APPAREL HAVING MULTIPLE ALTERNATIVE SENSORS AND CORRESPONDING METHOD

TECHNICAL FIELD

This invention relates generally to human and/or environmental monitoring and more particularly to such sensors as carried about by a person.

BACKGROUND

Various sensors are known in the art. Some sensors are useful to evaluate the physiological state of a human subject. For example, sensors exist that can monitor pulse (heart rate), respiration rate, blood oxygen, blood pressure, body temperature, and ambulatory electrocardiogram, to name a few. Typically, such sensors must be in contact with the skin of the subject in order to provide reliable measurements of the desired physical parameter. Often times the subject's skin must be prepared in a specific way to interface with the sensor. Other times a dielectric cream or conductive gel must be utilized to assure a satisfactory coupling. Most such sensors are designed for use in a controlled environment, such as a doctor's office or a hospital facility. A few sensors of these types are designed for more portable use. With respect to the latter, data is typically collected during one period of time and then batch evaluated at a later time by skilled technicians and/or medical personnel.

Other sensors are useful to evaluate the local environment. For example, sensors exist that can monitor for ambient temperature, carbon monoxide levels, explosive gases, harmful bacteria and/or viruses, hazardous chemicals, and so forth. Many such sensors are permanently installed to effect constant monitoring of a specific area. Other sensors are provided in a hand-held form factor to facilitate moving the sensor mechanism as needed.

Many occupations and even some hobby interests have a concomitant risk of exposure to potentially dangerous environmental conditions and/or to circumstances that otherwise present a physiological risk to a given subject. For example, fire fighters, strategic weapons and tactics squads, industrial maintenance workers and many others face the risk of working environments where the characteristics of that environment are either dangerous in and of themselves or where the working context is one that presents significant physiological challenges to the subject. Fire fighters, for example, face the risk of encountering high heat, leaking natural gas, chemical spills, and dangerous gases such as carbon monoxide. For these and a variety of other reasons, fire fighters also typically work in a high stress environment. Significant and repeated stress is known to raise dangerous health concerns, including heart attacks and other harmful circulatory events.

It would be beneficial if subjects such as fire fighters could readily and easily monitor their working environment for potentially dangerous conditions. It would also be beneficial if such subjects could also monitor their own relevant physiological state and thereby improve their likelihood of avoiding a sudden decrease in their working efficiency and/or personal safety. For a few individuals, such as astronauts, relevant physiological sensors can be and are attached in ordinary known ways to the skin of the astronaut to facilitate monitoring of their physical state. As noted, however, considerable preparation is required to properly prepare an individual in this way. For most individuals who could benefit from such monitoring, such as fire fighters, their mode of operation simply doesn't conveniently allow for sufficient time, personnel, or training to permit such practices. For the majority of individuals, little or no additional time can be allotted to the positioning and attachment of one or more sensors, notwithstanding the potential benefits of such monitoring.

BRIEF DESCRIPTION OF THE DRAWINGS

The above needs are at least partially met through provision of apparel having multiple alternative sensors and a corresponding method described in the following detailed description, particularly when studied in conjunction with the drawings, wherein:

FIG. **1** comprises a block diagram as configured in accordance with an embodiment of the invention;

FIG. **2** comprises a front elevational view as configured in accordance with an embodiment of the invention;

FIG. **3** comprises a palm-side view of a glove as configured in accordance with an embodiment of the invention;

FIG. **4** comprises a knuckle-side view of the glove as configured in accordance with an embodiment of the invention;

FIG. **5** comprises a flow diagram as configured in accordance with an embodiment of the invention;

FIG. **6** comprises a flow diagram as configured in accordance with an embodiment of the invention;

FIG. **7** comprises a diagram as configured in accordance with yet another embodiment of the invention; and

FIG. **8** comprises a graph depicting various monitorable parameters of a heart.

Skilled artisans will appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of various embodiments of the present invention. Also, common but well-understood elements that are useful or necessary in a commercially feasible embodiment are typically not depicted in order to facilitate a less obstructed view of these various embodiments of the present invention.

DETAILED DESCRIPTION

Generally speaking, pursuant to these various embodiments, one or more items of apparel have a plurality of sensors disposed collectively therein. At least two of the sensors sense, in alternative ways, a parameter that corresponds to a given physical state. In one embodiment, at least some of the sensors are removably disposed, such that the sensor can be removed to facilitate laundering of the item of apparel or installation in a different item of apparel. In one embodiment, at least one of the sensors is disposed without contacting the skin of the wearer. By leveraging sensor fusion and monitoring a physical state parameter in alternative ways, the error often associated with such non-skin contact monitoring for a given sensor can be significantly mitigated.

The sensors themselves can, if desired, be permanently affixed within the apparel items (as used herein, "within" includes disposing a sensor on an inner surface of an item of apparel, on an outer surface of an item of apparel, and between inner and outer surfaces of an item of apparel). This can be done, for example, by sewing or by use of appropriate adhesives, rivets, clips, and so forth. Such an approach, of course, raises laundering concerns if the item of apparel