Fundus Reading Hood

University of Wisconsin-Madison
College of Engineering-Biomedical Engineering
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Abstract:

In the grading of retina scans at the Fundus Photograph Reading Center, normal office light interferes with the graders ability to efficiently identify lesions and other spots on the retina that are indicative of certain diseases. Since these lesions are often very small it is imperative to have a standard environment in which the scans can be graded. The design of a monitor hood that blocks ambient light is the key element in obtaining accurate grading of retina scans.

§1. Problem Statement

The goal of this project is to develop a monitor hood that will block ambient light for the photograph graders at the Fundus Photograph Reading Center. Determining problematic sites in retinal scans is used to diagnose disease states in the eyes. A controlled environment is necessary for grading of these scans in order to assure correct identification of problematic sites. Creating a monitor hood will provide this controlled environment.

§2. Background

The Fundus Reading Center is a facility located on the UW-Madison campus. The photograph reading center "strives to further the understanding and treatment of preventable blindness through interpretation of ophthalmic images in clinical studies" (eyephoto.ophth.wisc.edu).

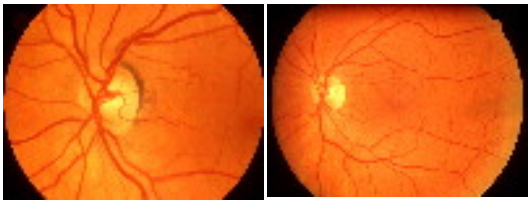

Figure 1. Fundus Photographs http://www.jhu.edu/wctb/coms/patient/photog/fundus.htm

Photographs, like those in Figure 1, are received at the Reading Center and are graded for ophthalmic research. The focus of ophthalmic research at the Fundus Reading Center consists of five main categories: Diabetic Retinopathy, Age-related Macular Degeneration, Hypertensive Changes of the Retina, Studies of the Ocular Complications of AIDS (CMVR), and Age-related Eye Disease Study (AREDS). Since the retina can be assessed by noninvasive methods such as retinal photography, analyzing these photographs is preferred in relation to other invasive procedures. For example, retinal changes have been observed in many cases of hypertension and sclerosis.

When a patient is photographed, special cameras take images of the eye with the patient's pupil dilated. This procedure causes no discomfort to the patient and provides a photograph that details "the retina, the retinal vasculature, and the optic nerve head, optic disc from which the retinal vessels enter the eye" (www.jhu.edu).

The purpose of grading photographs at the Fundus Center is for retinal quality. This quality is important the viewing of arteriolar abnormalities and lesions of diabetic retinopathy. To insure quality of the photographs, there are many grading protocols for the readers to assess these ophthalmic images. (eyephoto.ophth.wisc.edu)

The stereoscope also plays a role in grading retinal images and must be accounted for in our design. Stereo images are pairs of photographs of the same subject. (stereo.thurstons.org) There are many techniques to view stereo images on the computer monitor such as parallel free vision and cross vision. (www.findarticles.com) However, the Fundus Reading Center uses a stereoscope to facilitate this process.

The purpose of viewing through a stereoscope is to view a pair of images as a single 3-D image. The stereoscope (Figure 2) is used by the grader while viewing the photographs. A lever on the side adjusts mirrors to converge the images. A horizontally-centered position is necessary for proper viewing of the ophthalmic images. The image will become more distorted the further from the center the stereoscope is positioned. The viewer may have to adjust and rotate from this horizontal position to attain stereo. There are two components that must be taken into consideration when viewing the images: the horizontal and vertical positions, as in a Cartesian grid. Horizontally, if that

Figure 2. A stereoscope similar to those used at the Fundus Reading Center

landmark is at the origin for one image but at a different level vertically, turning your head can correct and re-align the images. Another problem occurs at the angle a person looks down at the screen; the eyes actually look down at a 30° angle. To correct this vertically, the monitor is positioned lower than the eyes and often tipped up slightly. (Hafford email)

The viewing of these images requires precision and accuracy of viewing conditions. Ambient light poses a problem. Problematic reflections on computer screens occur in two categories. The first category is with too much light falling on the screen. This type of reflection reduces contrast and washes out the image. The second category of reflections occurs from bright areas in the environment surrounding the computer monitor. These reflections superimpose on the screen image and make it hard to see. (www.pc.ibm.com)

§3. Literature Search

A patent search reveals Patent 5,900,979, Patent 5,243,463, Patent D422,579, Patent 6,356,439, and Patent 6,394,615 which all describe monitor hoods for both laptops and desktop computers. Further information on these patents can be found in Table 1 in Appendix A. Related monitor hoods are available from companies such as ColorGear, CompUshade, Photodon, Ergomart, and Hoodman (Figure 3). These monitor hoods range from $25-$80. The goal of these devices is to reduce glare and background light. These products do not focus specifically on the reading of ophthalmic images or blocking all ambient light. An extended viewing window is also not part of their design.

Figure 3. Photodon Monitor Hood (http://www.photodon.com/mgrh.htm)

§4. Design Constraints

The Fundus Reading Hood will be designed for LCD monitors and must block ambient so that the light intensity does not exceed 64 lux inside the hood. The design should be lightweight, sturdy, and self-supporting, with non-transparent fabric. The length must be adjustable and extend out 60.96 cm while keeping the monitor viewable at any length. While attached to the monitor, the design cannot extend significantly behind the monitor nor can it extend more than 38.10 cm in front of the monitor when not in use. The design must taper to a closed viewing port of approximately 20.96 cm by 6.0325 cm with the viewing window approximately 12.7 cm down from the top of the hood. Also, the hood should have an adjustable angle of view to allow the grader to maintain good posture. Most importantly, it should allow a clear view of the monitor at all times.

This design should be capable of operating in a regular, controlled office setting. No major safety issues exist; however, this device should comply with several International Ergonomics Association standards.

Additional design constraints are in the Product Design Specification (Appendix F).

§5. Alternative Designs

The rotating bar, and solid interlocking panels, and accordion are the three design alternatives that will be discussed in detail. Our final design solution, the modified accordion with support blocks will be addressed in §7.

§5.1 Rotating Bar Design

The first design option, the rotating bar design, is proposed to address the issue of taking up visual space on the monitor. This design is composed of several main parts: the rotating metal framework, the fabric encasement, and the fabric front.

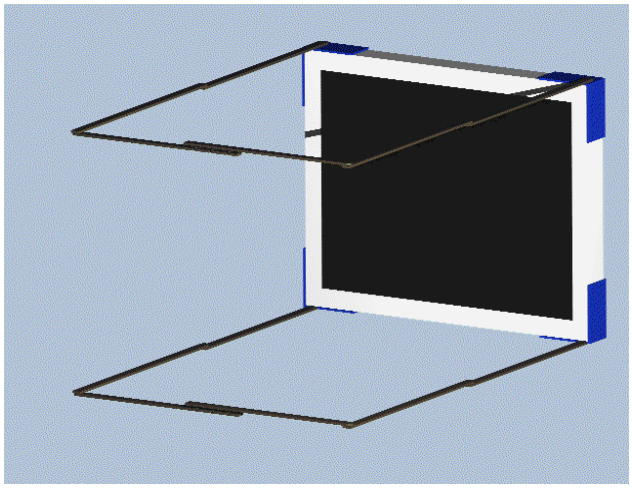

Figure 4. Rods connect to the monitor corner brackets

The metal framework consists of several aluminum bars that run about the length of the monitor (Figures 4 and 5). These bars can rotate 90° out from the monitor. This would provide the main extension of the hood. Since the smallest monitor is 43.18 cm long and the bar cannot exceed this length, a secondary bar is fastened to the end of the primary bars allowing the required 60.96 cm extension. The secondary bars have the ability to rotate to 180° from the primary bar. Attached to the secondary bar would be a tertiary bar that rotates 90° from the secondary bar. Each tertiary bar would have three locking mechanism positions to lock to the bar across from it. This provides the lateral support linking the two top bar units and the two bottom bar units.

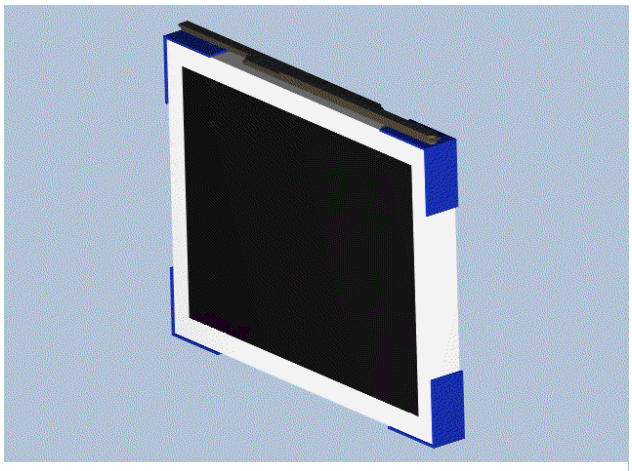

Figure 5. Rods collapse to fit tightly to the monitor

The fabric encasement is made of a dark, solid material, like vinyl. It would be wrapped around the entire framework and accommodate the three different sizes of monitors by providing

three locations of button snaps for where the encasement overlaps itself. This encasement would also provide the means to attach the fabric front (Figure 6).

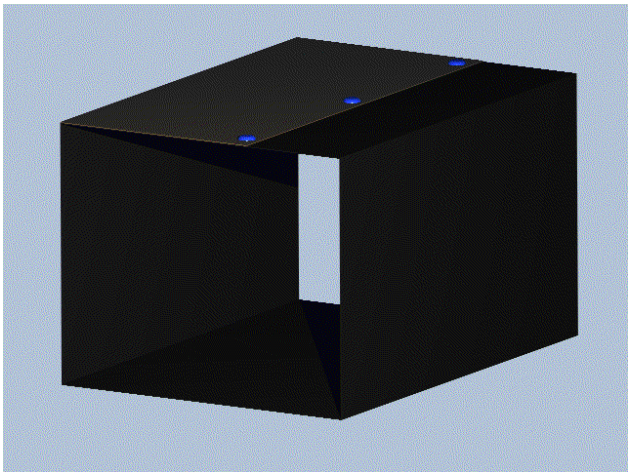

Figure 6. Fabric encasement snaps over the rod framework

The fabric front is designed to attach to the side encasement by several button snaps, each of which has multiple snaps for each size of monitor. The snaps are located on the tops and sides of the front, and extensions from the front that wrap around the corners. The center of the front panel will be open, to allow entry of the stereoscope viewer.

§5.2 Solid Interlocking Panels Design

This design would involve the use, in part or in whole, of a solid frame and sides. A frame would be made that will fit any flat screen monitor (Figure 7). The frame would incorporate a mechanism to tighten and loosen the frame to accompany various monitor widths. Other than the adjustable width, the frame's design would allow it to simply rest over the monitor, using the weight of the hood to keep a tight seal against the viewing monitor.

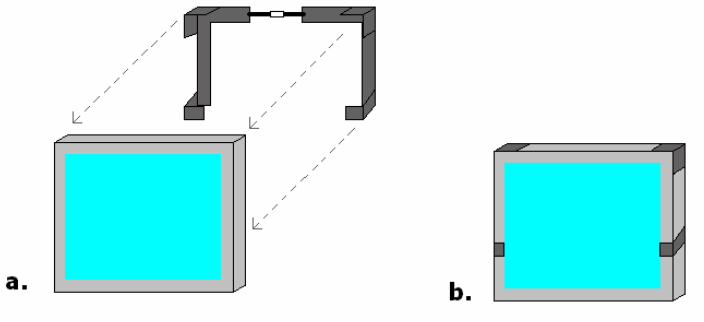

Figure 7. a/b Frame separate/attached to existing monitor

The sides of the design can extend and collapse due to a track and rail assembly built in between the panels. The track and rail assembly may incorporate filing cabinet tracks, or

possibly no moving parts at all, just sliding interlocking rails. These sides would be designed to block out light when fully extended.

The front plate with the stereoscope viewing window will be attached to one of the sides and will clip onto the other side when fully extended (Figure 8). Refinements to this would include a way to fix the stereoscope to the front plate while allowing full range of movement.

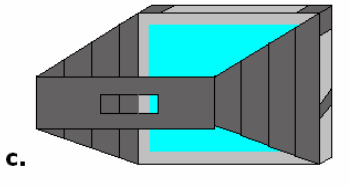

Figure 8. c Fully extended sides with front plate attached

The top and bottom coverings can be a hard material, but are currently represented as a cloth or vinyl with multiple sets of snaps to accommodate variations in monitor width (Figure 9: d/e). The multiple snaps would allow flexibility in extension length of the sides as well.

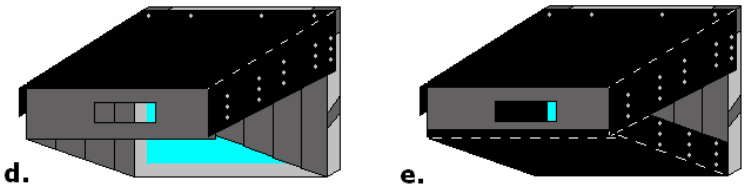

Figure 9. d/e Cloth top and bottom attached to extended sides

§5.3 Accordion Design

The accordion design, consists of four main components, the top hood, the main hood, and the retractable support devices.

The main hood (Figure 10) is the primary component for blocking out ambient light. It will be constructed of a black fabric, much like vinyl. The main hood will be able

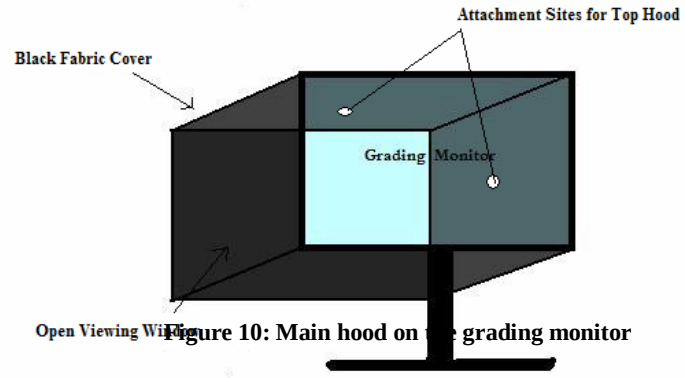

Figure 10: Main hood on grading monitor

to extend 60.96 cm and cover all four sides. On the four sides of the hood that face out there are attachment sites, or buttons, for attaching the top hood to the design.

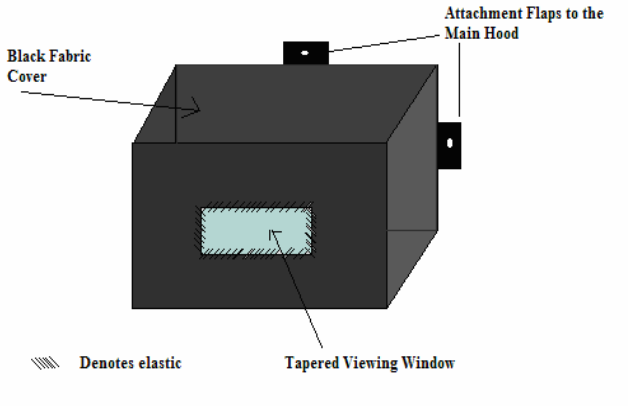

Figure 11: Top hood

The top hood (Figure 11) is required to meet the client requirement of the hood tapering to a closed viewing port of approximately 20.96 cm by 6.0325 cm. The perimeter of the viewing window is lined with elastic. This allows the stereoscope to fit snugly within the viewing window without allowing excess light to enter.

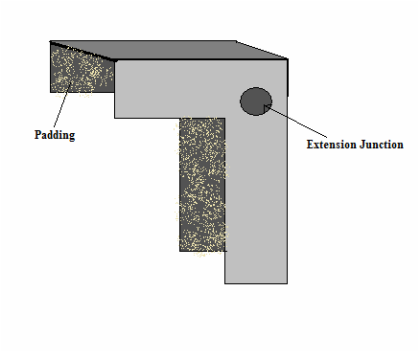

Figure 12: Corner piece

The main hood attaches directly to the grading monitor by metal corner pieces (Figure 12) at each corner of the monitor. The corner pieces are lined with a protective padding to prevent damage to the monitor. These corner pieces are attached to each other with thick elastic. This allows the design to accommodate varying monitor sizes. The corner pieces are also the base attachment point for the extension support devices.

These support devices (Figure 13) are attached to the main hood allowing the hood to contract when not in use and to be self supporting when fully extended. Another option of the contractible hood design concerns storage. Since the tapered viewing window is removable (a.k.a. the top hood), the device may be left on

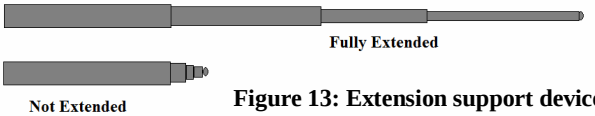

Figure 13: Extension support device

the monitor when not in use because it is contractible. However, if it is desired to have the hood removed from the monitor; the corner pieces can be stretched and taken off thanks to the elastic that connects them.

§6. Evaluation of Alternative Solutions: Advantages and Disadvantages

The use of a design matrix (see Appendix B) will compare the differences in each design including the final design with respect to categories such as cost, flexibility, storage, ease of use, stability, and the design's ability to block ambient light.

§6. 1 Rotating Bar Design

There are many advantages to this design. The manufacturing process would be fairly simple for the rods and brackets, because they could be made in the metals shop or bought. The fabric encasement is a simple pattern and would be easy to build. Along with the ease of manufacturing comes the lower projected cost. Storing the sections would be as simple as unsnapping the front panel, unsnapping the side encasements, unlocking the lateral bars, and rotating the bars inward to the monitor. These features also allow the ability to fit several different sized monitors. However, the instability of the rod frame is a concern. It could become rickety after prolonged use.

§6. 2 Solid Interlocking Panels

An advantage to this design is the sturdy construction due to rigid sides and front plate. The sides are easily adjustable for different monitor widths and have the ability to block out ambient light. Another advantage is the ease of use of this design, where setup just involves

extending the sides and snapping on the top and bottom covering. However, this design involves a small footprint that would be left behind the monitor when the collapsible sides are folded back. Also, the solid front plate does not allow for the uninhibited movement of stereoscope that is necessary for grading the photographs. A solid frame may not fit correctly on thicker monitors even though the design would ideally accommodate all currently available monitors at Fundus. Also, the snaps on tops and bottoms may be troublesome to work with when adjusting extension length of sides also. Finally, this design would be more costly than other alternatives and most likely more difficult to manufacture.

§6. 3 Accordion Design

This design allows flexibility in the range of monitors it can fit and in how it is stored. The elastic that attaches to each of the corner components allows the device to accommodate changes in monitor size insuring that the device remains useful even after several monitor upgrades. Also, when the device is no longer in use, it can either be contracted and left on the monitor or taken off and stored. If the device stays on the monitor the top hood needs to be removed and stored. Because the device is contractible, it should be able to stay on the monitor with little to no viewing obstruction. Taking the device off the monitor would add to the preparation time in using the device. Also, since there are two main hood components that need to be attached this may provide an opportunity for light to get through and also increases the amount of work that needs to be done to get the device ready for use. Another concern with this design is its stability and its ability to counteract the torque produced by the weight of the hood components.

§7 Final Design

The final design is a modified version of the accordion design. After further consideration of our previous final design, the accordion design, several modifications were made. Drastic modification of the corner pieces and the use of support blocks were added to the original accordion design. All design dimensions can be found in Appendix C and final design photographs can be found in Appendix E.

§7. 1 Design Components

The components of this design are similar to the components of the accordion design. The same main hood and extender pieces are used in this design. The main hood is constructed of Suraline fabric and elastic, with an aluminum wire sewn in to the top edge to prevent drooping. The extended corners of the main hood are sewn to the elastic which allows for hood expansion and a connection place for the extension pieces. The extender pieces are radio antennas that extend out 60.96 cm from the monitor face.

The corner pieces are constructed from steel and foam padding. These pieces keep the hood attached to the monitor and provide support for the extension pieces. The corner pieces have attachment sites for the extender pieces, the main hood, and the Velcro straps that help counteract the torque produced by the fully extended hood. These Velcro straps provide much needed additional support and prevent the design from slipping forward off the monitor.

The top hood is also made of Suraline fabric and elastic. It attaches to the main hood with Velcro at four locations and has an elastic viewing window to provide a tight fit around the

stereoscope. The fabric of the top hood is loose by design. This allows easy adjustments and movement of the stereoscope.

Wooden support blocks are placed under the monitor when the hood is fully extended. This again is done to stabilize the monitor hood and counteract any additional torque produced by the extended hood. As an additional means of keeping the hood elevated, a fabric loop is incorporated into the design. This loop is 76cm in circumference and pulls the lower extension pieces towards the upper ones. This tapers the design and takes up less space while insuring the lower extension pieces do not fall or droop during use.

To use the monitor hood, place the corner pieces at the corners of the monitor. Adjust the Velcro straps as needed to secure the hood to the monitor. Then, extend the extension pieces and cover with the main hood. Next, support blocks should be placed under the monitor so that the lower corner pieces are resting on top of the support blocks. Finally, attach the top hood by securing the Velcro to the main hood.

§7. 2 Advantages and Disadvantages

This design is sturdy and it can accommodate several different monitor sizes. It can be left on the monitor while not in use and will not disrupt the normal viewing capabilities of the monitor. In addition, the hood can be easily taken off the monitor and stored. The hood, while in use, allows flexible movement of the stereoscope and support blocks allow the grader to have the monitor angled upward.

Draw backs to this design do exist. Additional preparation time is required to set up the hood each time it is used, especially if the hood is taken off the monitor. Also, when the monitor is in use, some light does enter the hood from behind the monitor. However, the overall light

intensity inside the monitor hood is still less than the required 64 lux. In other words, the light entering from behind should not interfere with the grader's ability to identify problematic sites.

§7. 3 Cost Analysis

Materials used in construction of the prototype as well as costs are summarized in Table 1. The total cost of the project including materials that were not used can be found in Appendix D.

The total cost of the prototype is $81.93. This price may be misleading when re-producing this product. This is because production costs are not associated with the assembling of the prototype since this work was completed by the group. An estimate from the machine shop in the Engineering Centers Building gives $55/hr. In addition, either a seamstress or pre-made fabric encasement is needed to create the hood components. Furthermore, we were not charged for the wood blocks used for the monitor supports. These factors may increase the cost of reproducing the prototype. However, it would also decrease the time to

Table 1: Production Cost

Item	**Prototype Cost**
(2) 1/4" X 2" X 36 " Steel Plate	18.96
3' black Velcro	1.99
Black Thread	1.99
Suraline Fabric	10.98
Black Coarse Elastic	1.98
(5) RC Antenna	29.95
Plastic Steel Epoxy	3.99
(4) 3/4" Steel Cubes	1.00
Screws and Washers	2.38
(4) D-Rings	2.20
Nylon Straps	2.82
Fray Sealer	3.69
Foam Padding	-donated-
Aluminum wire	-donated-
Wood Blocks	-donated-
Total	**81.93**

produce an additional hood and the craftsmanship of the reproduction would be improved. Mass production of the prototype would also help alleviate some of the additional costs; however, it is our understanding that very few reproductions of the hood will be made.

§8. Future Work

While constructing this design, ideas on future ways to improve the design were found. First, further stabilization of the corner pieces would be helpful. This can be done by either replacing the side elastic with Velcro straps or by constructing a metal side that can adjust and be screwed into place depending on the height of the monitor. Another helpful alteration would be to find a more light-weight fabric to use in the construction of the hood. A lighter fabric would reduce the amount of torque caused by the extension of the hood. Ideally, we would also like to see the removal of the support blocks and decreasing the preparation time connected with operation of the hood.

Another source of modification requested by the client is to add a stand for the stereoscope to attach to the hood. This would allow a more hands-free work environment; however it will also produce a much larger torque when the hood is extended.

§9. Ethics

In order to ensure effective use of our prototype certain design requirements and standards given by the client and by international standard associations must be considered. An example of this is the required light intensity inside the monitor hood of 64 lux or less. To ensure our design complied with this requirement, fabric testing of light intensity was done before construction of the hood. Then, after the final design was constructed an additional check of the

light intensity was performed. In both cases our chosen fabric and design resulted in a light intensity of less than 64 lux.

Failure to adhere to set standards such as ergonomic office standards, light intensity standards (found in the PDS in Appendix F), and desired clients requirements would be unethical. These standards were put in place to provide the desired product that allows for a healthy and effective work environment and our design should and does, to the best of our knowledge, follow these standards.

§10. Conclusion

The modified accordion design adheres to the client requirements. The design's ability to fit to a variety of monitor sizes is due to the elastic and Velcro connections between corner pieces. When fully extended from the monitor, the design is able to support itself without having extended legs and does not leave a large footprint behind the monitor when contracted. The design does not require a lot of additional space for operation or storage which alleviates a primary concern of limited work space. The design also provides storage options since it is contractible without inhibiting the view of the screen and also removable from the monitor if so desired.

Further research is still suggested in order to get a better understanding of the production costs and manufacturing process involved in reproductions of this design. Still, the design presented is functional and within the client's price range thus far. With the client's approval of this product our team hopes it will be of use to the research being done at the Fundus Photograph Reading Center.

§11 References

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Appendix A

Patent Descriptions

U.S. Patent Number	Description
5,900,979	**A computer monitor hood**. Top, left side and right side shading panels, an elastic member or a spring member biases the left and right shading panels into frictional contact with said left and right side surfaces of the monitor.
5,243,463	**Visor for a video display terminal.** Left, right, and top wall with inner layers, granular or texturized for diffusing a part of the projected light beam in inner surface recesses
D422,579	**Video Monitor hood**
6,356,439	**Glare reducing hood for a laptop computer monitor.** Made of a fabric closure structure attached to and supported by an endless frame member.
6,394,615	**A collapsible-light shield for a portable computer.** Four flexible panels that form a tubular shape, a ring-like elastic fastener that detachably secures to three sides of the computer display.

Appendix B

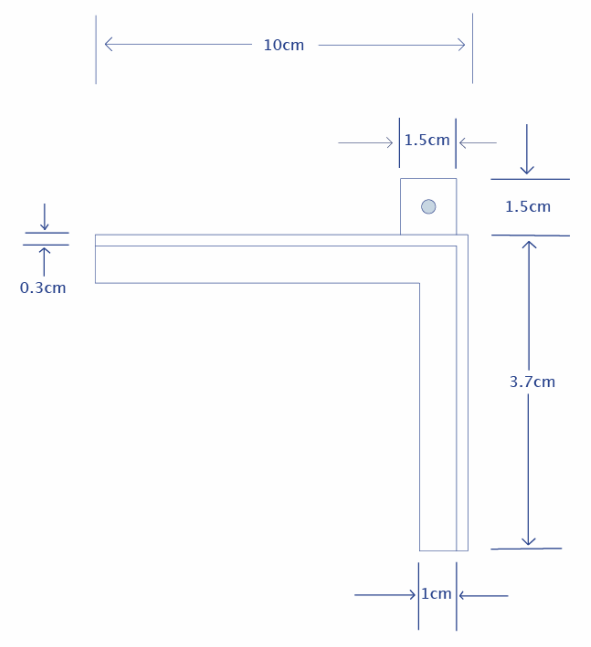
Design Matrix

Criteria	Rotating Bar Design	Solid Interlocking Panels Design	Modified Accordion	Accordion Design
Ability to Block Light	3	3	3	3
Flexibility	4	4	5	5
Projected Cost	4	2	4	3
Ease of Storage	4	4	3	3
Ease of multiple Use for Client	2	4	3	3
Ease of Manufacturing	3.5	2	3.5	3.5
Stability	3	4	4	4
Total	**23.5**	**23**	**25.5**	**24.5**

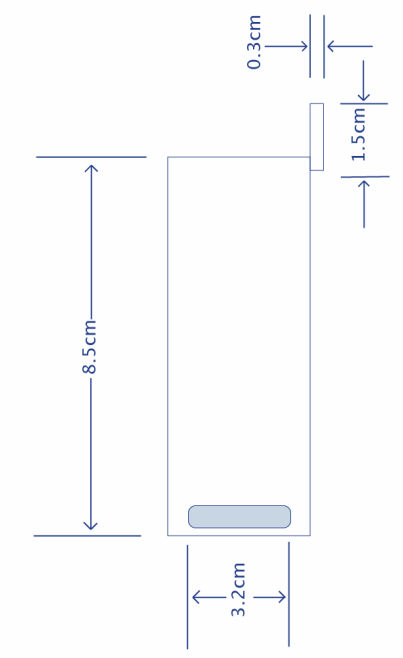
*Scale: 1-5
1: Poor
3: Satisfactory
5: Outstanding

Appendix C

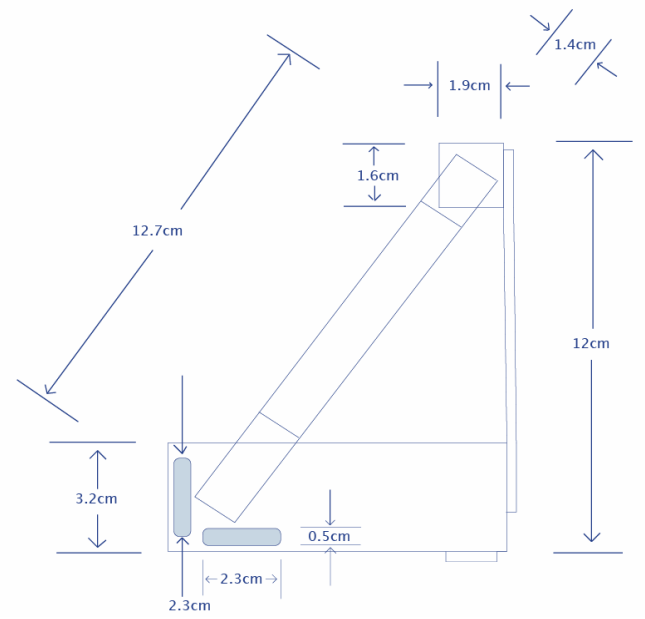
Design Dimensions



Corner piece: Rear view

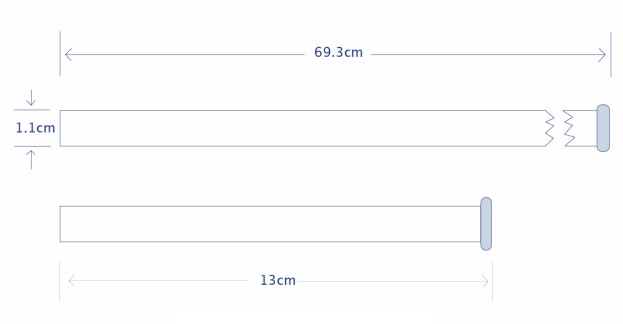


Corner piece: Side view along the height of the monitor

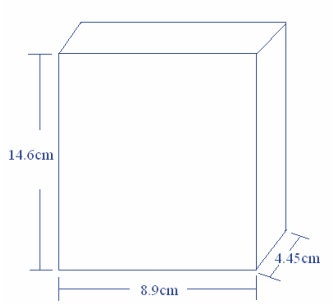


Corner piece: Top view

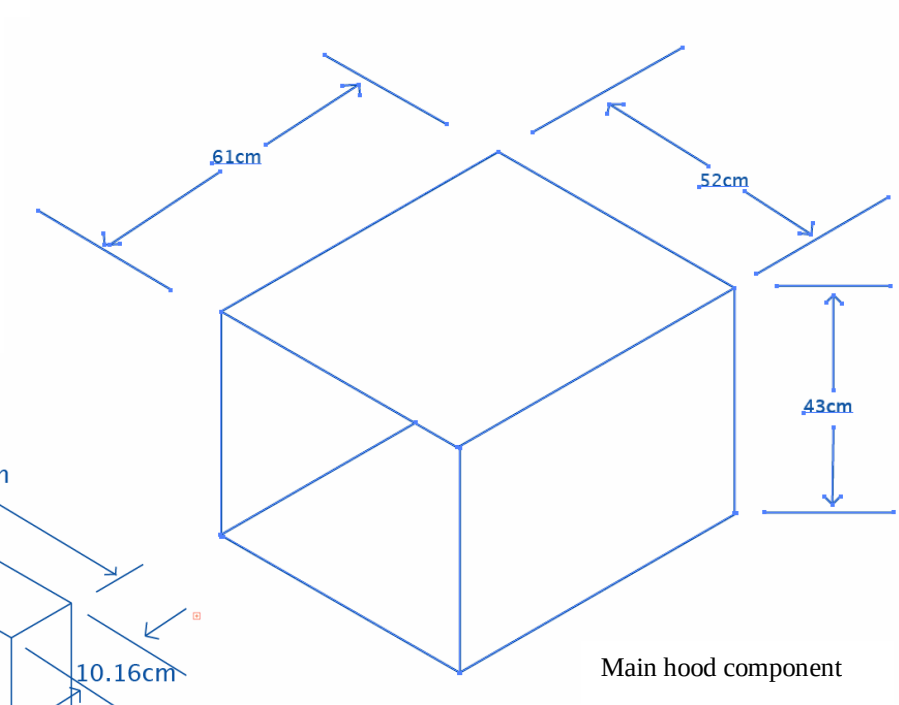
Appendix C



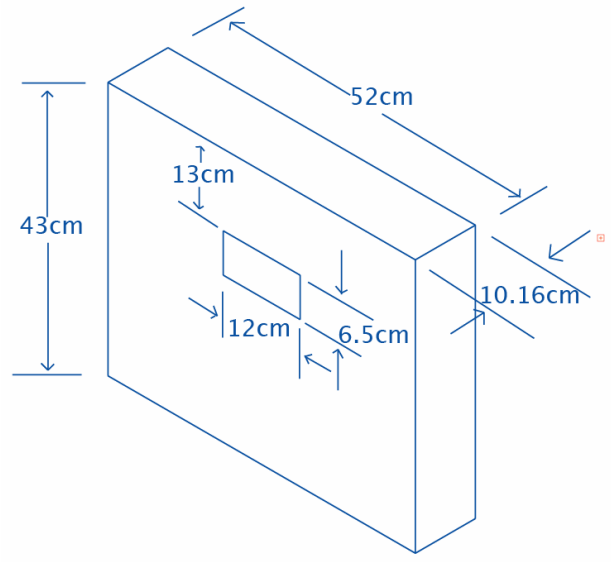
Extension pieces:
Top: Extended.
Bottom: Contracted



Support block

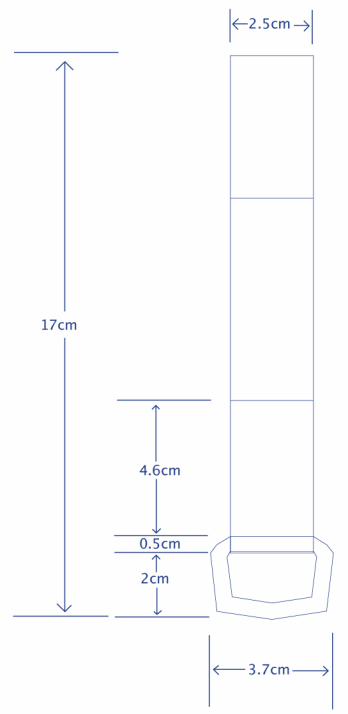


Main hood component

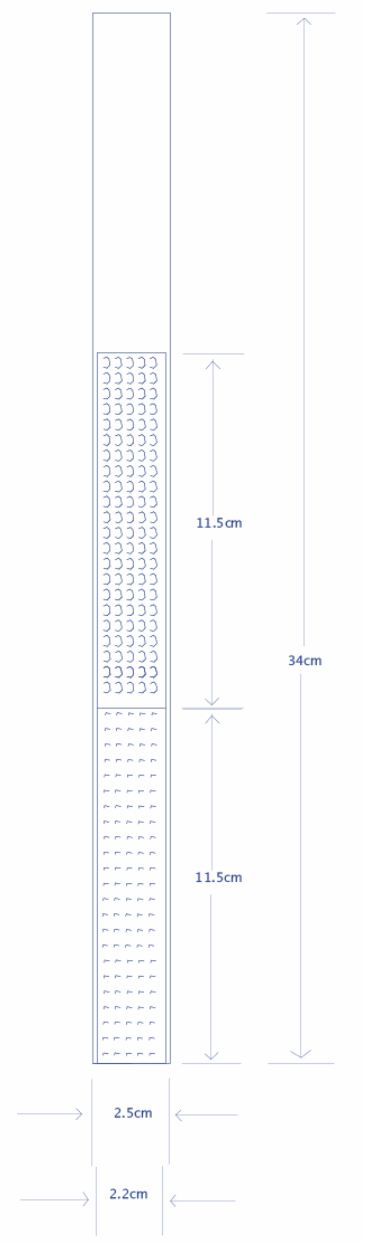


Top hood component

Appendix C



D-ring strap



Velcro strap

Appendix D

Summary of All Costs Associated with Production

Item	Production Costs
(2) 1/8” X 2” X 36“ Steel Plate	18.96
3’ Black Velcro	1.99
Black Thread	1.99
Suraline Fabric	13.23
Ripstop Nylon	8.58
Deco Fabric	15.95
Black Corse Elastic	1.98
(5) RC Antenna	29.95
Plastic Steel Epoxy	3.99
1/4” X 2” X 36” Steel Plate	4.77
1/4” X 2” X 36” Steel Angle Gauge	14.77
(4) 3/4” Steel Cubes	1.00
Screws and Washers	2.38
(4) D-Rings	2.20
Nylon Straps	2.82
Fray Sealer	3.69
Aluminum Wire	-donated-
Foam Padding	-donated-
Wood Blocks	-donated-
Total Tax	7.04
Total	135.29

Appendix E

Final Prototype Photos

Figure 1. The back side with the block supports, corner pieces, straps, and primary hood shown

Figure 2. The front side with corner pieces, contracted extenders, and primary hood shown

Appendix E

Figure 3. The complete prototype with block supports, and primary and secondary hoods shown

Figure 4. The front side with main hood, corner pieces, and extenders shown

Appendix F

Fundus Reading Hood:
Project Design Specification (PDS)

Team Members: Leah Brandon, Adam Dahlen, Nathan Kleinhans, Sara Worzella
Client: Dennis G. Hafford

Last updated: 10/21/05

Function: The goal of this project is to develop a flexible, easily stored monitor hood that will block ambient light. The monitor hood will be designed for LCD monitors used in grading retinal scans at the Fundus Reading Center.

Client Requirements:
The client requires the design to:

- Allow a clear view of the monitor at all times.
- Have an adjustable length of 60.96 cm.
- Be easily removable from the monitor or not extend out more than 38.10 cm. when not in use.
- Not to extend significantly behind the monitor.
- Take up a minimal amount of space when stored.
- Taper to a closed viewing port of approximately 20.96 cm by 6.03 cm.
- Viewing port needs to be about 12.70 cm. down from the top of the monitor.
- Be self-supporting with no legs when extended.
- Have an adjustable angle of view to allow grader to maintain good posture.
- Be flexible to fit a range of monitor sizes.
- Light intensity under the hood should not exceed 64 lux

If time allows, the client also requests that the hood accommodate a fixture to secure a stereoscope to reduce fatigue from holding the accessory. The following specifications are required:

- 60.96 cm from the screen
- Horizontally-centered position
- Variable tracking
- Slight rotational ability

1. Physical and Operational Characteristics

a. ***Performance requirements***: The hood will be used on a regular basis, likely for several hours each day. However, since the monitor is used for other tasks the device must detach or retract to allow for complete viewing. The actual hood is not moving when it is in position, but changing positions will be estimated to occur at least 8 times per day.

b. ***Safety***: There will be very few safety concerns for the product. One minimal concern would be pinching of the fingers as mechanical folding occurs, but the forces will most likely not be strong enough to be dangerous, as the product will most likely be manually operated.

c. ***Accuracy and Reliability***:

- The device must accommodate flat screen monitors with a depth of about 3.81 cm
- Adjustment to each monitor type should be made.
    - Monitor dimensions to adhere to:
        - VP201b 44.45 cm W x 34.29 cm H x 3.81 cm D
        - FP2000 51.44 cm W x 42.55 cm H x 3.81 cm D
        - FP2001 44.45 cm W x 35.56 cm H x 3.18 cm D

d. ***Life in Service***: A likely product would be used for a number of years, possibly until the end of the client's research. Travel, revolutions, and cycles do not apply.

e. ***Shelf Life***: Shelf life will be indefinite as long as it is kept in optimal conditions (cool, dry place) as to not promote rusting of mechanical joints.

f. ***Operating Environment***: Conditions of operation include those in a standard, air controlled, regular office setting:

- Normal room temperature operation (~70°)
- Normal pressure ("the standard atmosphere" (1 atm) = 101.325 kPa)
- Low humidity
- Dirt and dust levels are low and negligible
- Fluid corrosion will not be a factor, as the office setting does not produce volatile fluid to affect the product
- Vibrations may cause loosening and detachment of the device from the computer monitor and should be kept to a minimum.

g. ***Ergonomics***: The device should be restricted to movement by manual force. It should have a small footprint (should not take up space behind the monitor) as there is very little room in many of the workspaces. The device should allow the monitor to be slightly below the eyes and angled up. If a ledge is attached to support the stereoscope it must pivot to allow the grader to maintain good posture.

h. ***Size***: Static components of the reading hood should not exceed 38.10-45.72 cm, but the total extension should reach 60.96 cm with no additional support. The unit must be collapsible to a very small size, leaving no footprint behind monitor.

i. ***Weight:*** Product weight must be minimal, as no legs can be attached for support. Computer monitors must bear all weight.

j. ***Materials:*** Frame must be light and sturdy; screen/fabric for the sides cannot be transparent to any degree.

k. ***Aesthetics***, ***Appearance, and Finish***: Ideally, a dark matte finish will be applied to all inner surfaces of hood to reduce or eliminate light reflection. Product is not required to be aesthetically pleasing, so long as functionality is maximized.

2. Production Characteristics

a. ***Quantity***: Roughly 15 units for all photograph graders at Fundus and the ability to easily manufacture more units if needed.

b***. Target Product Cost***: Optimal cost is under $200 a unit, however, budget allows for the prototype to cost no more than $2000.

3. Miscellaneous

a. ***Standards and Specifications***: This product is not regulated by the FDA but has several national standards. The applicable standards from the International Ergonomics Associations standards include ISO 9241, ISO 9355, and ISO 14738. Theses standards address ergonomic requirements for office work with visual display terminals, for the design of displays and control actuators, and for safety of machinery, respectively.

b. ***Customer***: The customer would like a design that is lightweight, compact, and easily moved and stored in the lab. Previous designs presented to the client were too big, stationary, and heavy for the facility.

c. ***Patient-related concerns***: The privacy of patient data is a concern; however, the hood is offering further protection of privacy.

d. ***Competition***: Several monitor hoods exist on the market from companies such as ColorGear, CompUshade, Photodon, Ergomart, and Hoodman. These hoods sell from $25-$80, a lower price range than our reading hood. U.S. patents for monitor hoods and similar coverings are 5,900,979; 5,243,463; D422,579; 6,356,439; 6,394,615 The purpose of these monitor hoods is to reduce glare and background light. None of these products focus specifically on the reading of ophthalmic images or blocking all ambient light. Also, they do not include an extended viewing window.