Claims

1. A wearable electronic device configured to be worn by a user comprising:

a housing;

at least one imaging sensor associated with the housing; and

an augmented reality display associated with the housing;

wherein the device is configured to acquire an image of an invasive access site of a patient with the at least one imaging sensor, process the image to determine a location of a desired anatomical structure, and display within the user's field of view of the invasive access site a virtual trace of the anatomical structure to the user via the augmented reality display.

2. The wearable electronic device of claim 1, wherein the invasive access site is a vascular access site, and the desired anatomical structure is a desired vein.

3. The wearable electronic device of claim 1, further comprising:

a microprocessor for managing the at least one imaging sensor and augmented reality display; and

a program for acquiring and processing images from the at least one imaging sensor.

4. The wearable electronic device of claim 1, wherein the device acquires and processes the image automatically, without an input or actuation activity by the user.

5. The wearable electronic device of claim 1, wherein the augmented reality display provides the virtual trace to the user in a hands-free manner.

6. The wearable electronic device of claim 1, wherein the device processes the image to determine the location of the desired anatomical structure by identifying anatomical markers and determines the location of the desired anatomical structure based on a position of the anatomical markers.

7. The wearable electronic device of claim 6, wherein the anatomical markers comprise one or more of the following: physical locations on the patient's body, including at least one of the wrist, fingers, thumb, elbow, shoulder, or any combination thereof, and externally applied markers provided on the patient's skin or applied to a dressing.

8. The wearable electronic device of claim 1, wherein the virtual trace is color-coded to signify a preferred catheter gauge for insertion.

9. The wearable electronic device of claim 1, wherein the wearable electronic device is a head-worn computer, and wherein the augmented reality display is a projection prism configured to project a virtual layer to the user's field of view.

10. The wearable electronic device of claim 9, wherein the virtual layer includes the virtual trace and a user interface, the user interface comprising a patient information portion, a schematic drawing showing a position of an invasive access device relative to the desired anatomical structure, an invasive access device information portion, or any combination thereof.

11. The wearable electronic device of claim 10, wherein the virtual trace is positioned in the virtual layer such that the user sees the virtual trace over the actual invasive access site in the field of view of the user.

12. The wearable electronic device of claim 1, further comprising a sub-dermal illuminator enclosed within or associated with the housing, the sub-dermal illuminator comprising a radiation beam which, when directed toward the skin of the patient, increases visibility of a sub-dermal structure.

13. The wearable electronic device of claim 12, wherein the radiation beam is provided by a light bulb, light emitting diode, laser diode, laser light tube, or any combination thereof.

14. The wearable electronic device of claim 1, further comprising a peripheral data entry device that allows the user to manually enter data to the wearable electronic device.

15. The wearable electronic device of claim 14, wherein the peripheral data entry device is a motion sensor, gyroscope, pressure sensor, accelerometer, touchpad, touchscreen, or any combination thereof.

16. The wearable electronic device of claim 1, further comprising a power supply within the housing of the wearable electronic device.

17. The wearable electronic device of claim 1, further comprising a data transmission interface for sending data to or receiving data from an external electronic device

18. The wearable electronic device of claim 17, wherein the data transmission interface is configured to send data to and receive data from a patient data system.

19. The wearable electronic device of claim 18, wherein information received from the patient data system includes information about an invasive procedure to be performed, information about an invasive access device required for a particular procedure, or information about the patient.

20. A system comprising:

a wearable electronic device configured to be worn by a user comprising a housing and an augmented reality display integrally formed with or associated with the housing; and

an external sub-dermal imaging device for providing an image of sub-dermal structures in close proximity to an invasive access site,

wherein the wearable electronic device is configured to process images obtained by the sub-dermal imaging device to determine a location of a desired anatomical structure for an invasive access procedure and to display within the user's field of view of the invasive access site a virtual trace of the location to the user via the augmented reality display.

21. The system of claim 20, wherein the external sub-dermal imaging device is selected from one of the following: an ultrasound monitor, an infrared monitor, a magnetic resonance imaging monitor, or any combination thereof.

22. The system of claim 20, wherein the wearable electronic device further comprises one or more imaging sensors associated with the housing for acquiring an image of the invasive access site.

23. The system of claim 22, wherein the wearable electronic device is configured to process the image of the invasive access site captured by the one or more imaging sensors to determine positioning of the virtual trace.

24. The system of claim 20, wherein images provided by the sub-dermal imaging device are displayed to the user via the augmented reality display of the wearable electronic device in real time.

25. The system of claim 20, wherein a sub-dermal image of the invasive access site is saved on a data storage medium of the wearable electronic device or transmitted to an external data storage device via a data transmission interface, and wherein the image is accessible to determine an invasive access site for future invasive access procedures.

26. A system for vein access confirmation, comprising:

a wearable electronic device configured to be worn by a user comprising:

a housing;

one or more imaging sensors associated with the housing;

a data reporting accessory for providing data to the user; and

at least one microprocessor for managing and processing images from the one or more imaging sensors;

an external sub-dermal imaging device for acquiring images of sub-dermal structures positioned adjacent to a proposed vascular access site; and

a vascular access device for insertion into a vein of a patient at the vascular access site,

wherein the wearable electronic device is configured to process images obtained by the sub-dermal imaging device to determine a preferred vein for insertion of the vascular access device, to estimate a preferred size for an injection portion of the vascular access device based on the size of the preferred vein, and to report the preferred size for the injection portion to the user via the data reporting accessory.

27. The system of claim 26, further comprising at least one identification tag including or associated with information about the vascular access device, the at least one identification tag being attached to or integrally formed with the vascular access device, wherein the one or more imaging sensors are configured to acquire an image of the at least one identification tag.

28. The system of claim 27, wherein the at least one identification tag comprises a two-dimensional bar code, a three-dimensional bar code, a near field communication device, or a label having text readable by an optical character recognition algorithm.

29. The system of claim 27, wherein the wearable electronic device is configured to identify the at least one identification tag on the acquired image and to extract information from the at least one identification tag including the size of the vascular access device.

30. The system of claim 29, wherein the wearable electronic device is configured to provide an alert to the user when the size of the vascular access device is larger or smaller than the size of the preferred vein.

31. The system of claim 26, wherein the wearable electronic device is a head-worn computer, and wherein the data reporting accessory is a projection prism configured to project a virtual layer to a field of view of the user.

32. A method for insertion of a vascular access device to a vein assisted with a device for enhanced visualization, the method comprising:

capturing an image of a possible vascular access site with a wearable electronic device having at least one imaging sensor and a microprocessor for processing an image captured by the at least one imaging sensor;

processing the image to identify a preferred vein location within the vascular access site; and

displaying, within the user's field of view of the invasive access site, a virtual vein trace at the preferred vein location to a user via an augmented reality display of the wearable electronic device.

33. The method of claim 32, wherein the wearable electronic device is a head-worn computer, and wherein the augmented reality display is a projection prism configured to project a virtual layer, including the virtual vein trace, to a field of view of the user.