certain gaze direction; and, a control unit being adapted to receiving a three dimensional image data of the external scene; wherein the control unit is connected to the sensor and is configured and operable to receive data indicative of the reconstructed image, compare the data with the three dimensional image data, register between at least one parameter of the external scene and of the virtual image relative to the line of sight of the eye, to thereby enable projecting the virtual image onto the retina in registration with the external scene.

In some embodiments, the at least one parameter of the external scene and of the virtual image comprises at least one of position and orientation relative to the user's face.

In some embodiments, the sensor is integrated within the eye projection optical module.

In some embodiments, the system further comprises an imaging unit adapted to transmit light towards at least a region of interest of the external scene, collect light reflected therefrom, and process the collected light to generate a three dimensional image data thereof.

In some embodiments, the image generator comprises at least one light source configured and operable to generate at least one light beam portion at a certain wavelength range.

In some embodiments, the eye projection optical module comprises an image scanner. The scanner may be configured and operable to perform image scanning such that the reflected light beam portions, corresponding to various locations on the retina, are sequentially collected by the sensor.

In some embodiments, the system further comprises a beam splitter/combiner being adapted for transmitting light from the eye projection optical module towards the pupil of the user's eye, and reflecting the light beam portion reflected from the retina towards the sensor. The beam splitter/combiner may be configured as a notch filter adapted for transmitting one or more spectral bands towards the pupil of the user, or a broadband reflector.

In some embodiments, the sensor comprises an IR sensor configured and operable for detecting reflection of at least one IR light beam from the eye.

In some embodiments, the deflector is configured as an image scanner configured and operable to perform image scanning during which the light beam portions are

indicative of a gaze direction β of the eye, for example by the eye tracker, three dimensional image data of the external scene by the camera unit **106** and data indicative of the reconstructed image from sensor **102**. The acquisition (time and rate) of the data of the control unit should be synchronized with the sensor **102**, with the camera unit **106** and with the scanning mirror, to collect all the image data. The control unit **104** compares the data indicative of the reconstructed image from sensor **102** with the three dimensional image data of the camera unit **106**, registering between at least one parameter of the external scene and of the virtual image relative to the line of sight of the eye. The control unit **104** controls the eye projection optical module **130** to thereby enable pixels of the virtual image to be projected onto corresponding locations on the retina in registration with the external scene by carrying out the operations of method **700** in the following, for projecting each pixel of the image.

CLAIMS:

1. An eye projection system to be used with a user's eyes perceiving an external scene, the system comprising:

a sensor located in an optical path of light reflected from each user's eye and configured and operable for receiving a light beam portion reflected from the user's retina and imaging the reflected light beam portion being indicative of an image of the external scene to thereby generate a reconstructed image of the external scene;

an image generator adapted to obtain data indicative of a virtual image, produce a plurality of light beam portions corresponding to pixels of said virtual image and direct said light beam portions to propagate along a general optical propagation path;

an eye projection optical module located in said general optical propagation path comprises a deflector which is configured and operable for deflecting the general optical propagation path of the light beam portions towards the user's eye, thereby directly projecting said virtual image onto a retina of the eye; wherein said general optical propagation path is deflected such that the light beam portions incident on the pupil with different pupil incidence angles are directed at different gaze directions with respect to a line of sight of the eye associated with a certain gaze direction; and

a control unit being adapted to receive a three dimensional image data of the external scene; wherein said control unit is connected to said sensor and is configured and operable to receive data indicative of said reconstructed image, compare said data with said three dimensional image data, register between at least one parameter of the external scene and of said virtual image relative to the line of sight of the eye to thereby enable projecting said virtual image onto the retina in registration with the external scene.

2. The eye projection system of claim 1, wherein said at least one parameter of the external scene and of said virtual image comprises at least one of position and orientation.

3. The eye projection system of claim 1 or claim 2, wherein said sensor is integrated within said eye projection optical module.

4. The eye projection system of any one of claims 1 to 3, further comprising an imaging unit adapted to transmit light towards at least a region of interest of the external scene, collect light reflected therefrom, and process the collected light to generate a three dimensional image data thereof.

5. The eye projection system of any one of claims 1 to 4, wherein said image generator comprises at least one light source configured and operable to generate at least one light beam portion at a certain wavelength range.

6. The eye projection system of any one of claims 1 to 5, wherein said eye projection optical module comprises an image scanner; said scanner being configured and operable to perform image scanning such that the reflected light beam portions, corresponding to various locations on the retina, are sequentially collected by the sensor.

7. The eye projection system of any one of claims 1 to 6, further comprising a beam splitter/combiner being adapted for transmitting light from the eye projection optical module towards the pupil of the user's eye, and reflecting the light beam portion reflected from the retina towards said sensor.

8. The eye projection system of claim 7, wherein said beam splitter/combiner is configured as a notch or band pass filter adapted for transmitting one or more spectral bands towards the pupil of the user.

9. The eye projection system of any one of claims 1 to 8, wherein said sensor comprises an IR sensor configured and operable for detecting reflection of at least one IR light beam from the eye.

10. The eye projection system of any one of claims 1 to 9, wherein said deflector is configured as an image scanner configured and operable to perform image scanning during which the light beam portions are deflected such that the light beam portions are incident on the pupil with various pupil incident angles corresponding to various locations on the retina.

11. The eye projection system of any one of claims 1 to 10, further comprising an eye tracker adapted to determine a gaze direction of the user's eye.

12. The eye projection system of any one of claims 1 to 11, wherein said eye projection optical module comprises an adjustable focusing element for varying the divergence of the light beam portions towards the pupil of the user's eye.

13. A method for registration between an external scene perceived by a user's eyes and a virtual image comprising:

receiving a three dimensional image data indicative of the external scene and data indicative of the virtual image;

receiving a light beam portion reflected from the retina and imaging the reflected plurality of light beam portions being indicative of an image of the external scene to provide a reconstructed image;

comparing said reconstructed image with said three dimensional image data;

registering between at least one parameter of the external scene and of said virtual image relative to the user's eye to thereby enable projecting said virtual image onto the retina in registration with the external scene;

producing a plurality of light beam portions corresponding to pixels of said virtual image and directing said light beam portions to propagate along a general optical propagation path; and

deflecting the general optical propagation path of the light beam portions towards a pupil of each user's eye, according to the registration.

14. The method of claim 13, wherein said at least one parameter of the external scene and of said virtual image comprises at least one of position and orientation.

15. The method of claim 13 or claim 14, further comprising transmitting light towards the external scene, collecting light reflected therefrom, and processing the collected light to generate the three dimensional image data thereof.

16. The method of any one of claims 13 to 15, wherein said producing of a plurality of light beam portions comprises generating at least one light beam portion at a certain wavelength range.

17. The method of any one of claims 13 to 16, wherein said receiving of a light beam portion reflected from the retina comprises performing image scanning such that the reflected light beam portions corresponding to various locations on the retina are sequentially collected.

18. The method of any one of claims 13 to 17, wherein said deflecting of the general optical propagation path of the light beam portions towards a pupil of an user's eye comprises performing image scanning during which the light beam portions are deflected such that the light beam portions are incident on the pupil with various pupil incident angles corresponding to various locations on the retina.

19. The method of any one of claims 13 to 18, wherein said deflecting of the general optical propagation path of the light beam portions towards a pupil of an user's eye comprises transmitting one or more spectral bands of the light beam portions towards the pupil of the user.

20. The method of any one of claims 13 to 19, wherein said receiving a light beam portion reflected from the retina comprises detecting reflection of IR or a visible light beam portion.

21. A registration system to be used with an augmented reality system comprising:

a sensor configured and operable for receiving a light beam portion reflected from a retina of a user's eye and imaging the reflected light beam portion being indicative of an image of an external scene perceived by the user's eye to thereby generate a reconstructed image; and

a control unit connected to said sensor and being configured and operable to receive a three dimensional image data of an external scene, compare said reconstructed image with said three dimensional image data; and register between at least one parameter of the external scene and of a virtual image relative to the eye to thereby enable to project said virtual image onto the retina in registration with the external scene.

22. The registration system of claim 21, wherein said at least one parameter of the external scene and of said virtual image comprises at least one of position and orientation.

23. The registration system of claim 21 or claim 22, further comprising an image generator adapted to obtain data indicative of said virtual image, produce a plurality of light beam portions corresponding to pixels of said virtual image, and direct said light beam portions to propagate along a general optical propagation path.

24. The registration system of any one of claims 21 to 23, further comprising an eye projection optical module including a deflector, which is configured and operable for deflecting the general optical propagation path of the light beam portions towards a pupil of the user's eye, thereby directly projecting said virtual image onto a retina of the eye.

25. The registration system of any one of claims 21 to 24, further comprising an imaging unit adapted to transmit light towards the external scene, collect light reflected therefrom, and process the collected light to generate a captured three dimensional image thereof.