SUMMARY

[0005] Technology described herein includes systems and methods for computing the angle of repose for a lens, and for modifying a specification of a lens, such as an asymmetric lens, using the angle.

[0006] A method for operating a device or devices is described to determine the angle of repose of a lens, such as the angle of repose of a contact lens on an eye. The device or devices include a display, a data processor and a user input device such as a touchscreen overlying the display, such as commonly found on so-called "smart" phones. The method of operating includes storing an image including the lens captured using a camera and executing graphical user interface logic using the display. Graphical user interface logic includes a frame or frames including the captured image, and graphical constructs prompting input identifying a set of locations on the captured image that are usable to define a location of the lens in the image, and a location usable to define an angle of repose of the lens in the image. The graphical user interface logic accepts input data responsive to the graphical constructs that is interpreted as identifying locations on the captured image.

[0007] The device or devices can include a camera with an orientation sensor. The method can include displaying an orientation graphic on the display using the orientation sensor. The orientation graphic can include indicators of an orientation of a camera lens, or other indicators usable in composition of an image to be captured by the camera for use in the process. For example, the orientation graphic can include a graphical construct that indicates orientation of the camera lens around a line of sight axis normal to the camera lens, around a horizontal axis and around a vertical axis.

[0008] The method can include processing the input data accepted via the graphical user interface to determine an angle of repose of the lens. Also, the method can include using the angle of repose of the lens to produce a specification for a lens, such as a contact lens prescription, based on the determined angle of repose.

[0009] Technology described herein also includes a device configured to execute processes as described above. Also, technology described herein includes a computer program product comprising a non-transitory computer readable medium storing

[0032] **FIG. 11** shows a lookup table example for converting components of a spectacle prescription to a toric lens prescription.

[0033] **FIG. 12** is a simplified flow diagram illustrating graphical user interface logic for the top level functions for modifying a lens prescription for an eye measurement device.

[0034] **FIG. 13A** is a simplified flow diagram illustrating graphical user interface logic for processing a new record for a new patient for an eye measurement device.

[0035] **FIG. 13B** is a simplified flow diagram illustrating graphical user interface logic for processing a prescription for an eye measurement device.

[0036] **FIG. 13C** is a simplified flow diagram illustrating graphical user interface logic for marking locations for an eye measurement device.

[0037] **FIG. 14** is a simplified flow diagram illustrating graphical user interface logic showing the basic steps for listing and searching records, and for editing records for an eye measurement device.

[0038] **FIG. 15** is a simplified flow chart for editing a record, and for angle calculation and lens specification processes.

[0039] **FIG. 16** is a simplified flowchart showing a method of operating a device or devices for measuring an angle of repose and updating a lens specification.

DETAILED DESCRIPTION

[0040] The following detailed description is made with reference to the figures. Sample implementations are described to illustrate the technology disclosed, not to limit its scope, which is defined by the claims. Those of ordinary skill in the art will recognize a variety of equivalent variations on the description that follows.

[0041] The generation of the angle of repose for a lens on an eye, and methods for modifying a specification of a contact lens prescription using the angle will be discussed primarily with reference to **FIGS. 1-16**.

[0042] **FIG. 1** illustrates mobile phone **100** having a camera **142,** a processor **145**, a user input device **165** such as a touch screen, a display **152,** an orientation sensor **144**, and a data store **125.** The mobile phone **100** is configured with instructions on a non-transitory computer readable medium executable by the processor **145** to provide a graphical user interface, and that include logic supporting the determination of the angle

can process the input data to determine the angle of repose of the lens in the image. Example frames usable for this purpose are shown in **FIGS. 6-8**.

[0064] The frame shown in **FIG. 6** includes a field **720** in which the captured image is displayed, and a field **721** including a set of graphical constructs. The graphical constructs in the field **721** prompt input identifying a set of locations, and include a construct (*e.g.* **732**) which when selected identifies a particular member of the set of locations, and causes the graphical user interface to interpret coordinates of a selected point in the displayed image as the particular member of the set of locations. Other constructs **751**, **753** and **754** are included, and used to invoke actions by the graphical user interface logic.

[0065] In this example, the constructs in field **721** include a set of constructs (e.g. **732, 742, 752**) corresponding to locations usable to define a perimeter of the contact lens in the captured image, where the constructs in the set when selected identify respective members of the set of locations, and cause the graphical user interface to interpret coordinates of a selected point (*e.g.* point **715**) selected by a user touch on the touch screen in the captured image as the respective member of the set of locations.

[0066] In this example, the constructs (e.g. **732, 742** and **752)** are used to identify data that is interpreted as the locations of three points on the edge of a toric contact lens in the image, as selected by the user. The three selected points are interpreted by the graphical user interface logic as identifying the location of the circumference of the contact lens, usable in a process to define an angle of repose of the contact lens in the image. The graphical user interface logic can display values representing the coordinates of the locations of the three dots in fields P1 (construct **732)**, P2 (construct **742)** and P3 (construct **752).**

[0067] Also, the constructs in the field **721** include another construct **755** which corresponds to an index point location in the set of locations usable to define the location of an index point on the lens in the capture image. An index point can be the mark that is typically used on toric contact lenses, or any other feature of the lens that can indicate an angular position of the lens relative to a reference line, such as a vertical line. When selected, the construct **755** identifies the index point location, and causes the graphical

1. A method for operating a device or devices to determine an angle of repose of a contact lens on an eye, the device or devices including a display, a camera with a camera lens, an orientation sensor, a data processor, and a user input device, comprising:

displaying a view finder image from the camera on the display prior to capturing the image;

displaying an orientation graphic on the display using the orientation sensor while displaying the view finder image, the orientation graphic to indicate orientation of the camera lens around a line of sight axis normal to the camera lens around a horizontal axis and around a vertical axis;

capturing and storing an image using the camera;

executing a graphical user interface using the display, the graphical user interface including a frame or frames including the captured image, and graphical constructs prompting input identifying a set of locations on the captured image usable to define a location of the contact lens in the image, and a location usable to define an angle of repose of the contact lens in the image; and

accepting input data responsive to the graphical constructs that identifies the set of locations to define the location of the contact lens in the captured image and the location to define the angle of response of the contact lens in the captured image.

2. The method of claim **1**, including processing the input data to determine the angle of repose of the contact lens in the captured image.

3. The method of claim 1, wherein the graphical constructs prompting input identifying a set of locations include a construct which when selected identifies a particular member of the set of locations, and causes the graphical user interface to interpret coordinates of a selected point in the displayed image as the particular member of the set of locations.

4. The method of claim 1, wherein the graphical constructs prompting input identifying a set of locations includes:

a set of constructs corresponding to locations usable to define a perimeter of the contact lens in the captured image, where the constructs in the set when selected identify respective members of the set of locations, and cause the graphical user interface to interpret coordinates of a selected point in the captured image as the respective member of the set of locations; and

another construct corresponding to an index point location in the set of locations usable to define the location of an index point on the contact lens in the captured image which when selected identifies the index point location, and causes the graphical user interface to interpret coordinates of a selected point in the captured image as the index point location in the set of locations.

5. The method of claim 1, including:

interpreting the input data as locations on edges of the contact lens in the captured image, and a location of a position of an index point on the contact lens in the captured image; and

processing the input identifying the set of locations to determine a center of the contact lens in the captured image, and to determine the angle of repose of the contact lens on an eye.

6. The method of claim 1, including:

processing the input data to determine the angle of repose of the contact lens on an eye; and

producing a lens specification based on the determined angle of repose.

7. The method of claim 1, wherein the user input device includes a touch screen overlying the display.

8. The method of claim 1, wherein the orientation graphic overlies the view finder image on the display, and includes a feature useable as reference for sizing the contact lens within the area of the captured image.

9. A device for determining an angle of repose of a contact lens on an eye, comprising:

a display; a camera with a camera lens, a data processor; an orientation sensor and a user input device, and including instructions executable by the data processor to:

display a view finder image from the camera on the display prior to capturing an image;

display an orientation graphic on the display using the orientation sensor while displaying the view finder image, the orientation graphic including graphical constructs that indicate orientation of the camera lens around a line of sight axis normal to the camera lens, around a horizontal axis and around a vertical axis;

store an image captured using the camera;

execute a graphical user interface using the display, the graphical user interface including a frame or frames including the captured image, and graphical constructs prompting input identifying a set of locations on the captured image usable to define a location of the contact lens in the image, and a location usable to define an angle of repose of the contact lens in the image; and

accept input data responsive to the graphical constructs that identifies the set of locations to define the location of the lens in the captured image and the location to define the angle of response of the contact lens in the captured image.

10. The device of claim **9**, including instructions executable to process the input data to determine the angle of repose.

11. The device of claim **9**, wherein the graphical constructs prompting input identifying a set of locations include a construct which when selected identifies a particular member of the set of locations, and causes the graphical user interface to interpret coordinates of a selected point in the displayed image as the particular member of the set of locations.

12. The device of claim **9**, wherein the graphical constructs prompting input identifying a set of locations include:

a set of constructs corresponding to locations usable to define a perimeter of the contact lens in the captured image, where the constructs in the set when selected identify respective members of the set of locations, and cause the graphical user interface to interpret coordinates of a selected point in the captured image as the respective member of the set of locations; and

another construct corresponding to an index point location in the set of locations usable to define the location of an index point on the contact lens in the captured image which when selected identifies the index point location, and causes the graphical user interface to interpret coordinates of a selected point in the captured image as the index point location in the set of locations.

13. The device of claim **9**, including instructions executable to:

interpret the input data as locations on edges of the contact lens in the captured image, and a location of a position of an index point on the lens in the captured image; and

process the input identifying the set of locations to determine a center of the contact lens in the captured image, and to determine the angle of repose of the lens.

14. The device of claim **9**, including instructions executable to:

process the input data to determine the angle of repose of the contact lens on an eye; and

produce a lens specification based on the determined angle of repose.

15. The device of claim **9**, wherein the user input device includes a touch screen overlying the display.

16. The device of claim **9**, wherein the orientation graphic overlies the view finder image on the display, and includes a feature useable as reference for sizing the contact lens within the area of the captured image.

17. A computer program product for determining an angle of repose of a contact lens on an eye using a device having a display; a camera with a camera lens, a data processor, an orientation sensor and a user input device, the product comprising a non-transitory computer readable medium storing instructions executable by the data processor, the instructions comprising:

logic to display a view finder image from a camera on the display prior to capturing the image;

logic to display an orientation graphic on the display while displaying the view finder image, using the orientation sensor, the orientation graphic including graphical constructs that indicate orientation of the camera lens around a line of sight axis normal to the cameral lens, around a horizontal axis and around a vertical axis;

logic to store an image captured using the camera;

logic to execute a graphical user interface using the display, the graphical user interface including a frame or frames including the captured image, and graphical constructs prompting input identifying a set of locations on the captured image usable to define a location of the contact lens in the image, and a location usable to define an angle of repose of the contact lens in the image; and

logic to accept input data responsive to the graphical constructs that identifies the set of locations to define the location of the contact lens in the captured image and the location to define the angle of repose of the contact lens in the captured image.

18. The product of claim **17**, wherein the instructions include logic to process the input data to determine the angle of repose of the contact lens on the capture image.

19. The product of claim **17**, wherein the graphical constructs prompting input identifying a set of locations include a construct which when selected identifies a particular member of the set of locations, and causes the graphical user interface to interpret coordinates of a selected point in the displayed image as the particular member of the set of locations.

20. The product of claim **17**, wherein the graphical constructs prompting input identifying a set of locations include:

a set of constructs corresponding to locations usable to define a perimeter of the contact lens in the captured image, where the constructs in the set when selected identify respective members of the set of locations, and cause the graphical user interface to interpret coordinates of a selected point in the captured image as the respective member of the set of locations; and

another construct corresponding to an index point location in the set of locations usable to define location of an index point on the contact lens in the captured image which when selected identifies the index point location, and causes the graphical user interface to interpret coordinates of a selected point in the captured image as the index point location in the set of locations.

21. The product of claim **17**, wherein the instructions include logic to:

interpret the input data as locations on edges of the contact lens in the captured image, and a location of a position of an index point on the contact lens in the captured image; and

process the input identifying the set of locations to determine a center of the contact lens in the captured image, and to determine the angle of repose of the contact lens.

22. The product of claim **17**, wherein the instructions include logic to:

process the input data to determine the angle of repose of the contact lens; and

produce a lens specification based on a determined angle of repose.

23. The product of claim **17**, wherein the user input device includes a touch screen overlying the display.

24. The product of claim **17**, wherein the orientation graphic overlies the view finder image on the display, and includes a feature useable as reference for sizing the contact lens within the area of the captured image.