0<ACCEL2<200

0<ACCEL3<20000

Sensed activity data is converted to ASCII, so that ACCEL1 and ACCEL2 can be represented by a single byte and ACCEL3 is represented by only two bytes. These four bytes are then written to the data storage area of memory **46**.

Environmental data is stored periodically in all modes (FIGS. **6–10**, **12**) except Simple Alarm Mode, FIG. **11**. In Write Environmental Data to Storage (FIG. **19**), environmental data is stored. At every five minute operating interval, the program will write the average reading from the various environmental sensors **14** to the data storage area **46**.

To obtain an average, each sensor variable is divided by 15 since each sensor is sampled three times/minute for five minutes. The resulting data is converted to ASCII format and stored to the data storage area of memory **46** in the following format:

!KKNTT

where "!" is a single byte that indicates that the subsequent section of data represents the environmental data readings. "KK" represents two bytes of data which encode the sound intensity levels sensed at sound sensor **70**. "N" is a single byte representing the sensed light intensity level at light sensor **75**. "TT" is a two byte word representing the average sensed temperature from temperature sensor **72** in degrees Celsius. Additional sensors such as humidity or toxic gas sensors (FIG. **16**) are similarly encoded into the data file.

Check Battery Power Levels is illustrated in FIG. **20**. The program instruction set **110** includes a routine to test and indicate the battery **56** power levels to the subject **16**, and if necessary to shut down operation of the monitor **10** to preserve all measurement data that has been stored in memory **46**.

Initially, all LEDs **74***a*–**74***c* are powered down to clear possible inputs from different modules. The value supplied to the A/D bus **64** input corresponding to the voltage splitter/sensor **68** is then checked to determine if the shut down mode action of the software is necessary. If the battery **56** power measured by splitter **68** is of sufficient strength, the program instruction set **110** continues normal operation. As the battery voltage decays (signaling an imminent power shortage), either the yellow or red LED **74***b* or **74***c* (or both) is lighted continuously to alert the subject **16**. Once the battery **56** voltage level has fallen to a predetermined threshold point, the monitor **10** goes into an automatic shutdown mode (FIG. **20**) procedure to preserve the data stored in memory **46**. The shutdown sequence can, for example, consist of a series of low frequency, long duration signalling tones. The monitor then only checks the state of the pushbuttons. If either pushbutton is depressed, the low power alarm sequence is repeated once again and the monitor completely terminates operation of the program instruction set **110**.

The Examine Environmental Factors routine is illustrated in FIG. **21**. This portion of the program instruction set **110** is configured to examine several sensed environmental factors and sensed subject **16** activity levels to warn the subject of potentially hazardous environmental situations. When such an environmental situation is encountered, the monitor **10** sound stimulator **76** will signal the alarm. Different combinations of LEDs **74***a*–**74***c* can also be used to indicate the potential problem without an audible alarm. The alarm can be signalled once every measurement cycle until either the hazardous situation is terminated or until the subject **16** disables the alarm for a period of time.

Some typical examples of potentially stressful or hazardous situations that the system **10** can monitor include:

Lack of sensed movement of subject **16**

Low sensed subject activity levels combined with low sensed environmental temperatures

High sensed subject activity levels combined with high sensed environmental temperatures

High levels of toxic gases sensed (FIG. **16**)

Moderate levels of sensed toxic gases sensed in combination with high sensed subject activity levels

Sensed slowing subject reaction times (FIGS. **6–7**) combined with changes in sensed toxic gases or temperature extremes.

It is contemplated that the reaction task can be modified to also evaluate performance and/or memory abilities of the wearer. Either at preset times of the day, or when activity and reaction time tests indicate an increase in sleepiness, simple or complex mental, or psychomotor tests can be presented to the wearer. Such tasks can be configured to be of either short or long duration. Some examples of possible tasks are:

Requiring the subject to distinguish between different frequency tones by pressing either the red or green pushbutton.

Requiring the subject to distinguish between long or short tones.

Requiring the subject to press different pushbuttons depending on LED color combinations displayed.

Requiring the subject to respond when a short sequence of LED light flashes is repeated during a long sequence of flashes.

Requiring the subject to respond when either a frequency or tone duration matches a LED light flash.

Requiring the subject to recall a short sequence of red and green LED light flashes by pressing the red and green pushbuttons in the correct sequence either after no delay, or after a short delay. The number of events in the sequence can be gradually increased.

Based on substandard performance a warning alarm can be provided.

Although certain presently preferred embodiments of the invention have been described herein, it will be apparent to those skilled in the art to which the invention pertains that variations and modifications of the described embodiment may be made without departing from the spirit and scope of the invention. Accordingly, it is intended that the invention be limited only to the extent required by the appended claims and the applicable rules of law.

I claim:

1. A human subject vigilance monitor, comprising:

a) a plurality of ambient environmental sensors, each adapted to produce an output signal;

b) at least one source of human subject stimuli;

c) at least one human subject response sensor, each adapted to produce an output related to subject initiated responses to the stimuli;

d) a controller having a CPU, a digital I/O communications circuit communicating with the CPU, an A/D converter communicating with the CPU, memory communicating with the CPU, and an UART for communication with a data device external to the vigilance monitor;

wherein the ambient environmental sensors include a light level sensor coupled to the A/D converter to communicate with the CPU, the source of stimuli includes a visual source of stimulation and an aural source of stimulation which are coupled to the digital I/O circuit to communicate with the CPU, and