METHOD AND SYSTEM FOR PROVIDING SAFE PATIENT MONITORING IN AN ELECTRONIC MEDICAL DEVICE WHILE SERVING AS A GENERAL-PURPOSE WINDOWED DISPLAY

DESCRIPTION

1. Technical Field

The invention relates generally to a method and system for presenting visual output in an electronic medical device, and more specifically, to a method and system for providing safe patient monitoring while serving as a general-purpose windowed display.

2. Background of the Invention

Electronic medical devices such as electrocardiogram (E.C.G.) monitors are generally used to monitor a patient's condition using medical sensors and/or to deliver medical care via automatic medical care delivery systems. These devices have long been able to display information directly relating to patient condition or medical care delivery in both graphical and textual forms. For example, an E.C.G. monitor might display an electrocardiograph waveform and associated text, e.g., pulse rate. This information, displayed together, is called a physiological parameter.

These electronic medical devices have customarily employed custom hardware and software to achieve their results. The advent of general-purpose computing software, however, has made it expeditious to implement electronic medical devices using some general-purpose software. In fact, using general-purpose software permits the implemented electronic medical device to leverage existing operating systems, graphical operating environments, and application programs. The use of existing operating systems and graphical environments makes the implemented electronic medical device more flexible by providing a ready-made development environment in which third-party vendors may develop add-on software products that can execute on the electronic medical device.

In particular, it is desirable to permit third-party applications, such as a calculator application, to execute in a graphical operating environment, such as the public domain X-Window distributed operating environment, along with the monitoring programs that perform the primary monitoring function of the electronic medical device. This permits the third-party applications to display output in a window on the display device and receive input from input devices connected to the electronic medical device.

In many cases, however, third-party applications can interfere with the primary monitoring function of the electronic medical device. Third-party applications can, in many cases, capture all user input for extended periods of time, lockup the processor when a run-time error occurs, change the color of monitoring display, or obscure or generally disrupt the display organization. Such interference with the primary monitoring function of the electronic medical device is a matter of great concern, as it could cause important information from the electronic medical device to go unobserved by personnel monitoring the electronic medical device, adversely impacting patient care.

First, in most windowed operating environments, all the active applications are eligible to receive user input. User input in most windowed operating environments is directed to the application which has the input focus. Typically, the cursor is used to select the application window which is to have the input focus. In many window operating environments, however, a single application can "capture" the cursor and prevent the system and operator from changing the input focus. This permits third-party applications to deprive patient monitoring applications of user input for extended periods of time. This deprivation can significantly interfere with the primary monitoring functions of the electronic medical device such as acknowledging alarm events, turning alarms off, or just generally interacting with the electronic medical device.

In many windowing systems, capturing the cursor also causes the display contents to "freeze" until the cursor is "released." A typical example is scroll bars that update the display only after a user has positioned the scroll bar and released the cursor. Under this circumstance, however, stale or incorrect patient information will be displayed while the electronic medical device's display is frozen.

Second, in many windowed operating environments, when a runtime error occurs during the execution of a request from a third-party application, "processor lockup" occurs. This is a condition of a processor which prevents it from completing the execution of the current request and proceeding to execute further requests. If a third-party application causes processor lockup to occur, requests from patient monitoring applications waiting for execution cannot be executed. This interferes with the primary monitoring function of the electronic medical device by preventing the display of important patient monitoring information.

Third, most windowed operating environments permit third-party applications to modify the colors used to display information. Most graphical operating environments maintain a single color table to map virtual colors, understood by applications, to actual color values that may be displayed on a display device. In order to be able to select the actual colors displayed, each application is permitted to change the contents of the color table. The number of colors required by all the applications often exceeds the capacity of the color table. When this occurs, most windowed operating environments permit applications to maintain their own virtual color map, which is loaded into the physical color map whenever that particular application has the input focus. This has the side effect of changing the display colors for the entire display adversely affecting the rest of the applications. For instance, a third-party application could change the actual color of the monitoring applications information to the actual color of the background making the patient information invisible. This would also allow third party applications to change monitoring applications colors which have special significance, e.g., red for an alarm condition, to another color having a different significance, e.g., blue for a non-alarm condition. In this example, an alarm condition could be displayed in blue instead of red, giving those monitoring the electronic medical device the false impression that no alarm condition is active.

Fourth, most modem windowing environments support overlapping windows in which windows are permitted to overlay some or all of the area of other windows. This permits a third-party application's window to overlay important information displayed by the monitoring applications. For example, a user of a third-party application may drag the window containing output from the third-party application to a portion of the display occupied by important information such as alarm notification messages. At this point, the important information "displayed" by the monitoring programs is actually obscured by the applications window, and cannot be seen by those monitoring the electronic medical device. Important command windows or notifications of alarm events needed by the user to begin monitoring new