**DALHOUSIE UNIVERSITY** 

FACULTY OF ENGINEERING

#### Department of Mechanical Engineering

#### **Background Information**

- SOLAS Ultraviolet Inc. is a company within the Dalhousie Emera IdeaHUB which focuses on developing UV LED technology research devices for applications in fields such as disinfection and water treatment.
- There are currently bottlenecks in UV LED treatment research due to its benchtop application methods requiring extensive manual labour (MacIsaac, Sweeney, and Gagnon, 2021).

#### **Project Scope**

- The goal of this project is to design and construct a proof of concept automated UV LED benchtop apparatus with the intent of relieving bottlenecks in the UV treatment procedure by minimizing manual labour.
- The proof of concept apparatus is to be developed on top of a benchtop CNC device provided by SOLAS Ultraviolet.



(SainSMART.com, n.d.)

The apparatus is to be designed to test sample trays varying in well size and amount. Ranging from 6 to 96 sample wells.



#### **Components**

Four separate components of the design were identified to meet the requirements:

- Enclosure: Protects user from UV light and protects device from debris or interference.
- Collimating Tube: Collimates and directs UV light into the sample wells.
- Mounting Tray: Conveniently allows user to securely load sample trays to the apparatus.
- User Interface/Program: Provides user with easy setup of the apparatus and runs it automatically.

## Team 24 Adam MacKenzie - Caden Coglon David Fox - Jacob Lafond

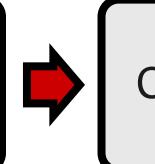
# UV Benchtop Apparatus

#### Requirements

- The device shall be capable of using LEDs of varying size and chip configurations, allowing for further adaptation as new UV LED technology is developed.
- The device shall be capable of exposing sample wells of diameters 35 mm, 16 mm, and 6.5 mm to UV light without exposing surrounding wells at the same time.
- The device shall have a housing/enclosure to safely separate a user from UV light exposure during operation and to prevent unwanted debris from getting into the device.
- The device shall be capable of operating on a standard benchtop (23" x 40").
- The device shall weigh less than 23 kg.

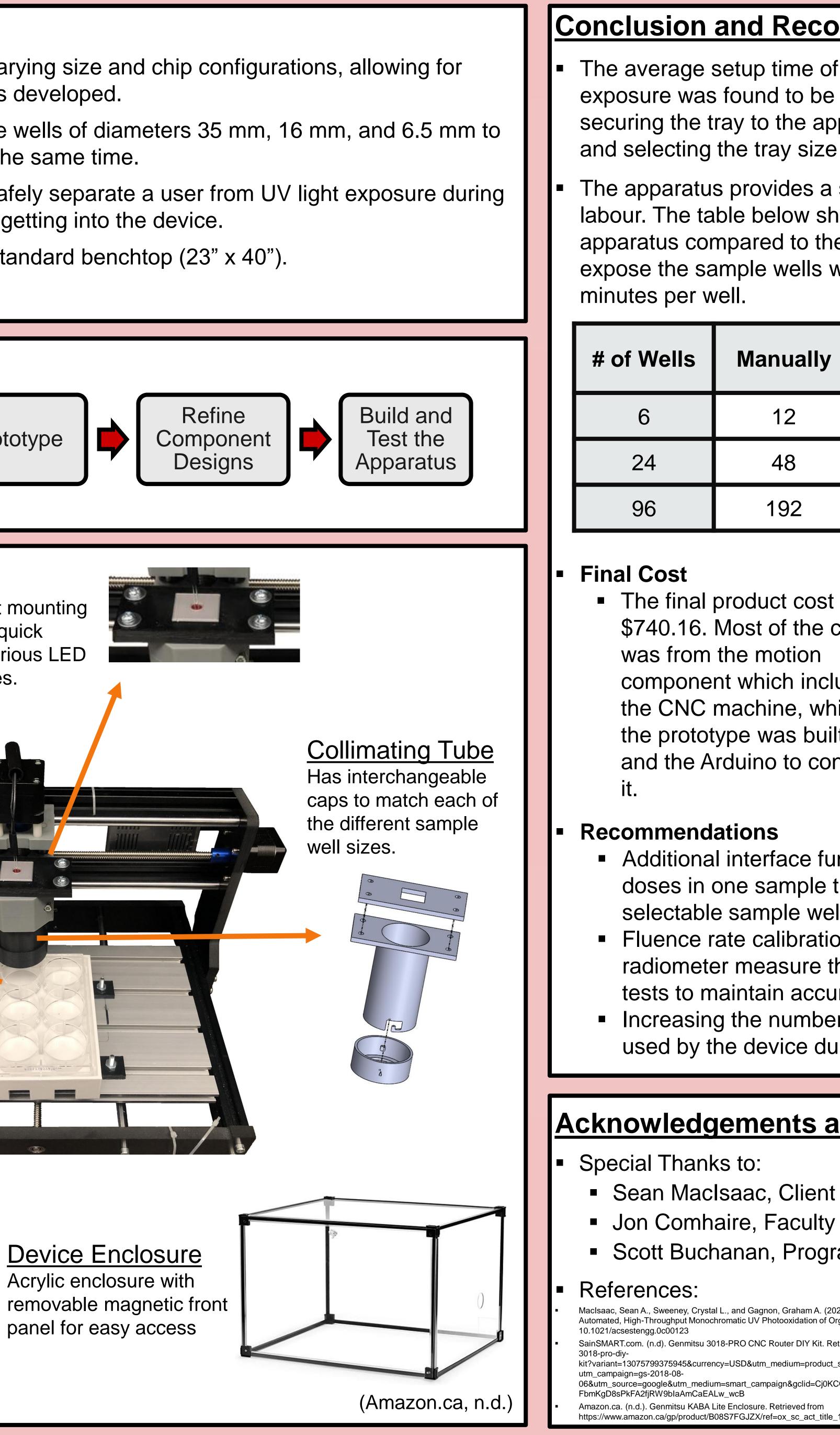
#### **Design Process**





Develop Conceptual Designs





#### **Details of Design**

### Light Mount

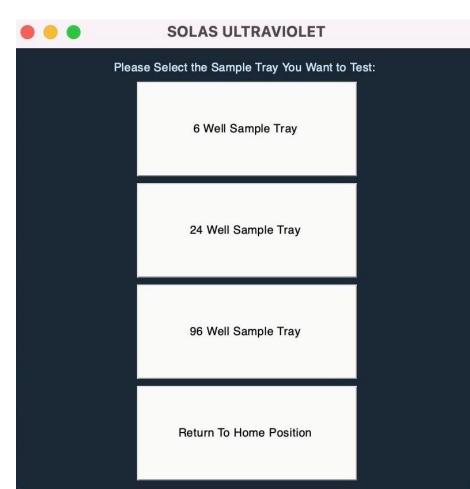
Removable light mounting plate allows for quick adaptation to various LED sizes and profiles.

#### Mounting Tray

Tray holder is secured both physically and magnetically by rails and magnets located at its rear

### User Interface

Allows the user to select between three separate sample tray sizes



# Solas Ultraviolet





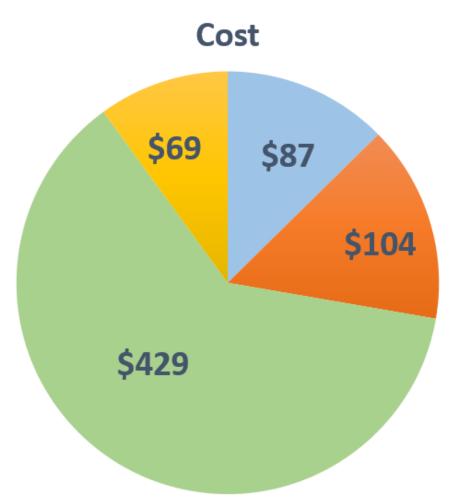
#### **Conclusion and Recommendations**

The average setup time of the apparatus for sample tray exposure was found to be 30 seconds. This includes securing the tray to the apparatus, opening the program, and selecting the tray size via the user interface.

The apparatus provides a significant reduction in manual labour. The table below shows the setup time of the apparatus compared to the time required to manually expose the sample wells with an average exposure of 2

<b>Nanually</b>	Using Apparatus	% Reduction
12	0.5	95.8
48	0.5	98.9
192	0.5	99.7

The final product cost was \$740.16. Most of the cost component which includes the CNC machine, which the prototype was built off, and the Arduino to control



Collimating Tube Enclosure

Platform Motion Additional interface functionality, such as variable UV doses in one sample tray, and a full GUI with selectable sample wells and options. Fluence rate calibration by having a built-in radiometer measure the UV dose before and after tests to maintain accurate results. Increasing the number of sample trays able to be used by the device during one disinfection run.

#### **Acknowledgements and References**

Jon Comhaire, Faculty Advisor Scott Buchanan, Programming Consultant

Maclsaac, Sean A., Sweeney, Crystal L., and Gagnon, Graham A. (2021). "Instrument Hacking: Repurposing and Recoding a Multiwell Instrument for Automated, High-Throughput Monochromatic UV Photooxidation of Organic Compounds". ACS ES&T Engineering 2021. Volume 1 (2), 281-288. DOI:

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