

**RMSC Exhibit Prototypes
Product Requirements Document
OPT 310 – Spring 2014**

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Authentication Block

The Rochester Museum and Science Center Prototypes

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A	Release	31 October '14	DKMR
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The Rochester Museum and Science Center Prototypes

The RMSC Project is a Senior Design driven product. As such its design inputs were derived from our own passions and perceptions of fun, as well as those of our customer, Calvin Uzelmeier, Director of Education at the Rochester Museum and Science Center.

Vision:

The end product visions are:

Creating four optics display prototypes with label copies that involve and interest families in optics.

Rochester Cloaking: Develop an interactive, paraxial multi-directional cloaking device.

LED Rubens' Tube: Develop an LED Rubens' Tube with mist or CO₂ illuminated with LEDs. The system will have an auxiliary cable for use with phones and other audio devices. This exhibit may also incorporate other elements of lighting design.

Cell Phone Magnification Fun: Develop an imaging system to magnify cell phone screens or other digital displays to show pixel patterns in everyday technology. The exhibit will include older models of cell phones as well as the ability for the user to examine their own device. The exhibit may have multiple magnification options available.

Schlieren Photography: Develop a Schlieren Photography demonstration to illustrate changes of index of refraction in air and changes in air density.

Environment:

As a prototype, it needs to operate in the following environment:

Temperature (Room Temperature)

55-85 °F - safe operation

65-75 °F - meets specifications

Relative Humidity

Non-condensing – safe operation

Rubens' Tube: Condensation acceptable

Prototypes may require electrical power.

Prototypes are expected to reliably reproduce the same effect many times.

Prototypes must be durable enough to withstand repeated use.

Prototype should fit on a standard 3'x 5' table.

Regulatory Issues:

These prototypes must adhere to lab safety protocol.
IEC 60825-1 “Safety of Laser Products”

Fitness for use:

Prototypes will:

- Teach science and technology pertaining to light/optics at multiple levels such that the exhibit can be explored multiple times.
- Adhere to the intermediate level of the NY science standards curriculum.
- Be unique, creative, and robust
- Be engaging and interactive, with a “hook” that draws in the museum patrons.
- Be able to captivate families with children ranging from 5 – 13 years old.
- Be transportable to the RMSC by the end of May.
- Prototypes will be created mostly from recycled projects and exhibits, as well as University of Rochester lab equipment.
- Prototype will require little to no reading in order to begin interaction.
- Be able to capture audience attention for longer than a minute.

Exhibit Evaluation:

1. Interactivity and engagement
2. Age group and fun
3. Aesthetic
4. STEM Content
5. Communicates our past, present, and future
6. Group interactions
7. Curriculum connections
8. Durability
9. Storyline
10. Accessibility

Rochester Cloaking:

Can cloak objects of significant size such that it is interactive.



Figure 1: A ray diagram for a 4 lens cloaking device system.

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LED Rubens' Tube: A visually stimulating Rubens' tube with interactivity that illustrates waveforms using light scattering on water vapor or CO₂. Compatible with cell phones or other music playing devices (AUX cable input). Device will also play music in the background, and will require speakers.

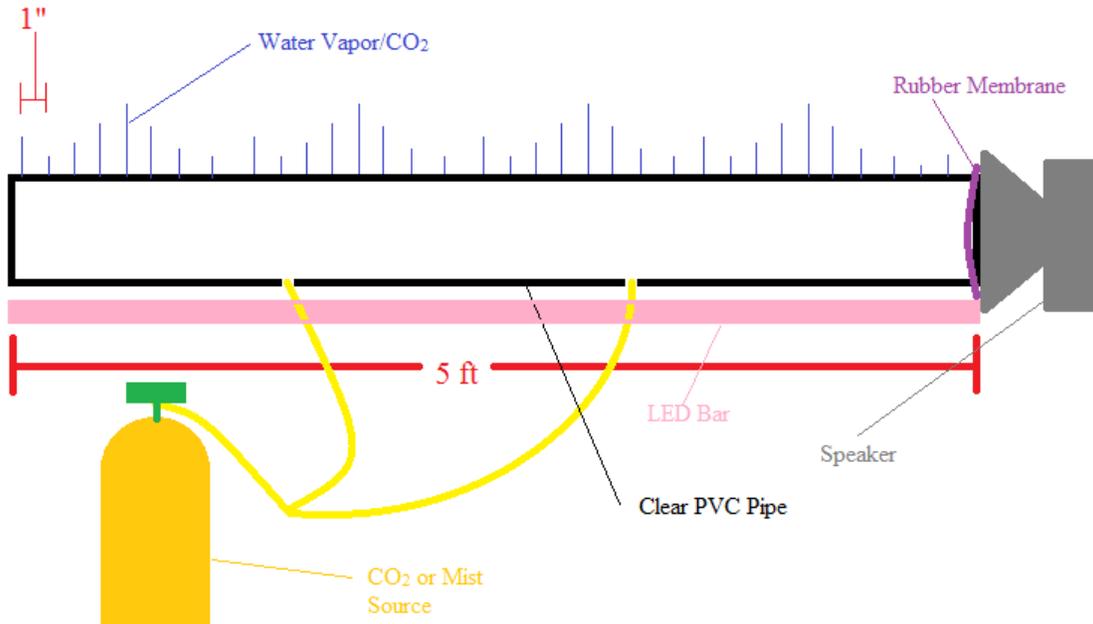


Figure 2: An example of a CO₂ or Misting Rubens' tube with the same schematic as a propane model.

Cell Phone Magnification Fun: Use of a “scope on a rope” and possibly other magnification systems to magnify cell phone screens or other digital displays in order to image individual pixels and the corresponding display array. Magnified images will be displayed either on a large video screen or projector screen. Ability to image different cell phone generations, change magnification, and use on user owned devices. The “scope on a rope” will be tethered to the exhibit, as well as stationary cell phones of older generations (to prevent stealing).

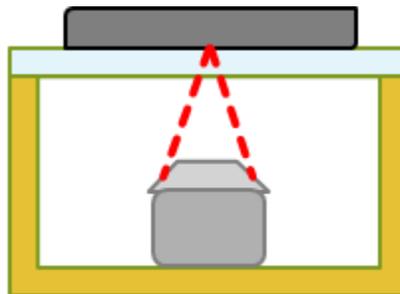


Figure 3: Example Diagram of Possible Cell Phone Magnification System.

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The “scope-on-a-rope” sits inside a cubic housing with a clear top such that the cell phone can be placed on the top and be in focus with the scope.

Schlieren Photography: The prototype will include a Schlieren imaging system, with objects of varying index and temperature. The system will require a heating element.

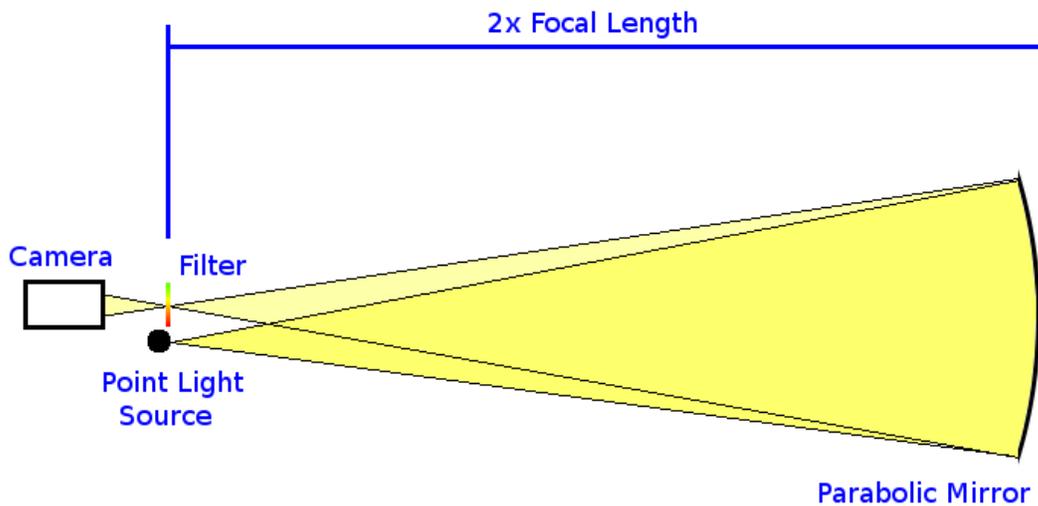


Figure 4: Set Up for Schlieren Photography using a sanded down LED through a Pinhole, a parabolic mirror, a colored filter instead of a knife edge, and a camera that has zoom capabilities.

Label Copies will:

Explain the technical details of the exhibit such that the label copy makes sense without the exhibit

Provide the title of the exhibit, which should guide the museum patron towards the function of the exhibit

Will be as short and concise as possible.

Exhibit Evaluation:

1. Navigation
2. Content information

3. Storyline

It is desirable that:

The systems fit on a 3' x 5' optical table (optical tables in the collaboratory).
The systems can be scaled to fit on a bus.

Rochester Cloaking: To insert a ray-tracing mechanism such that we can define the cloaked and uncloaked regions. To reduce aberrations. To increase the FOV. To make the system larger than the demonstration model.

LED Rubens' Tube: In addition to the LED Rubens' tube, there will be other lighting elements to produce an exhibit where one can "create your own light show". If an LED board is used for illumination, a simple example of color mixing can be implemented by having variable intensity of red, green, and blue light.

Cell Phone Magnification Fun: The exhibit would benefit from a large display for the "scope on a rope" in order to provide a good visual representation of pixels. There could be more than one magnifying element so that multiple users may interact with the exhibit. The magnifier could also have a housing that the user can manipulate to adjust the focus.

Schlieren Photography: Having multiple ways to interact with the Schlieren Photography so it has a better retention time with guests. These might include: a gas that is denser than air, a hair dryer, a hand/foot warmer pouch, and a whistle/wind tube.