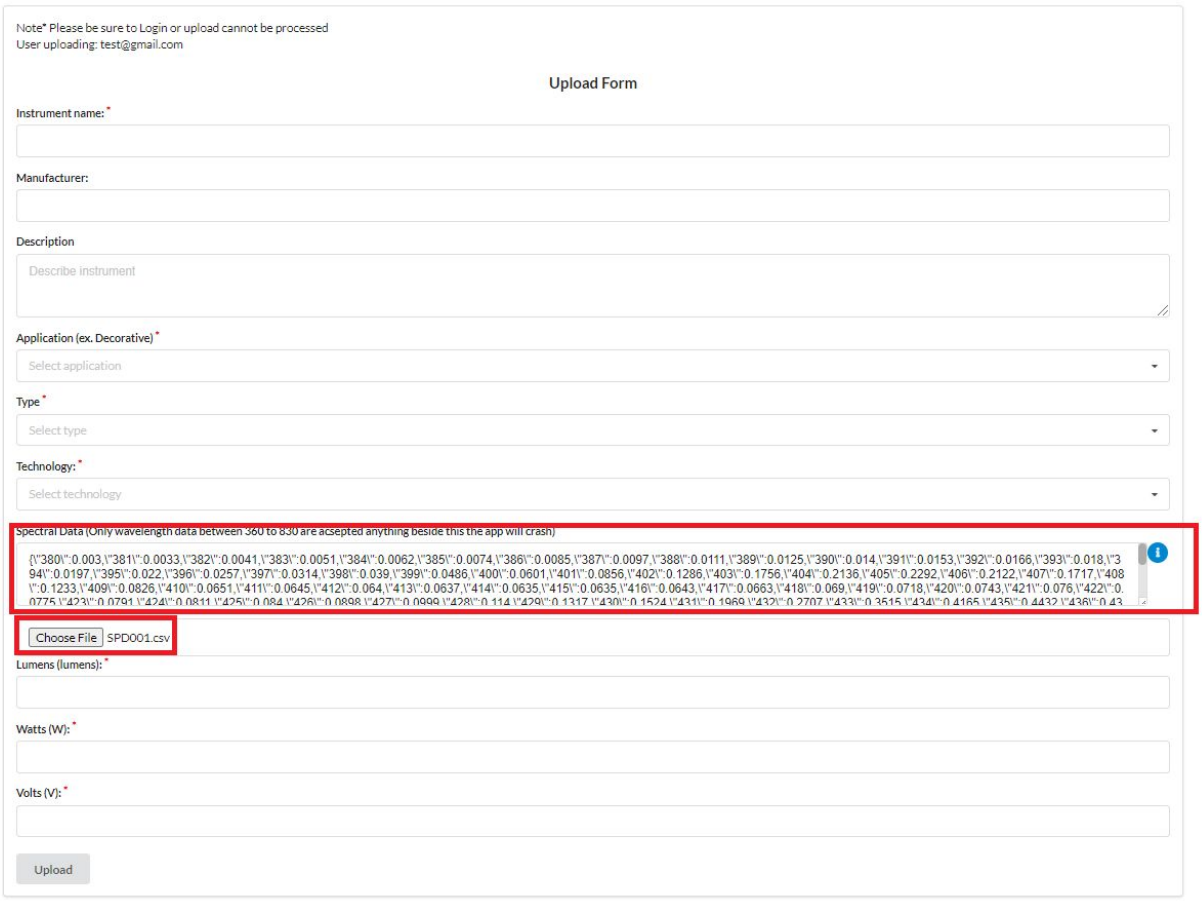
2- The PDF export function of the information and graph as a PDF is done.

To be able to go to the upload page you will have to login the application with the right credentials or sign up if you don't have any. Otherwise you will be met with this warning:

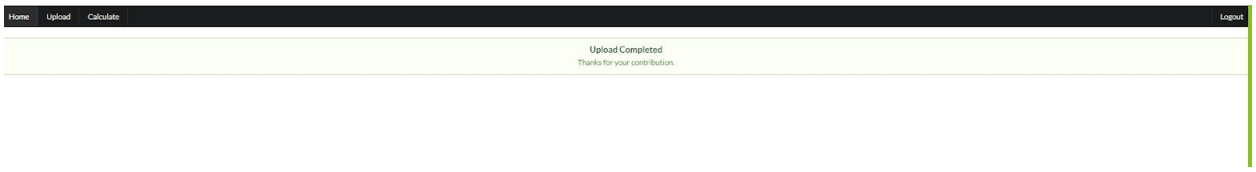


The upload page allows the contribution of the public and the open community to lighting information and instruments. They must fill in the information required as this: instrument name, manufacturer, description, application, Type, Technology. Spectral Data, Lumens, Watts and Volts. Then the user will have to press on the upload button to submit.

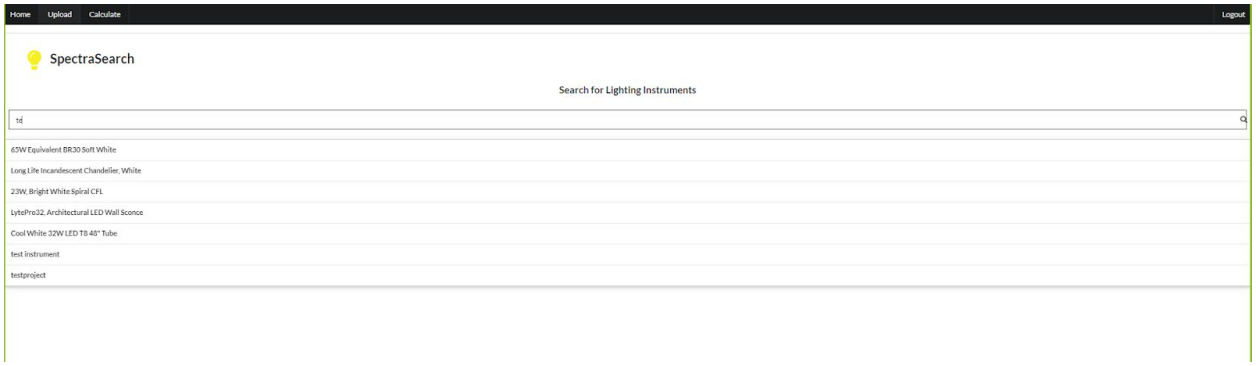




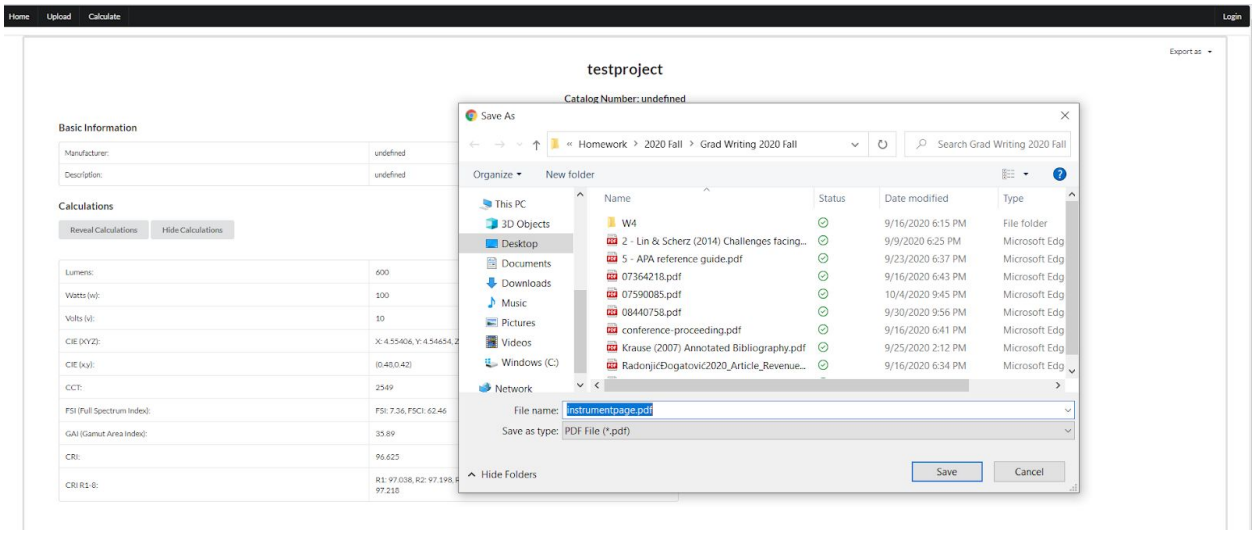
After clicking the upload button, the user will be met with this message:

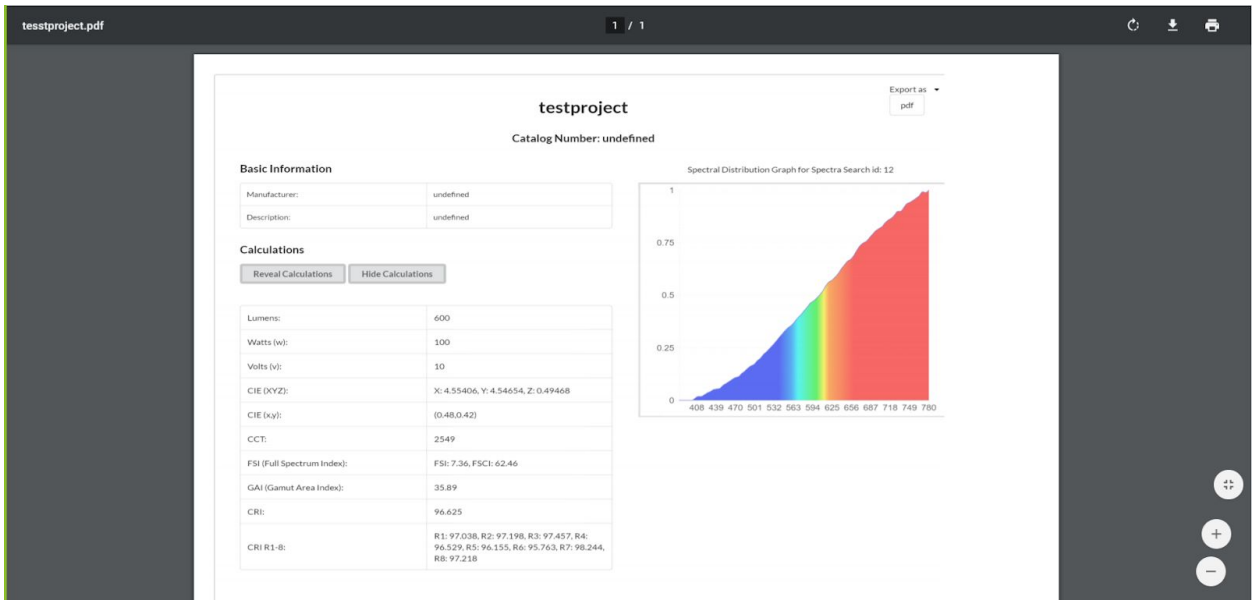


And then he can go and search for the result in the search bar:



At the moment if you want to export you can click on the export button and it will help you to export the information as PDF.
It should be mentioned that a future feature can be a review of the information so that incompatible data cannot be entered.





4.3 Preliminary Documentation (Technical According To The Rubric)

What a user needs to know to use our application:

A basic setup and implementation manual was offered to the client and they can give it to anyone they desire to start using the application designed according to what is in the disposal and hand of the repo that holds the most up to date application. As for the browsing of the application by any typical user, the only requirement is to have basic information about how to use the computer and working browser such as Google Chrome or Firefox.

Skills that other developers need to know before jumping into the design or maintenance of our application:

- For Javascript and React:
  - The developer should have an understanding of Javascript in the web building realm and the ability to tailor the application with other components such as the database (PHP My Admin) or etc….
  - React Native: Developers should have an understanding of how to use the library to enhance the user interface development process as needed.
- For SQL/PHPMyAdmin:
  - Developers should know how to use SQL, such as create tables, import and fetch data from DB.
  - Data format: JSON.
- For HTML:
  - HTML is essential for this project since it affects front end development directly. Therefore, developers should know how to build components by HTML and how to build the connection between HTML code and javascript functions.
- React package that are in the use:
  - Semantic-ui-react: This is used for building the look of the front end, such as the search bar, dropdown & the interactive Icon.

Reference: https://react.semantic-ui.com/
    - Html2canvas: This package provides all the needed functions that allow the app to transform the webpage into a PDF format file.
      Reference:https://html2canvas.hertzen.com/
    - Recharts: We use this package to visualize the data that is being calculated using the calculation function.
      Reference:https://recharts.org/en-US/guide
- Accommodated tutorial:
    - For TM-30 protocol:
        - http://www.ies.org/redirect/tm-30/ in addition to the file Excel file that the client provided to us that is the IES TM-30-18 Basic Calculation Tool v2.01.xlsm file(can be found in the repo).
        - https://www.energystar.gov/sites/default/files/asset/document/TM-30%20ES%20%28Final%29_0.pdf
        - https://www.slideshare.net/LEDucationNYC/ies-tm3015-introduction-and-latest-updates
        - https://www.ies.org/fires/using-tm-30-to-improve-your-lighting-design/
    - For HTML:
        - https://www.w3schools.com/html/
    - For JavaScript:
        - https://www.w3schools.com/js/DEFAULT.asp
    - For React:
        - https://reactjs.org/tutorial/tutorial.html
        - React tutorial video

How will your customer maintain what you have?
For that we need to visit the AU Fall 2019 client's requirements and legal concerns(Business Consideration):
(1) This product will be considered as an open-source software that can be freely used, modified, and shared;

(2) Once delivered, our team will be hands off regarding warranty for this product and will not be liable for its maintenance, security, distribution and performance

(3) (Restrictive) GNU General Public License, version 3 (GPLv3) will be in effect:

(a) All source code must be public;

(b) Modifications of the software must be released under the same license;

(c) Changes to the source code must be documented;

(d) This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version. This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR

PURPOSE. See the GNU General Public License for more details. For a copy of the GNU General Public Licenses see (http://www.gnu.org/licenses/).

5. Encountered issue and risks:

A. **Issue:** Communication issues due to pandemic and social distancing
Fallback: With increased mandates pushing social distancing due to the Coronavirus pandemic mostly all of group communication and client communication is now digital. With this in mind group members must work harder and smarter to increase communication to decrease loss of efficiency and communication errors that may come with this issue. Weekly meetings and deadlines will be set up at least a week ahead of time and contact with clients will also be set up in a timely manner to ensure nothing is lost in digital communication.
Incidents & Encounters: None

B. **Issue:** Team issues
Fallback: If problems arise either with team members not being able to finish their part before the next sprint or team members are falling behind in keeping up with project work we will, as a group all work together to help the group member catch up and finish their part because the team cannot be successful if we are all at different points in our progress. This may include issues in pushing/pulling new code, solving code problems or other issues regarding team communication and progress. These problems will all be addressed as a team and solved as a team. If a team member leaves the team or does not come to any meetings all work from their end will be redistributed among the rest of the current team members
Incidents & Encounters: On multiple occasions the team felt that some members were left behind due to life circumstances or other things. The team tried to work together and around this by transmitting the needed knowledge and skill required to advance in this project and catching the needed members with what was going on and up.

C. **Issue:** Time zone issues
Fallback: With multiple group members being in various time zones we will implement strict but reasonable timelines for submitting work to keep progress on track and set meetings ahead of time.
Incidents & Encounters: Due to the different time zones, it is hard for us (as students & workers) to schedule a meeting in our own available time. There are many attempts to schedule meetings on specific websites (such as “timeanddate.com” as suggested) which help us ease & check the right time in other time zones (for all members) and find the suitable slots. Sadly this is still challenging for some of us especially those that are in different time zones than Washington DC to meet some of the critical meetings and

deadlines required.

D. **Issue:** Learning curve of the technical aspects and practicality of the project requirement
Fallback: There have been various technical aspects that have been required of us to complete the project. For instance, some of us are not familiar with Javascript as we would like to be which has proven to be a setback when it comes to dealing with time. It seems that there is much to learn for all of us, and we would need to know the language, in order for the project to move as smoothly as we'd expected. Javascript is a difficult language and it will be a timely process to learn and convey.
Incidents & Encounters: Although the previous team covered most of the code and the build regarding React, there is still much to work with especially when it comes to the logic of Javascript and the relation to it. As this is a project that requires all moving parts, we would all be required to help in the building and debugging of the code so that we are able to meet our goals.

E. **Issue:** Software issues such as lost code, slow runtimes or/and version control issues
Fallback: If any code is lost we will have the last updated piece of code from github as all of our progress will be continually updated through their, if any slow run times are found with the code we will work as a group to either determine if the problem is with the hardware it is run on or if its a bug in the code itself.
Incidents & Encounters: We encountered this problem (unexpectedly) at the beginning of the project development in the old team repo because the previous team didn't update their latest version and software on github. Due to that reason, we took a lot of time trying to fix the functionalities and search for the bugs. For now, we are still frequently checking out our software version on github and making sure every change has been completely noted and as needed has been amended.

F. **Issue:** Understanding TM-30 data and equations and all of the following in depth pieces (changed)
Fallback: We must learn more about the equations within the variables of given equations and get help from the client where needed. As there are so many variables there are many equations that are needed to complete the calculations.
Incidents & Encounters: We began to realize this complication after examining the initial equation given to us by the client more carefully. And as we began scouring the web for more information pertaining to the TM-30 equations, we had issues with simply finding resources that could be potentially helpful. This is when we discovered that there wasn't much information on the lighting protocols made public for use. Also after reaching out to the client, he explained to us that he also had limitations when it came to accessing the information.

G. **Issue:** Loss of support and findings towards the DOE
Fallback: With increased attention and funding toward other government organizations focused on coronavirus efforts the DOE may see decreased funding and therefore support for this project. The solution here will be for our group to work with what resources and progress the project currently has and hope to not see decreased support and resources from the DOE. If we see decreased support from the governmental organizations we will have to work to make a more generalised database product that could work for other non governmental agencies.

H. **Issue:** Technical Integration with in the DOE infrastructure
Fallback: Technical issues may be raised during the implementation of our project into the DOE infrastructure. This might be either due to incompatibility with the tools and services they have or that they are not ready for such an integration.

I. **Issue:** Not uploading/input incorrect data into the program
Fallback: This upload feature on the web app will require, in its current state, a specified form of data inputted (first column is wavelength, second column is intensity) via CSV file for example. We will start by creating a functional upload feature presuming the user is inputting only wavelength and intensity data values and also clearly state on the web app to upload in this way.