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# United States Patent [19]

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[54] **ALERTNESS AND DROWSINESS DETECTION AND TRACKING SYSTEM**

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[58] Field of Search ..... 128/731, 732, 128/630; 600/26, 544, 545, 300

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[57] **ABSTRACT**

A drowsiness detection system constructed according to the invention provides improved performance by preserving and analyzing newly discovered information contained in rhythmic signal components above 30 Hz which the prior art has universally ignored or discarded as "noise." In the first and second embodiments of the invention, one or more analog EEG signals are collected from a subject, appropriately filtered, converted into digital form, and subjected to frequency analysis. Selected signal components from the frequencies above 30 Hz (such as the frequency range 80-420 Hz), which have a high correlation with subject drowsiness, are isolated, and their amplitude, energy, or power contribution to the EEG signal is used to produce a continuous output measure reflecting the subject's alertness or drowsiness. The output measure may be compared with a threshold to provide an indication of whether the subject is excessively drowsy. In a third embodiment, the analog EEG signal is supplied to a plurality of analog signal processing channels corresponding to respective predefined frequency ranges. Selected signal components in frequencies above 30 Hz are isolated (in a manner analogous to that of the first and second embodiments), and their amplitude, energy, or power contribution to the EEG signal is used to produce a continuous output measure reflecting the subject's alertness or drowsiness.

**67 Claims, 22 Drawing Sheets**

