Apparatus for Improving Binocular Vision Disorders

Field of the Invention

The present invention pertains to the field of orthoptics. More particularly the invention relates to apparatus and methods for perceptual motor learning with respect to the visual system of a person having an eye disorder, in particular, a binocular vision disorder.

Background of the Invention

Vision therapy programs typically involve eye exercises using various types of hardware, including lenses, prisms, filters, occluders, specialized instruments, and/or computer programs. The course of therapy may last weeks to several years, with intermittent monitoring by an ophthalmologist. Therapies for vision disorders are often expensive and inconvenient for patients. The present invention addresses this problem by providing economical equipment that can easily be used to perform therapies in a patient's home.

Summary of the Invention

An apparatus for treating binocular vision disorders is disclosed which may be used to provide perceptual motor learning for a patient having a binocular vision disorder. The apparatus is used in conjunction with a computer and allows a patient to engage in therapy by controlling the output of light from the computer screen. Preferably a tablet type computer will be used with the apparatus and the description below assumes that this is the case. However, adaptations will be apparent to those of skill in the art that would allow other types of computers and similar devices with computer screens (*e.g.*, some types of cell phones) to be used as well. Thus, as used herein, the terms "tablet" or "tablet screen" should not be considered as limiting unless otherwise indicated either expressly or by context.

By using masks and mirrors with the device and computer, methods requiring a vertically oriented viewing plane can be performed in which both eyes of a patient must focus on a object that is directly in front of them, at varying distances of 1 to 12 inches. The general effect of such mirrors and masks is to provide a double-sided, image-able area directly in front of the person. In a preferred embodiment, the tablet will be masked in such a way that the user is only able to see

the depth axis of the visual display, the process of viewing a screen that is vertically attached to a display shall be referred to as depth-of-field viewing.

General Summary

The present invention is directed to an apparatus that can be used in conjunction with a computer to provide therapies for patients with vision disorders. The main component of the apparatus is a flat, typically triangular shaped, device with reflective, opposing, front and back surfaces (also referred to herein as a "double-sided mirror"). This is designed so that it may be positioned to extend perpendicularly from the center of the screen of a tablet-type computer such that the left side of the screen reflects to the left side of the double-sided mirror, and the right side of the screen reflects to the right side of the double-sided mirror.

The apparatus may include a headrest that maintains the eye position of a patient at a constant distance from the device with opposing mirrored surfaces and from the computer screen. Typically, the headrest will be part of, or attached to, a frame or casing that forms a structure or shell of the apparatus and in which the device can be contained, supported or suspended. Preferably, the apparatus is designed so that the double-sided mirror can be removed or repositioned during a therapy session and thereby allow a patient to view the two-dimensional computer screen in its entirety. The chassis will keep the user in a consistent position during a therapy session in which both two-dimensional and depth-of-field viewing is required.

The device can be as large as the tablet computer itself, or may use only a subsection of the computer in order to allow the user to make real time adjustments on the touch screen display while in therapy. The user will view a double-sided mirror, with the left eye viewing the left side and the right eye viewing the right side. The display, as depicted on the mirror and seen with the left eye, not including what is projected from the tablet device can be considered the left plane with a depth axis, and vice versa for the right eye.

In order to prevent a user from confusing what is presented on the mirrors with the original display, a series of interchangeable masks may preferably be used to provide various

viewing angles for respective therapeutic methods. In addition to the masks, the device may have a permanent outer casing to refract ambient light to be used as a control for exercises.

The apparatus and computer screen may sit or be mounted on a horizontal surface*, e.g.* a table, or a desk, or the computer screen may be supported on a surface so that it is vertical and the positioning of the apparatus and device altered accordingly. (e.g. smaller mobile devices) It is also possible to use non-perpendicular angles between the screen and mirrored device and to allow for adjustments in angles and headrest positions either for therapeutic purposes or for the comfort of the user. (e.g. larger tablet devices)

Specific Summary

In its first aspect, the invention is directed to an apparatus for treating binocular vision disorders that includes a planar device with a mirrored front and back surface, a headrest that, during use, will maintain head of a patient in a constant position and means that allow the device to extend from the screen of a computer at an angle that, when viewed by a user of the device from the headrest, allows one eye of the user to view the front mirrored surface of the planar device and the other eye of the user to simultaneously view the back mirrored surface of the planar device. Means that allow the device to extend from the screen of a computer include supports that allow device to stand on a flat horizontal surface without falling, a frame that surrounds a tablet computer or similar device and includes groves, notches or braces that hold the device. The apparatus may also include a frame or casing that supports the headrest and from which the mirrored device may be suspended using brackets, lines, clamps etc. Support pieces, clamps, brackets, etc. may either be separate from the device or may be part of the device.

In addition, the apparatus may include one or more opaque masks that can be positioned over the computer screen to partially or fully prevent it from being visible when viewed with a line of sight approximately perpendicular to its surface, except on the mirrored surface of the device. These masks may attach to a support, frame or platform that is separate from the device and that allows the masks to be adjusted, while attached, to different horizontal or vertical positions.

The apparatus of may also include an outer case that encloses the device and computer screen to reduce or eliminate ambient light when the apparatus is in use. The outer case may include eye placement sockets (4) that serve as part of the headrest of the apparatus and light vents that can be used to adjust the amount of light inside the case during use of the apparatus.

In another aspect, the invention is directed to a system for treating binocular vision disorders that includes: a) a computer with a computer screen capable of displaying images; b) an apparatus comprising: i) a headrest and ii) a planar device with mirrored front and back surfaces located between the computer screen and headrest, and which extends from the computer screen at an angle that, when viewed by a user of the device from the headrest, allows one eye of a user to view the front mirrored surface of said planar device and the other eye of the user to simultaneously view the back mirrored surface of said planar device.

The planar device used in the system will typically extend from the computer screen at an angle of approximately 90 degrees (*e.g.*, plus or minus 10 degrees) and the headrest will typically be 6-18 inches away from the computer screen. The computer screen may be in horizontal orientation (*e.g.*, laying on a table) with the device extending in an upward direction from the computer screen or in a vertical orientation (*e.g.*, suspended from an upright support) with the device extending in an outward direction from the computer screen.

Any type of support may be used to hold the device in position as long is does not interfere with its mirrored surfaces reflecting the computer screen in the manner desired. Supports may include support legs that hold the device in an upright position over the screen when the screen is in a horizontal orientation or in front of the screen when it is in a vertical orientation. Alternatively the apparatus may include at least one support piece that is separate from the device but which holds the device in position over the screen. The apparatus may also have a frame or platform that is separate from the device but which holds it in position.

The system may additionally include one or more opaque masks that can be positioned over the computer screen to partially or fully prevent the screen from being visible when viewed with a line of sight approximately perpendicular to its surface, except on a mirrored surface of

the device. The masks may be attached to a support piece, frame or platform of the apparatus that is separate from the device in a way that allows them to be adjusted to different horizontal or vertical positions.

The system may include an outer case that encloses the device and computer screen to reduce or eliminate ambient light when the apparatus is in use. This outer case may have one or more light vents that can be used to adjust the amount of light inside the case during use of the apparatus and may also include eye placement sockets that are part of the headrest.

The invention is also directed to a method of treating a patient for a binocular vision disorder using any of the systems described above and in which: a) a computer program is run on the computer and generates images on the mirrored surface on either side of the device of the apparatus, some of which images are not identically aligned with one another; and b) the patient adjusts the positions of the images either electronically using the computer or manually using the apparatus until the patient believes that they are identically aligned. Typically, the computer program will compare the size, position, color, brightness, or scale of the images chosen by the patient as resulting in identically alignment with predetermined correct positions for alignment to determine the accuracy with which the images were aligned by the patient.

Brief Description of the Drawings

These and other aspects, features and advantages of which embodiments of the invention are capable of will be apparent and elucidated from the following description of embodiments of the present invention, reference being made to the accompanying drawings, in which

FIG. 1 is an orthographic view of the apparatus containing masks, and tablet device with the relative positioning of the double-sided mirror above it. The eye socket above depicts the viewing position and the dotted lines depict angles of reflection.

FIG. 2 is an isometric view of the apparatus with an outer case applied so as to block external light from entering the therapeutic space. It also depicts how the tablet device and the masks may be inserted.

Detailed Description of the Invention

The present invention will now be described more fully hereinafter with reference to the accompanying drawings and photographs, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, and prime notation is used to indicate similar elements in different embodiments.

Fig. 1 is an orthographic view of the lower assembly, which comprises the most significant embodiments of the invention. A tablet device (1) is inserted into a chassis, which suspends a double-sided mirror (2) in a perpendicular fashion above it. The purpose of the double-sided mirror is to divide the display into two separate areas, in which a computer program may generate graphics on the tablet (1) and they will be reflected on the double-sided mirror (2). The patient will look directly at the device from above (3), in that the view with the user's right eye will see only the right display, and the user's left eye will see only the left display.

To create an environment that will provide therapy for binocular disorders, masks (4) are applied in such a way, that the graphics projected on the two-sided mirror are only seen on the mirror and not the device: The graphic (5), originating on the tablet (1), has a visible channel (6) to the (2) two-sided mirror, and only it's reflection (7) on the mirror is visible to the user whereas the direct line of sight to the graphic (8) on the tablet is masked so the user is only able to see the graphic at it's reflection point (7) upon the mirror. Masks to the side (9) allow for access to user interface buttons directly on the tablet device.

The lower chassis, (10) holds the mirror and masks in place. The eye socket (11), similar in design to a ski mask, is shown in FIG1 to depict the resting position of the user's head while in therapy using the apparatus.

Certain tests may require the masks (4) be in place, not in place, or any position in between. Thus, the casing of the device must provide means to remove or partially remove the

masks. Additionally, the height positioning of the mask may be affected to match the optimal masking potential for the specified tablet device.

FIG 1 also depicts the effect of projection upon the two fields in the therapeutic space. The mirror serves as a vertical mask, which disallows one eye from seeing the other side. The perspective the patient would see as viewed from directly above, would cause the viewer to focus on the reflections of the projected graphic in the double-sided mirror. Wherein, the following therapeutic methods can be considered:

One of the two graphics (5), when scaled slightly smaller would normally be perceived as further away than the second graphic which is scaled slightly larger. The user would then use the provided user interface buttons to change the scale of the objects until they perceive them to be of the same size, which may or may not be accurate. This test measures the ability of the eyes or brain to perceive depth by comparing the user's input with the accuracy of true values.

One of the two graphics (5), positioned differently than an identical second graphic should appear out of place upon the reflection. Should these graphics be on the same depth plane, (FIG2, 16) the user would then use the provided user interface buttons to change the position of the objects until they are perceived as one object, that is, where both eyes focus on the respective projections, and the brain calculates that it is the same object. This test is another method, which measures the ability of the eyes and brain to perceive depth by comparing the user's input with the accuracy of true values.

One of the two graphics (5), whose color is slightly different than the second graphic's color would normally be perceived as different colors. The brain does not blend colors; If the color on the right is red, and the color on the left is blue, the brain will perceive this to be red-blue and not violet. In a subtler test, two similar, slightly different colors may be presented on either side wherein the user adjusts one of the colors to match the other. This test would be able to assess a user's color sensitivity in either eye, again by comparing the user's input with true values.

One of the two graphics (5), whose brightness is slightly different than the second graphic's color would normally be perceived as of a different brightness. This test is another method, which measures the ability of the eyes and brain to perceive brightness by comparing the user's input with the accuracy of true values.

Identifying vision deficiencies using these methods may also potentially diagnose or determine the location of a trauma; e.g. if the same defect is in both eyes the trauma may be located in the brain; or if the defect is only in one eye a trauma may be located within that eye.

In each of these examples, the user may use the suggested tests along with a therapeutic regimen that repeats several similar challenges, re-tests and compares the history of said tests in order to determine which methods help the user along in their recovery.

In order to block external light from entering the therapeutic space, FIG 2 presents a view of the apparatus with an outer case (12). In general, the inside of the case should have nonreflective surfaces. Some therapies may be required to eliminate ambient light as much as possible whereas other therapies may require that an amount of ambient light be allowed in the therapeutic space. Therefore, the case may include adjustable light vents, which allow light to be fed into the space in a controlled way. In general, the case should only be slightly larger than the field of vision in test. Form fitting eye placement sockets, e.g. a ski mask (4) should be used to ensure that all light is blocked out.

FIG 2 also depicts how the mask (14) and tablet device (15) can be inserted into the apparatus. The user will look through the eye socket through the chassis where the mirrors are. Additionally, The mirror can be removed for certain tests that call for full screen viewing in a controlled environment.

The tablet device shown depicts software, which could be used along with the device. As shown, a typical set of test graphics will fall along similar opposite paths (16) centered on the device. Adjustment of the objects along the path will be the primary method the device will use to perform therapy or diagnosis of a given condition. User interface buttons, + (17) and – (18)

will adjust the size, position, color, brightness, or scale of the graphic on it's respective side. The check button will be used when the user is complete with a given exercise.

During a typical therapeutic regimen, the apparatus allows the user to interact with the tablet device to manually align the opposite projections until they appear identical to the user, which user input may or may not be factually accurate. The degree to which the chosen positions vary from the correct positions can be assessed and therapy can be implemented to improve binocular accuracy, with results measured over time.

The embodiments depicted above outline a potential application of the apparatus. In a second embodiment, the apparatus may employ existing technologies to limit its size, reduce the thickness of the double-sided mirror or provide a more accurate improvement upon the invention's therapeutic ability. The double-sided mirror may be replaced with any highly reflective film or surface (e.g. polyimide film or stainless steel); it may also be replaced with opposing OLED (organic light-emitting diode) displays, thereby eliminating the tablet device altogether; it may also include a separate wired or wireless hand controller with user interface buttons may also be used in tandem with the invention.

There may be other uses for the apparatus outside of the medical field, such as games, which use the inventions disclosed for leisure, wherein any application of using a double-sided mirror in a perpendicular manner above a tablet device, would also be considered an application of this invention.

References:

US 8,770,750: Apparatus and method for establishing and/or improving binocular vision

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Having now fully described the invention, it will be understood by those of skill in the art that the invention may be practiced within a wide and equivalent range of conditions, parameters and the like, without affecting the spirit or scope of the invention or any embodiment thereof.

What is Claimed is:

1. An apparatus for treating binocular vision disorders, wherein said apparatus comprises a planar device with a mirrored front and back surface, a headrest that, during use, will maintain head of a patient in a constant position and means that allows the device to extend from the screen of a computer at an angle that, when viewed by a user of the device from said headrest, allows one eye of the user to view the front mirrored surface of said planar device and the other eye of the user to simultaneously view the back mirrored surface of said planar device.

2. The apparatus of claim 1, wherein, said device comprises means that allow the device to be attached to, be suspended above, or rest on top of the screen of a tablet type computer such that the apparatus extends in an upward direction from the screen when said tablet is in a horizontal orientation.

3. The apparatus of claim 1, wherein, said device comprises means that allow the device to be attached to, be suspended in front of or rest in front of the screen of a tablet type computer such that the apparatus extends in an outward direction from the screen when said tablet is in a vertical orientation.

4. The apparatus of any one of claims 1-3, wherein said device comprises support legs that holds said device in an upright position over said screen when said screen is in a horizontal orientation and in front of said screen when said screen is in a vertical orientation.

5. The apparatus of any one of claims 1-3, further comprising at least one support piece that is separate from said device but which holds said device in an upright position over said screen when said screen is in a horizontal orientation and in front of said screen when said screen is in a vertical orientation.

6. The apparatus of any one of claims 1-3, further comprising a frame or platform that is separate from said device but which holds said device in an upright position over said screen when said screen is in a horizontal orientation and in front of said screen when said screen is in a vertical orientation.

7. The apparatus of any one of claims 1-7, further comprising one or more opaque masks that can be positioned over said screen to partially or fully prevent said screen from being visible when viewed with a line of sight approximately perpendicular to the surface of said screen, except on a mirrored surface of said device.

8. The apparatus of claim 7, wherein said one or more opaque masks attach to at least one support piece, frame or platform that is separate from said device and that allows said masks to be adjusted to different horizontal or vertical positions with respect to said screen.

9. The apparatus of any one of claims 1-8, further comprising an outer case that encloses said device and screen to reduce or eliminate ambient light when said apparatus is in use.

10. The apparatus of claims 9, wherein said outer case comprises form fitting eye placement sockets (4) that are part of the headrest of the apparatus and that can be used to further reduce ambient light when said apparatus is in use.

11. The apparatus of claims 9 or 10, wherein said outer case comprises one or more light vents that can be used to adjust the amount of light inside said case during use of the apparatus.

12. A system for treating binocular vision disorders comprising:
    a) a computer with a computer screen capable of displaying images;
    b) an apparatus comprising;
        i) a headrest;

ii) a planar device with mirrored front and back surface that is located between said computer screen and said headrest, wherein said planar device extends from the computer screen at an angle that, when viewed by a user of the device from the headrest, allows one eye of the user to view the front mirrored surface of said planar device and the other eye of the user to simultaneously view the back mirrored surface of said planar device.

13. The system of claim 12, wherein said wherein said planar device extends from the computer screen at an angle of approximately 90 degrees.

14. The system of either claim 12 or claim 13, wherein said headrest is 6-18 inches away from said computer screen.

15. The system of any one of claims 12-14, wherein, said computer screen is in a horizontal orientation and said device extends in an upward direction from the computer screen.

16. The system any one of claims 12-14, wherein, said computer screen is in a vertical orientation and said device extends in an outward direction from the computer screen.

17. The system of any one of claims 12-16, wherein the device of said apparatus further comprises support legs that holds said device in an upright position over said screen when said screen is in a horizontal orientation and in front of said screen when said screen is in a vertical orientation.

18. The system of any one of claims 12-16, wherein said apparatus further comprises at least one support piece that is separate from said device but which holds said device in an upright position over said screen when said screen is in a horizontal orientation and in front of said screen when said screen is in a vertical orientation.

19. The system of any one of claims 12-16, wherein said apparatus further comprises a frame or platform that is separate from said device but which holds said device in an upright position over said screen when said screen is in a horizontal orientation and in front of said screen when said screen is in a vertical orientation.

20. The system of any one of claims 12-19, further comprising one or more opaque masks that can be positioned over said screen to partially or fully prevent said screen from being visible when viewed with a line of sight approximately perpendicular to the surface of said screen, except on a mirrored surface of said device.

21. The system of any one of claim 20, wherein said one or more opaque masks attach to at least one support piece, frame or platform of said apparatus that is separate from said device and wherein, when attached, said masks can be adjusted to different horizontal or vertical positions with respect to said screen.

22. The system of any one of claims 12-20, further comprising an outer case that encloses said device and screen to reduce or eliminate ambient light when said apparatus is in use.

23. The system of claim 22, wherein said outer case comprises one or more light vents that can be used to adjust the amount of light inside said case during use of the apparatus.

24. A method of treating a patient for a binocular vision disorder using the system of any one of claims 12-22, wherein:

a) a computer program is run on said computer which generates images on the mirrored surface on either side of the device of said apparatus, some of which images are not identically aligned with one another;

b) said patient adjusts the positions of the images either electronically using said computer or manually using said apparatus until said patient believes that they are identically aligned.

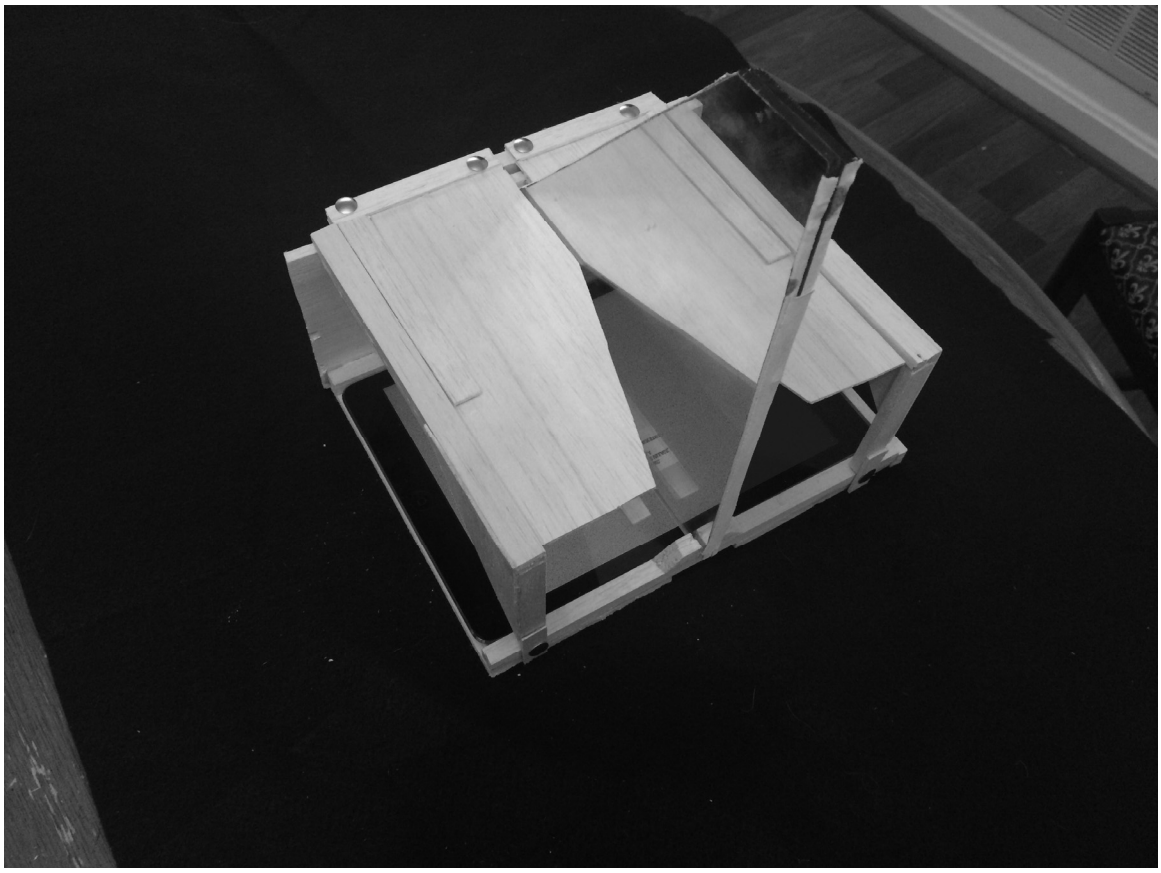
25. The method of claim 24, wherein the positions of said images chosen by said patient as resulting in identically aligned images are compared by said computer program to predetermined correct positions for alignment to determine the accuracy with which the images were aligned by the patient.

Abstract

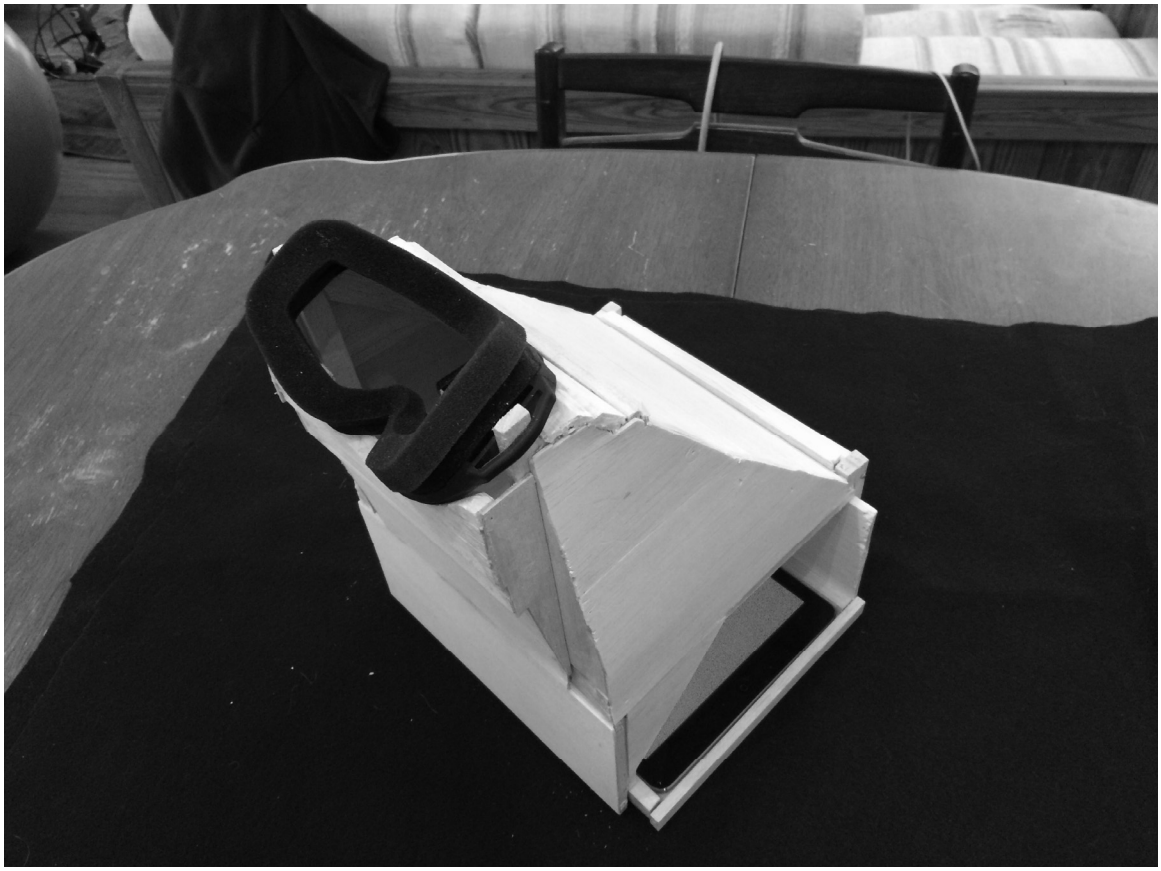
An apparatus and method are disclosed which provide for improving binocular vision disorders.

Appendix

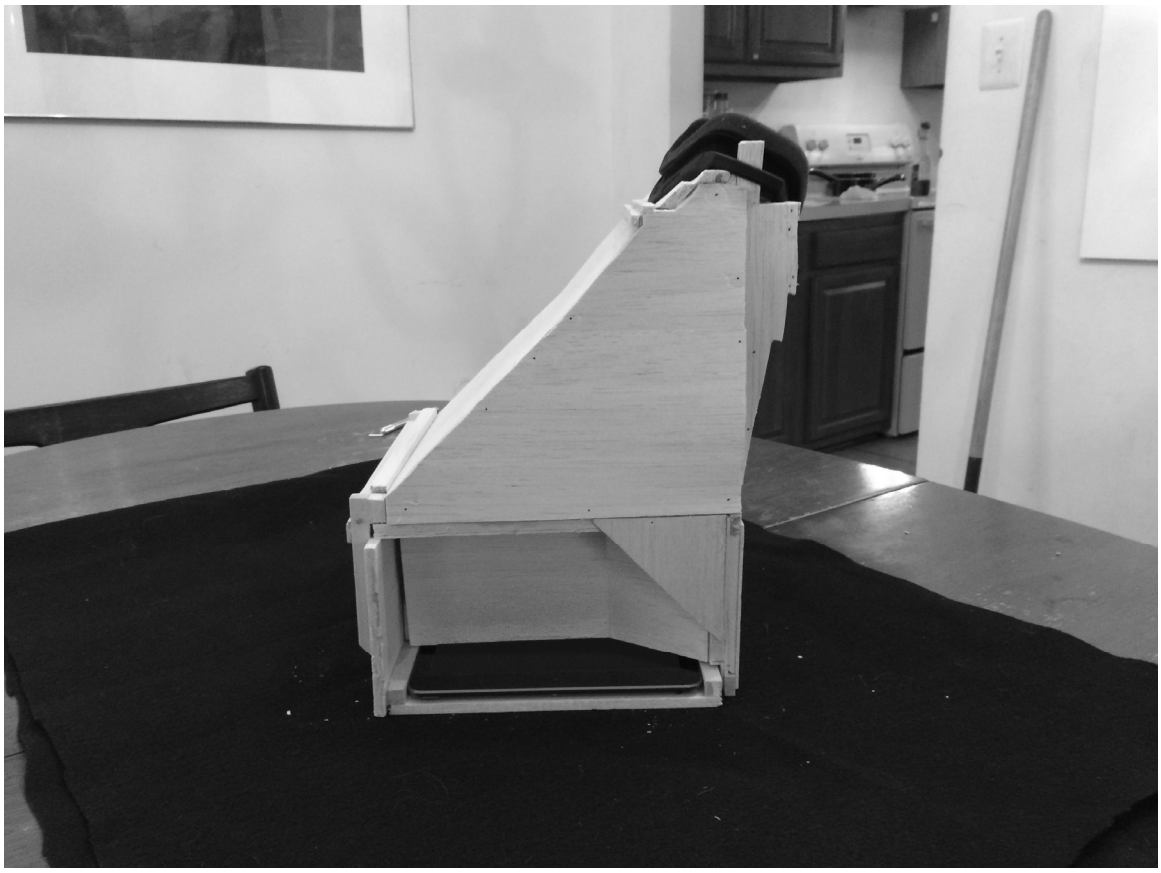
Images of Prototype Apparatus



The double-sided mirror with masks applied in order to selectively display content only on mirror regions



the encased apparatus



Access to the tablet device is allowed through recessed openings on the sides while the remaining surface of the tablet remains blocked from ambient light

Matte black applied to inside and outside of prototype in order to further mask ambient light from entering the apparatus.