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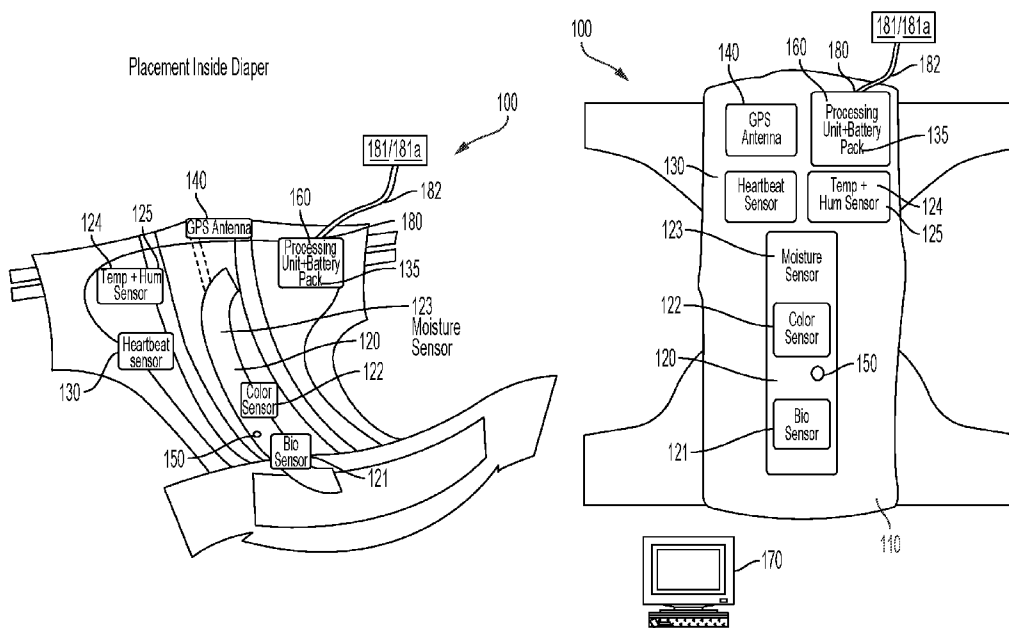


FIG. 1

(57) Abstract: Disclosed are systems and methods of a health monitoring device comprising: a flexible circuit, an absorbent product, and, a processing unit. The flexible circuit comprises: an electrochemical biosensor, a color sensor, an LED, and, a moisture sensor. The electrochemical biosensor comprises a plurality of reference electrodes. The processing unit comprises: a GPS antenna, a power unit, a bluetooth low energy transceiver, a GPS transceiver, a microcontroller, and, an accelerometer. The processing unit is electronically coupled to the flexible circuit. The methods comprise: obtaining health data from health monitoring device; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.



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SYSTEMS AND METHODS OF A HEALTH MONITORING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application Serial No. 62/555,563, entitled "SYSTEMS AND METHODS OF A HEALTH MONITORING SYSTEM" filed September 7, 2017, the content of which is hereby incorporated by reference for all purposes.

BACKGROUND OF THE INVENTION

[0002] The present invention is in the technical field of biomedical technologies. More particularly, the invention is in the technical field of biomedical disposable sensor and digital health device attached to disposable and non-disposable diapers. Conventional diapers do not warn parents, users, and caregivers about any stage of wet and/or soiled diapers. Conventional diapers also do not gather, analyze, process and provide any medical information contained in body fluids whatsoever.

BRIEF SUMMARY OF THE INVENTION

[0003] An object of the present invention is a health monitoring device comprising: a flexible circuit, an absorbent product, and, a processing unit. The flexible circuit comprises: an electrochemical biosensor, a color sensor, an LED, and, a moisture sensor. The electrochemical biosensor comprises a plurality of reference electrodes. The processing unit comprises: a GPS antenna, a power unit, a bluetooth low energy transceiver, a GPS transceiver, a microcontroller, and, an accelerometer. The processing unit is electronically coupled to the flexible circuit.

[0004] Another object of the present invention is a health monitoring device, wherein the flexible circuit further comprises: a temperature sensor, a humidity sensor, and, a heart rate sensor.

[0005] Yet, another object of the present invention is a health monitoring device, wherein the processing unit further comprises: a temperature sensor, a humidity sensor, and, a heart rate sensor.

[0006] Another object of the present invention is a health monitoring device, wherein each of the plurality of reference electrodes detects an analyte selected from the group consisting of albumin, ascorbic acid, bilirubin, blood, creatinine, glucose, hemoglobin, ketones, leukocytes, microalbumin, myoglobin, nitrite, pH, protein, specific gravity, urea, uric acid, urobilinogen, vitamins, and combinations thereof.

[0007] Yet another object of the present invention is a health monitoring device, further comprising a data communication device.

[0008] Another object of the present invention is a health monitoring device, wherein the processing unit further comprises an input/output device connection port, wherein the input/output device connection port electronically couples a secondary monitoring device to the processing unit.

[0009] Yet another object of the present invention is a health monitoring device, wherein the secondary monitoring device is selected from the group consisting of pulse oximeters, blood pressure monitors, blood glucose meters, blood coagulation meters, blood oxygen monitor, thermometers, apnea monitors, electrocardiogram monitors, fetal monitors, hemoglobin trackers, breathalyzers, capnography monitors, fitness monitors, pedometers, medical monitors, vital sign monitors, cardiac monitors, hemodynamic monitors, respiratory monitors, neurological monitors, body temperature monitors, heart rate monitors, respiratory rate monitors, stress monitors, serotonin biosensors, epilepsy monitors, toxicity monitors, mercury monitors, lead monitors, biosensors, electrochemical biosensors, moisture sensors, temperature sensors, humidity sensors, color sensors, heart rate sensors, accelerometers, and combinations thereof.

[0010] Another object of the present invention is a health monitoring device, wherein the secondary monitoring device is a blood oxygen monitor.

[0011] Yet another object of the present invention is a health monitoring device, wherein the flexible circuit and the processing unit are reusable; and, wherein the health monitoring device further comprises an adhesion means to adhere the flexible circuit and the processing unit to the absorbent product.

[0012] Another object of the present invention is a health monitoring device, wherein the flexible circuit and the processing unit are disposable.

[0013] Yet another object of the present invention is a health monitoring device, wherein the flexible circuit is integrally formed with the absorbent product.

[0014] Another object of the present invention is a health monitoring device comprising: a flexible circuit, an absorbent product, and, a processing unit. The flexible circuit comprises: an electrochemical biosensor, a color sensor, an LED, and, a moisture sensor. The electrochemical biosensor comprises a plurality of reference electrodes. The processing unit comprises: a GPS antenna, a power unit, a bluetooth low energy transceiver, a GPS, transceiver, a microprocessor, a ROM chip, a RAM chip, an analog to digital converter, a digital to analog converter, a serial

peripheral interface, a universal asynchronous receiver/transmitter, a power regulator, and, an accelerometer. The processing unit is electronically coupled to the flexible circuit.

[0015] Another object of the present invention is a computer system comprising: at least one processor unit; at least one memory unit coupled to the at least one processor unit; and, computer readable instructions embodied in the memory unit and executable by the processor unit, wherein execution of the instructions by the processor unit causes the computing system to perform a method of monitoring the health of a user of a health monitoring device. The method comprising: obtaining health data from health monitoring device; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device. The health monitoring device comprises: a flexible circuit, an absorbent product, and, a processing unit. The flexible circuit comprises: an electrochemical biosensor, a color sensor, an LED, and, a moisture sensor. The electrochemical biosensor comprises a plurality of reference electrodes. The processing unit comprises: a GPS antenna, a power unit, a bluetooth low energy transceiver, a GPS transceiver, a microcontroller, and, an accelerometer. The processing unit is electronically coupled to the flexible circuit.

[0016] Yet another object of the present invention is a computer system, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

[0017] Another object of the present invention is a computer system, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0018] Yet another object of the present invention is a computer system, the method further comprising providing alerts if the health data falls outside of predefined levels.

[0019] Another object of the present invention is a computer system, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

[0020] Another object of the present invention is a method of monitoring the health of a user of a health monitoring device, the method comprising: obtaining health data from health monitoring device; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device. The health monitoring device comprises: a flexible circuit, an absorbent product, and, a processing unit. The flexible circuit comprises: an electrochemical biosensor, a color sensor, an LED, and, a moisture sensor. The electrochemical biosensor comprises a plurality of reference electrodes. The processing unit comprises: a GPS antenna, a power unit, a bluetooth low

energy transceiver, a GPS transceiver, a microcontroller, and, an accelerometer. The processing unit is electronically coupled to the flexible circuit.

[0021] Yet another object of the present invention is a method of monitoring the health of a user of a health monitoring device, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

[0022] Another object of the present invention is a method of monitoring the health of a user of a health monitoring device, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0023] Yet another object of the present invention is a method of monitoring the health of a user of a health monitoring device, the method further comprising providing alerts if the health data falls outside of predefined levels.

[0024] Another object of the present invention is a method of monitoring the health of a user of a health monitoring device, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

[0025] Another object of the present invention is a non-transitory computer readable medium having computer readable instructions embodied therein, the computer readable instructions being configured to implement a method of monitoring the health of a user of a health monitoring device when executed, the method comprising: obtaining health data from health monitoring device; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device. The health monitoring device comprises: a flexible circuit, an absorbent product, and, a processing unit. The flexible circuit comprises: an electrochemical biosensor, a color sensor, an LED, and, a moisture sensor. The electrochemical biosensor comprises a plurality of reference electrodes. The processing unit comprises: a GPS antenna, a power unit, a bluetooth low energy transceiver, a GPS transceiver, a microcontroller, and, an accelerometer. The processing unit is electronically coupled to the flexible circuit.

[0026] Yet another object of the present invention is a non-transitory computer readable medium, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

[0027] Another object of the present invention is a non-transitory computer readable medium, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0028] Yet another object of the present invention is a non-transitory computer readable medium, the method further comprising providing alerts if the health data falls outside of predefined levels.

[0029] Another object of the present invention is a non-transitory computer readable medium, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0030] The advantages and features of the present invention will be better understood as the following description is read in conjunction with the accompanying drawings, wherein:

[0031] FIG. 1 is a perspective view of an embodiment of the present invention.

[0032] FIG. 2 is an embodiment of the power unit, the processing unit and the flexible circuit of the present invention.

[0033] FIG. 3 is an embodiment of the electrochemical biosensor of the present invention.

[0034] FIG. 4A is an embodiment of the processing unit of the present invention.

[0035] FIG. 4B is an embodiment of the processing unit of the present invention.

[0036] FIG. 5 is an embodiment of the flexible circuit integrally formed with the absorbent product of the present invention.

[0037] FIG. 6 is an embodiment of one of the methods of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0038] The figures show various embodiments of the present invention. As depicted in FIG. 1, a health monitoring device 100 comprises a flexible circuit 120, an absorbent product 110, and, a processing unit 160. The flexible circuit 120 comprises an electrochemical biosensor 121, a color sensor 122, an LED 150, and, a moisture sensor 123.

[0039] As shown in FIG. 3, the electrochemical biosensor 121 comprises a plurality of reference electrodes 121a. The plurality of reference electrodes 121 detects an analyte selected from the group consisting of albumin, ascorbic acid, bilirubin, blood, creatinine, glucose, hemoglobin, ketones, leukocytes, microalbumin, myoglobin, nitrite, pH, protein, specific gravity, urea, uric acid, urobilinogen, vitamins, and combinations thereof.

[0040] As depicted in FIGS. 4A and 4B, the processing unit 160 comprises a GPS antenna 140, a power unit 135, a bluetooth low energy transceiver 161, a GPS transceiver 163, a microcontroller 164, and, an accelerometer 165. The processing unit 160 is electronically

coupled to the flexible circuit 120. In some embodiments the processing unit 160 may communicate wirelessly with the sensors of the flexible circuit 120. Bluetooth low energy is preferred for the safety of the user, as bluetooth low energy has lower radiation exposure.

[0041] In some embodiments, the flexible circuit 120 further comprises a temperature sensor 124, a humidity sensor 125, and, a heart rate sensor 130.

[0042] In some embodiments, the processing unit 160 further comprises a temperature sensor 124, a humidity sensor 125, and, a heart rate sensor 130.

[0043] In some embodiments, the health monitoring device 100 may further comprise a data communication device 170. The data communication device includes wired and wireless computing devices, such as mobile phones, smart phones, personal computers, laptop computers, tablet computers, or dedicated devices to receive data from the health monitoring device 100.

[0044] In some embodiments, the health monitoring device 100 may further comprise an input/output device connection port 180 (as shown in FIG. 1), wherein the input/output device connection port 180 electronically couples a secondary monitoring device 181 to the processing unit 160. A cable that utilizes USB, micro USB, pin connectors, other known electrically coupling connectors known to one skilled in the art, or combinations thereof, may be used to electronically couple the secondary monitoring device 181 to the processing unit 160. An example of a secondary monitoring device 181 is a pulse oximeters 181a. In alternative embodiments, the secondary monitoring device 181 does not utilize a cable to communicate with the processing unit 160; instead, the secondary monitoring device 181 may communicate wirelessly (e.g., by bluetooth) with the processing unit 160. Among the many advantages of wireless communication is not having wires and cables interfering with the user's comfort. Another advantage of wireless communication is that the present invention may utilize numerous secondary monitoring devices 181, and would not be limited to the number of available input/output device connection ports 180.

[0045] Other secondary monitoring devices 181 include, but are not limited to, blood pressure monitors, blood glucose meters, blood coagulation meters, blood oxygen monitor, thermometers, apnea monitors, electrocardiogram monitors, fetal monitors, hemoglobin trackers, breathalyzers, capnography monitors, fitness monitors, pedometers, medical monitors, vital sign monitors, cardiac monitors, hemodynamic monitors, respiratory monitors, neurological monitors, body temperature monitors, heart rate monitors, respiratory rate monitors, stress monitors, serotonin biosensors, epilepsy monitors, toxicity monitors, mercury monitors, lead

monitors, biosensors, electrochemical biosensors, moisture sensors, temperature sensors, humidity sensors, color sensors, heart rate sensors, accelerometers, and combinations thereof.

[0046] In some embodiments, the secondary monitoring device 181 is a blood oxygen monitor 190. The blood oxygen monitor 190 is electronically coupled to the processing unit 160.

[0047] In some embodiments, the flexible circuit 120 and the processing unit 160 (including electrochemical biosensor 121, the color sensor 122, the LED 150, the moisture sensor 123, the GPS antenna 140, the power unit 135, the bluetooth low energy transceiver 161, the GPS transceiver 163, the microcontroller 164, the accelerometer 165, the microprocessor 166, the ROM chip 166a, the RAM chip 166b, the analog to digital converter 166c, the digital to analog converter 166d, the serial peripheral interface 166e, the universal asynchronous receiver/transmitter 166f, the power regulator 166g, the temperature sensor 124, the humidity sensor 125, and the heart rate sensor 130) are reusable. The health monitoring device 100 may further comprise an adhesion means to adhere the flexible circuit 120 and the processing unit 160 to the absorbent product 110. The adhesion means include, but is not limited to, adhesive tape, velcro, clips, pins, glue, and combinations thereof. In some embodiments, the flexible circuit 120 and the processing unit 160 and their components are waterproof. With regard to the moisture sensor 123, the humidity sensor 125, and the electrochemical sensor 121, these components are waterproof except where the components receive analytes from urine, blood, stool, menses, or combinations thereof.

[0048] In other embodiments, the flexible circuit 120 and the processing unit 160 are disposable. In such embodiments, the flexible circuit 120 and the processing unit 160 may be integrally formed with the absorbent product. As shown in FIG. 5, the moisture sensor 123, color sensor 122 and electrochemical biosensor 121 (other disposable components are not depicted for clarity purposes) are inserted in between layers of absorbent product 110.

[0049] For example, FIG. 5 shows an example of an absorbent product 110 that includes a waterproof layer 111, an extra absorbent layer 112, and a wickaway liner 113. The components would be inserted between the extra absorbent layer 112, and the wickaway liner 113. The absorbent product 110 shown in FIG. 5 is for illustrative purposes and the present invention is not limited to absorbent products with the illustrated configuration. In some embodiments, the color sensor 122 may detect color changes (due to urine, blood, stool, menses, or combinations thereof) to the extra absorbent layer 112, the wickaway liner 113, or both. For example, the present invention may notify a caretaker that an occurrence of an event (urination, bleeding, a bowel movement, menstruation, or combinations thereof) has occurred. If a user has an event,

then the moisture sensor 123, humidity sensor 125, or both, are activated. The activation will indicate to the caretaker that an event has occurred. After the moisture sensor 123, humidity sensor 125, or both, are activated, the color sensor 122 and the LED 150 are triggered to activate to capture the color of the stained extra absorbent layer 112, the wickaway liner 113, or both. The color detected will inform the caretaker whether the event is urination, bleeding, a bowel movement, menstruation, or combinations thereof.

[0050] In some embodiments, the processing unit 160 of the health monitoring device 100 comprises, in place or in addition to a microcontroller 164, a microprocessor 166, a ROM chip 166a, a RAM chip 166b, an analog to digital converter 166c, a digital to analog converter 166d, a serial peripheral interface 166e, a universal asynchronous receiver/transmitter 166f, and, a power regulator 166g, as shown in FIGs. 4A and 4B.

[0051] In other embodiments of the present invention, a computer system comprises at least one processor unit, at least one memory unit coupled to the at least one processor unit, and, computer readable instructions embodied in the memory unit and executable by the processor unit, wherein execution of the instructions by the processor unit causes the computing system to perform a method of monitoring the health of a user of a health monitoring device 100. The method 200, as illustrated in FIG. 6, comprises obtaining health data from health monitoring device 100, recording the health data on the memory unit, transmitting the health data to a data communication device 170, and, displaying the health data on the data communication device 170.

[0052] In other embodiments, a method of monitoring the health of a user of a health monitoring device comprises obtaining health data from health monitoring device 100, recording the health data on the memory unit, transmitting the health data to a data communication device 170, and, displaying the health data on the data communication device 170.

[0053] In other embodiments, a non-transitory computer readable medium has computer readable instructions embodied therein, the computer readable instructions being configured to implement a method of monitoring the health of a user of a health monitoring device when executed, the method comprises obtaining health data from health monitoring device 100, recording the health data on the memory unit, transmitting the health data to a data communication device 170, and, displaying the health data on the data communication device 170. "Non-transitory computer readable medium" may not include a transitory signal.

[0054] In some embodiments, the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0055] In some embodiments, the method 200 further comprises providing alerts if the health data falls outside of predefined levels. For example, the health monitoring device 100 may be designed with predetermined levels for a certain amount of moisture or humidity (via the moisture sensor 123 and the humidity sensor 125, respectively) to notify a caretaker or the user of the health monitoring device that the absorbent product 110 needs to be replaced. The moisture sensor may also be utilized to measure the amount of water in urine. For example, if the amount of water is lower than normal, then it may indicate that more substances in the urine; if the amount of water is greater than normal, then it may indicate that less substances in the urine. Taking body temperature as another example, the average normal body temperature is generally 98.6 degrees fahrenheit. Throughout the day, body temperature will normally range from 97.0 to 99.0 degrees fahrenheit. The predefined levels may be set at 96.5 to 99.5 degrees fahrenheit. As a result, an alert is provided to the caretaker if the body temperature falls below 96.5 or rises above 99.5 degrees fahrenheit. A body temperature over 100.4 degrees fahrenheit often means a fever caused by an infection or illness.

[0056] In some embodiments, the method 200 further comprises providing alerts if the rate of change of health data falls outside of predefined rates. Again with body temperature as an example, the average normal body temperature is generally 98.6 degrees fahrenheit. Throughout the day, body temperature will normally range from 97.0 to 99.0 degrees fahrenheit. The predefined rate may be defined at a set rate, for example, +/- 0.01 degrees fahrenheit per 5 minutes. As a result, an alert is provided to the caretaker if the rate of change in body temperature changes (increases or decreases) greater than 0.01 degrees every 5 minutes. Alternatively, the predefined rate may be defined by the recording the user's normal change in rate of the user's body temperature. For example, the user's body temperature may normally change +/- 0.01 degrees fahrenheit per 10 minutes. As a result, an alert is provided to the caretaker if the rate of change in body temperature changes (increases or decreases) greater than 0.01 degrees every 10 minutes.

[0057] The health monitoring device 100 may have predetermined levels for the analytes to be detected by the electrochemical biosensor 121. For example, ranges for the following analytes include:

[0058] Albumin and creatinine - a ratio of albumin (mcg/L) to creatinine (mg/L) of less than 30 is normal. A ratio of 30-300 signifies microalbuminuria and ratios above 300 signifies macroalbuminuria. Abnormal levels of creatinine may be indicative of kidney failure, heart attacks, and muscle destruction.

[0059] Normal ranges for ascorbic acid are from about 0.6 to about 2 mg/dL. Levels of ascorbic acid that are less than 0.3 mg/dL indicate significant deficiency. Prolonged deficiency may cause scurvy. Excess urine ascorbic acid may be indicative of kidney stones.

[0060] Bilirubin is not normally present in urine. Presence of bilirubin in urine is an early indicator of liver disease.

[0061] Blood is not normally found in urine. The presence of hemoglobin in the urine may be indicative of hemoglobinuria or hematuria. The presence of myoglobin may be indicative of muscle injury. The presence of blood may also be indicative of kidney disorders and diseases, and urine duct disease.

[0062] Glucose is not normally present in urine. Glucosuria is the presence of glucose in urine, which may be the result of excessively high blood glucose levels, a sign of diabetes. Other causes of glucosuria include hormonal disorders, pregnancy, kidney and liver diseases, and diabetes.

[0063] Ketones are not normally found in urine. The presence of ketones may be an early indication of insufficient insulin, which may be characteristic of a person with diabetes.

[0064] Normal range of urine leukocytes are about 0 to about 5 white blood cells per high power field. High levels of white blood cells may indicate an infection, such as kidney or urinary tract infections.

[0065] Normal ranges of microalbumin is from about 20 to about 2000 mg/L. Abnormal levels of microalbumin may be indicative of cardiovascular and kidney diseases.

[0066] Urine is normally free of nitrite. Many bacteria can convert nitrate (a normal substance in urine) to nitrite. Therefore, the presence of nitrite in urine may indicate the presence of bacteria or a bacterial infection.

[0067] Typical pH values of urine is about pH 6, but may range from about 4.5 to about 8. Because the kidneys play an important role in maintaining acid-base balance of the body, non-typical pH values may indicate kidney problems and acidosis.

[0068] Normally, there is no or only a small amount of protein in urine. One of the proteins measured is albumin. Proteinuria is an elevated level of urine protein. Proteinuria may result from fever, stress, and exposure to cold. Protein in urine may also indicate cardiovascular and kidney diseases.

[0069] Specific gravity is a measure of urine concentration. A specific gravity of 1.035 indicates concentrated urine, which is urine with substances dissolved in the urine. A high

specific gravity (concentrated urine) may be indicative of fever, diarrhea, excessive perspiration, vomiting, hepatic disease, and heart failure. A low specific gravity (diluted urine) may be indicative of antidiuretic hormone deficiency, kidney infections, and calcium and potassium deficiencies.

[0070] Urobilinogen is normally present in urine in low concentrations. Urobilinogen levels greater than 1.0 mg/dL may be indicative of liver diseases.

[0071] The electrochemical biosensor may detect analytes found in urine, blood, stool and menses.

[0072] Preferably, the power unit 135 is a coin battery, a thin disposable bio-safe and environmentally-safe battery, or a rechargeable module. Charging of the power unit 135 may be done by a wired or wireless means.

[0073] The LED 150 provides light for the color sensor 122 to get a reading. The LED 150 will turn on for a moment while the color sensor 122 gets a reading and then the LED 150 will turn off. Preferably the LED 150 will be multi-color, for example, an RGBW (red, green, blue & white) LED. The color sensor 122 and the LED 150 may be separate; alternatively, the color sensor 122 may have an LED as part of the color sensor 122.

[0074] Preferably, any connecting wires between any of the components of the health monitoring device 100 will be flexible for comfort and fitting purposes of the user.

[0075] Exemplary methods, non-transitory computer-readable storage media, systems, and electronic devices are set out in example implementations of the following items:

[0076] Item 1. A health monitoring device comprising:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor; an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises: a GPS antenna;

a power unit;

a bluetooth low energy transceiver; a GPS transceiver;

a microcontroller; and, an accelerometer; wherein the processing unit is electronically coupled to the flexible circuit.

[0077] Item 2. The health monitoring device of item 1, wherein the flexible circuit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

[0078] Item 3. The health monitoring device of item 1, wherein the processing unit further comprises: a temperature sensor;

a humidity sensor; and,

a heart rate sensor.

[0079] Item 4. The health monitoring device of items 2 or 3, wherein each of the plurality of reference electrodes detects an analyte selected from the group consisting of albumin, ascorbic acid, bilirubin, blood, creatinine, glucose, hemoglobin, ketones, leukocytes, microalbumin, myoglobin, nitrite, pH, protein, specific gravity, urea, uric acid, urobilinogen, vitamins, and combinations thereof.

[0080] Item 5. The health monitoring device of item 4, further comprising a data communication device.

[0081] Item 6. The health monitoring device of item 5, wherein the processing unit further comprises an input/output device connection port, wherein the input/output device connection port electronically couples a secondary monitoring device to the processing unit.

[0082] Item 7. The health monitoring device of item 6, wherein the secondary monitoring device is selected from the group consisting of pulse oximeters, blood pressure monitors, blood glucose meters, blood coagulation meters, blood oxygen monitor, thermometers, apnea monitors, electrocardiogram monitors, fetal monitors, hemoglobin trackers, breathalyzers, capnography monitors, fitness monitors, pedometers, medical monitors, vital sign monitors, cardiac monitors, hemodynamic monitors, respiratory monitors, neurological monitors, body temperature monitors, heart rate monitors, respiratory rate monitors, stress monitors, serotonin biosensors, epilepsy monitors, toxicity monitors, mercury monitors, lead monitors, biosensors, electrochemical biosensors, moisture sensors, temperature sensors, humidity sensors, color sensors, heart rate sensors, accelerometers, and combinations thereof.

[0083] Item 8. The health monitoring device of item 7, wherein the secondary monitoring device is a blood oxygen monitor.

[0084] Item 9. The health monitoring device of item 8, wherein the flexible circuit and the processing unit are reusable; and, wherein the health monitoring device further comprises an adhesion means to adhere the flexible circuit and the processing unit to the absorbent product.

[0085] Item 10. The health monitoring device of item 8, wherein the flexible circuit and the processing unit are disposable.

[0086] Item 11. The health monitoring device of item 10, wherein the flexible circuit is integrally formed with the absorbent product.

[0087] Item 12. A health monitoring device comprising:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor; an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises: a GPS antenna;

a power unit;

a bluetooth low energy transceiver; a GPS transceiver;

a microprocessor; a ROM chip;

a RAM chip;

an analog to digital converter; a digital to analog converter; a serial peripheral interface;

a universal asynchronous receiver/transmitter; a power regulator; and,

an accelerometer; wherein the processing unit is electronically coupled to the flexible circuit.

[0088] Item 13. The health monitoring device of item 12, wherein the flexible circuit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

[0089] Item 14. The health monitoring device of item 12, wherein the processing unit further comprises:

a temperature sensor; a humidity sensor; and, a heart rate sensor.

[0090] Item 15. The health monitoring device of items 13 or 14, wherein each of the plurality of reference electrodes detects an analyte selected from the group consisting of albumin, ascorbic acid, bilirubin, blood, creatinine, glucose, hemoglobin, ketones, leukocytes, microalbumin, myoglobin, nitrite, pH, protein, specific gravity, urea, uric acid, urobilinogen, vitamins, and combinations thereof.

[0091] Item 16. The health monitoring device of item 15, further comprising a data communication device.

[0092] Item 17. The health monitoring device of item 16, wherein the processing unit further comprises an input/output device connection port, wherein the input/output device connection port electronically couples a secondary monitoring device to the processing unit.

[0093] Item 18. The health monitoring device of item 17, wherein the secondary monitoring device is selected from the group consisting of pulse oximeters, blood pressure monitors, blood glucose meters, blood coagulation meters, blood oxygen monitor, thermometers, apnea monitors, electrocardiogram monitors, fetal monitors, hemoglobin trackers, breathalyzers, capnography monitors, fitness monitors, pedometers, medical monitors, vital sign monitors, cardiac monitors, hemodynamic monitors, respiratory monitors, neurological monitors, body temperature monitors, heart rate monitors, respiratory rate monitors, stress monitors, serotonin biosensors, epilepsy monitors, toxicity monitors, mercury monitors, lead monitors, biosensors, electrochemical biosensors, moisture sensors, temperature sensors, humidity sensors, color sensors, heart rate sensors, accelerometers, and combinations thereof.

[0094] Item 19. The health monitoring device of item 18, wherein the secondary monitoring device is a blood oxygen monitor.

[0095] Item 20. The health monitoring device of item 19, wherein the flexible circuit and the processing unit are reusable; and, wherein the health monitoring device further comprises an adhesion means to adhere the flexible circuit and the processing unit to the absorbent product.

[0096] Item 21. The health monitoring device of item 19, wherein the flexible circuit and the processing unit are disposable.

[0097] Item 22. The health monitoring device of item 21, wherein the flexible circuit is integrally formed with the absorbent product.

[0098] Item 23. A computer system comprising: at least one processor unit;
at least one memory unit coupled to the at least one processor unit; and,

computer readable instructions embodied in the memory unit and executable by the processor unit, wherein execution of the instructions by the processor unit causes the computing system to perform a method of monitoring the health of a user of a health monitoring device, the method comprising:

obtaining health data from health monitoring device; wherein the health monitoring device comprises:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor;

an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises:

a GPS antenna;

a power unit;

a bluetooth low energy transceiver; a GPS transceiver;

a microcontroller; and, an accelerometer;

wherein the processing unit is electronically coupled to the flexible circuit; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.

[0099] Item 24. The computer system of item 23, wherein the flexible circuit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

[0100] Item 25. The computer system of item 23, wherein the processing unit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

[0101] Item 26. The computer system of items 24 or 25, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

[0102] Item 27. The computer system of item 26, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0103] Item 28. The computer system of item 27, the method further comprising providing alerts if the health data falls outside of predefined levels.

[0104] Item 29. The computer system of item 27, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

[0105] Item 30. A method of monitoring the health of a user of a health monitoring device, the method comprising:

obtaining health data from health monitoring device; wherein the health monitoring device comprises:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor; an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises: a GPS antenna;

a power unit;

a bluetooth low energy transceiver; a GPS transceiver;

a microcontroller; and,

an accelerometer;

wherein the processing unit is electronically coupled to the flexible circuit; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.

[0106] Item 31. The method of item 30, wherein the flexible circuit further comprises: a temperature sensor;

a humidity sensor; and,

a heart rate sensor.

[0107] Item 32. The method of item 30, wherein the processing unit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

[0108] Item 33. The method of items of 31 or 32, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

[0109] Item 34. The method of item 33, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0110] Item 35. The method of item 34, the method further comprising providing alerts if the health data falls outside of predefined levels.

[0111] Item 36. The computer system of item 34, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

[0112] Item 37. A non-transitory computer readable medium having computer readable instructions embodied therein, the computer readable instructions being configured to implement a method of monitoring the health of a user of a health monitoring device when executed, the method comprising: obtaining health data from health monitoring device; wherein the health monitoring device comprises:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor; an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises:

a GPS antenna;

a power unit;

a bluetooth low energy transceiver;

a GPS transceiver;

a microcontroller; and, an accelerometer;

wherein the processing unit is electronically coupled to the flexible circuit; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.

[0113] Item 38. The non-transitory computer readable medium of item 37, wherein the flexible circuit further comprises:

- a temperature sensor;
- a humidity sensor; and,
- a heart rate sensor.

[0114] Item 39. The non-transitory computer readable medium of item 37, wherein the processing unit further comprises:

- a temperature sensor;
- a humidity sensor; and,
- a heart rate sensor.

[0115] Item 40. The non-transitory computer readable medium of items 38 or 39, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

[0116] Item 41. The non-transitory computer readable medium of item 40, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

[0117] Item 42. The non-transitory computer readable medium of item 41, the method further comprising providing alerts if the health data falls outside of predefined levels.

[0118] Item 43. The computer system of item 11, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

[0119] Item 44. A computer-implemented method for monitoring a health condition of an individual, comprising:

- detecting, using a first sensor of a disposable article, an occurrence of an event, wherein the event corresponds to an excretion of bodily waste;

- in response to detecting the occurrence of an event, activating a second sensor of the disposable article, wherein the second sensor is different from the first sensor;

capturing, using the second sensor, color information associated with the bodily waste;

based on the captured color information, identifying an event type from a plurality of predefined event types; and

providing an output indicative of the identified event type.

[0120] Item 45. The method of item 44, wherein the event comprises urination, bleeding, menstruation, excretion of other bodily fluids, a bowel movement, passing of gas, or any combination thereof.

[0121] Item 46. The method of any of items 44-45, wherein the bodily waste comprises urine, blood, other bodily fluids, feces, gas, or any combination thereof.

[0122] Item 47. The method of any of items 44-46, wherein the first sensor comprises a moisture sensor, a humidity sensor, or both.

[0123] Item 48. The method of any of items 44-47, wherein the second sensor comprises a color sensor, a LED unit, or a combination thereof.

[0124] Item 49. The method of any of items 44-48, wherein capturing color information comprises capturing color information of a portion of the disposable article.

[0125] Item 50. The method of any of items 44-49, wherein capturing color information comprises capturing color information of the bodily waste.

[0126] Item 51. The method of any of items 44-50, further comprising:

detecting, using an electrochemical biosensor of the disposable article, a level of an analyte in the bodily waste;

based on the level of the analyte in the bodily waste, determining a condition of a plurality of predetermined conditions; and

providing an output indicative of the determined condition.

[0127] Item 52. The method of any of items 44-51, further comprising:

detecting, using a temperature sensor, a temperature reading;

based on the temperature reading, determining a condition of a plurality of predetermined conditions; and

providing an output indicative of the determined condition.

[0128] Item 53. The method of any of items 44-52, wherein the disposable article further comprises a heart rate monitor.

[0129] Item 54. The method of any of items 44-53, wherein the disposable article further comprises an accelerometer or a gyroscope.

[0130] Item 55. A non-transitory computer-readable storage medium storing one or more programs, the one or more programs comprising instructions, which when executed by one or more processors of an electronic device having a display, cause the electronic device to:

detect, using a first sensor of a disposable article, an occurrence of an event, wherein the event corresponds to an excretion of bodily waste;

in response to detecting the occurrence of an event, activate a second sensor of the disposable article, wherein the second sensor is different from the first sensor;

capture, using the second sensor, color information associated with the bodily waste;

based on the captured color information, identify an event type from a plurality of predefined event types; and

provide an output indicative of the identified event type.

[0131] Various exemplary embodiments are described herein. Reference is made to these examples in a non-limiting sense. They are provided to illustrate more broadly applicable aspects of the disclosed technology. Various changes may be made and equivalents may be substituted without departing from the true spirit and scope of the various embodiments. In addition, many modifications may be made to adapt a particular situation, material, composition of matter, process, process act(s) or step(s) to the objective(s), spirit or scope of the various embodiments. Further, as will be appreciated by those with skill in the art, each of the individual variations described and illustrated herein has discrete components and features which may be readily separated from or combined with the features of any of the other several embodiments without departing from the scope or spirit of the various embodiments.

CLAIMS

We Claim:

1. A health monitoring device comprising:
a flexible circuit, wherein the flexible circuit comprises:
an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;
a color sensor; an LED; and,
a moisture sensor;
an absorbent product; and,
a processing unit, wherein the processing unit comprises: a GPS antenna;
a power unit;
a bluetooth low energy transceiver; a GPS transceiver;
a microcontroller; and, an accelerometer; wherein the processing unit is electronically coupled to the flexible circuit.
2. The health monitoring device of claim 1, wherein the flexible circuit further comprises: a temperature sensor;
a humidity sensor; and, a heart rate sensor.
3. The health monitoring device of claim 1, wherein the processing unit further comprises: a temperature sensor;
a humidity sensor; and,
a heart rate sensor.
4. The health monitoring device of claims 2 or 3, wherein each of the plurality of reference electrodes detects an analyte selected from the group consisting of albumin, ascorbic acid, bilirubin, blood, creatinine, glucose, hemoglobin, ketones, leukocytes, microalbumin, myoglobin, nitrite, pH, protein, specific gravity, urea, uric acid, urobilinogen, vitamins, and combinations thereof.
5. The health monitoring device of claim 4, further comprising a data communication device.

6. The health monitoring device of claim 5, wherein the processing unit further comprises an input/output device connection port, wherein the input/output device connection port electronically couples a secondary monitoring device to the processing unit.
7. The health monitoring device of claim 6, wherein the secondary monitoring device is selected from the group consisting of pulse oximeters, blood pressure monitors, blood glucose meters, blood coagulation meters, blood oxygen monitor, thermometers, apnea monitors, electrocardiogram monitors, fetal monitors, hemoglobin trackers, breathalyzers, capnography monitors, fitness monitors, pedometers, medical monitors, vital sign monitors, cardiac monitors, hemodynamic monitors, respiratory monitors, neurological monitors, body temperature monitors, heart rate monitors, respiratory rate monitors, stress monitors, serotonin biosensors, epilepsy monitors, toxicity monitors, mercury monitors, lead monitors, biosensors, electrochemical biosensors, moisture sensors, temperature sensors, humidity sensors, color sensors, heart rate sensors, accelerometers, and combinations thereof.
8. The health monitoring device of claim 7, wherein the secondary monitoring device is a blood oxygen monitor.
9. The health monitoring device of claim 8, wherein the flexible circuit and the processing unit are reusable; and, wherein the health monitoring device further comprises an adhesion means to adhere the flexible circuit and the processing unit to the absorbent product.
10. The health monitoring device of claim 8, wherein the flexible circuit and the processing unit are disposable.
11. The health monitoring device of claim 10, wherein the flexible circuit is integrally formed with the absorbent product.
12. A health monitoring device comprising:
 - a flexible circuit, wherein the flexible circuit comprises:
 - an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;
 - a color sensor; an LED; and,
 - a moisture sensor;
 - an absorbent product; and,
 - a processing unit, wherein the processing unit comprises: a GPS antenna;

a power unit;
a bluetooth low energy transceiver; a GPS transceiver;
a microprocessor; a ROM chip;
a RAM chip;
an analog to digital converter; a digital to analog converter; a serial peripheral interface;
a universal asynchronous receiver/transmitter; a power regulator; and,
an accelerometer; wherein the processing unit is electronically coupled to the flexible circuit.

13. The health monitoring device of claim 12, wherein the flexible circuit further comprises:
a temperature sensor;

a humidity sensor; and, a heart rate sensor.

14. The health monitoring device of claim 12, wherein the processing unit further comprises:
a temperature sensor; a humidity sensor; and, a heart rate sensor.

15. The health monitoring device of claims 13 or 14, wherein each of the plurality of reference electrodes detects an analyte selected from the group consisting of albumin, ascorbic acid, bilirubin, blood, creatinine, glucose, hemoglobin, ketones, leukocytes, microalbumin, myoglobin, nitrite, pH, protein, specific gravity, urea, uric acid, urobilinogen, vitamins, and combinations thereof.

16. The health monitoring device of claim 15, further comprising a data communication device.

17. The health monitoring device of claim 16, wherein the processing unit further comprises an input/output device connection port, wherein the input/output device connection port electronically couples a secondary monitoring device to the processing unit.

18. The health monitoring device of claim 17, wherein the secondary monitoring device is selected from the group consisting of pulse oximeters, blood pressure monitors, blood glucose meters, blood coagulation meters, blood oxygen monitor, thermometers, apnea monitors, electrocardiogram monitors, fetal monitors, hemoglobin trackers, breathalyzers, capnography monitors, fitness monitors, pedometers, medical monitors, vital sign monitors, cardiac monitors, hemodynamic monitors, respiratory monitors, neurological monitors, body temperature monitors, heart rate monitors, respiratory rate monitors, stress monitors, serotonin biosensors,

epilepsy monitors, toxicity monitors, mercury monitors, lead monitors, biosensors, electrochemical biosensors, moisture sensors, temperature sensors, humidity sensors, color sensors, heart rate sensors, accelerometers, and combinations thereof.

19. The health monitoring device of claim 18, wherein the secondary monitoring device is a blood oxygen monitor.

20. The health monitoring device of claim 19, wherein the flexible circuit and the processing unit are reusable; and, wherein the health monitoring device further comprises an adhesion means to adhere the flexible circuit and the processing unit to the absorbent product.

21. The health monitoring device of claim 19, wherein the flexible circuit and the processing unit are disposable.

22. The health monitoring device of claim 21, wherein the flexible circuit is integrally formed with the absorbent product.

23. A computer system comprising: at least one processor unit;
at least one memory unit coupled to the at least one processor unit; and,
computer readable instructions embodied in the memory unit and executable by the processor unit, wherein execution of the instructions by the processor unit causes the computing system to perform a method of monitoring the health of a user of a health monitoring device, the method comprising:

obtaining health data from health monitoring device; wherein the health monitoring device comprises:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor;

an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises:

a GPS antenna;

a power unit;

a bluetooth low energy transceiver; a GPS transceiver;
a microcontroller; and, an accelerometer;

wherein the processing unit is electronically coupled to the flexible circuit; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.

24. The computer system of claim 23, wherein the flexible circuit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

25. The computer system of claim 23, wherein the processing unit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

26. The computer system of claims 24 or 25, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

27. The computer system of claim 26, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

28. The computer system of claim 27, the method further comprising providing alerts if the health data falls outside of predefined levels.

29. The computer system of claim 27, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

30. A method of monitoring the health of a user of a health monitoring device, the method comprising:

obtaining health data from health monitoring device; wherein the health monitoring device comprises:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor; an LED; and,

a moisture sensor;

an absorbent product; and,
a processing unit, wherein the processing unit comprises: a GPS antenna;
a power unit;
a bluetooth low energy transceiver; a GPS transceiver;
a microcontroller; and,
an accelerometer;
wherein the processing unit is electronically coupled to the flexible circuit; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.

31. The method of claim 30, wherein the flexible circuit further comprises: a temperature sensor;

a humidity sensor; and,
a heart rate sensor.

32. The method of claim 30, wherein the processing unit further comprises: a temperature sensor;

a humidity sensor; and, a heart rate sensor.

33. The method of claims of 31 or 32, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

34. The method of claim 33, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.

35. The method of claim 34, the method further comprising providing alerts if the health data falls outside of predefined levels.

36. The computer system of claim 34, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.

37. A non-transitory computer readable medium having computer readable instructions embodied therein, the computer readable instructions being configured to implement a method of monitoring the health of a user of a health monitoring device when executed, the method

comprising: obtaining health data from health monitoring device; wherein the health monitoring device comprises:

a flexible circuit, wherein the flexible circuit comprises:

an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes;

a color sensor; an LED; and,

a moisture sensor;

an absorbent product; and,

a processing unit, wherein the processing unit comprises:

a GPS antenna;

a power unit;

a bluetooth low energy transceiver;

a GPS transceiver;

a microcontroller; and, an accelerometer;

wherein the processing unit is electronically coupled to the flexible circuit; recording the health data on the memory unit; transmitting the health data to a data communication device; and, displaying the health data on the data communication device.

38. The non-transitory computer readable medium of claim 37, wherein the flexible circuit further comprises:

a temperature sensor;

a humidity sensor; and,

a heart rate sensor.

39. The non-transitory computer readable medium of claim 37, wherein the processing unit further comprises:

a temperature sensor;

a humidity sensor; and,

a heart rate sensor.

40. The non-transitory computer readable medium of claims 38 or 39, wherein the health monitoring device further comprises a blood oxygen monitor, wherein the blood oxygen monitor is electronically coupled to the flexible circuit.

41. The non-transitory computer readable medium of claim 40, wherein the obtaining, recording, transmitting and displaying the health data are repeatedly performed at regular, predefined intervals.
42. The non-transitory computer readable medium of claim 41, the method further comprising providing alerts if the health data falls outside of predefined levels.
43. The computer system of claim 11, the method further comprising providing alerts if the rate of change of health data falls outside of predefined rates.
44. A computer-implemented method for monitoring a health condition of an individual, comprising:
- detecting, using a first sensor of a disposable article, an occurrence of an event, wherein the event corresponds to an excretion of bodily waste;
 - in response to detecting the occurrence of an event, activating a second sensor of the disposable article, wherein the second sensor is different from the first sensor;
 - capturing, using the second sensor, color information associated with the bodily waste;
 - based on the captured color information, identifying an event type from a plurality of predefined event types; and
 - providing an output indicative of the identified event type.
45. The method of claim 44, wherein the event comprises urination, bleeding, menstruation, excretion of other bodily fluids, a bowel movement, passing of gas, or any combination thereof.
46. The method of any of claims 44-45, wherein the bodily waste comprises urine, blood, other bodily fluids, feces, gas, or any combination thereof.
47. The method of any of claims 44-46, wherein the first sensor comprises a moisture sensor, a humidity sensor, or both.
48. The method of any of claims 44-47, wherein the second sensor comprises a color sensor, a LED unit, or a combination thereof.

49. The method of any of claims 44-48, wherein capturing color information comprises capturing color information of a portion of the disposable article.
50. The method of any of claims 44-49, wherein capturing color information comprises capturing color information of the bodily waste.
51. The method of any of claims 44-50, further comprising:
detecting, using an electrochemical biosensor of the disposable article, a level of an analyte in the bodily waste;
based on the level of the analyte in the bodily waste, determining a condition of a plurality of predetermined conditions; and
providing an output indicative of the determined condition.
52. The method of any of claims 44-51, further comprising:
detecting, using a temperature sensor, a temperature reading;
based on the temperature reading, determining a condition of a plurality of predetermined conditions; and
providing an output indicative of the determined condition.
53. The method of any of claims 44-52, wherein the disposable article further comprises a heart rate monitor.
54. The method of any of claims 44-53, wherein the disposable article further comprises an accelerometer or a gyroscope.
55. A non-transitory computer-readable storage medium storing one or more programs, the one or more programs comprising instructions, which when executed by one or more processors of an electronic device having a display, cause the electronic device to:
detect, using a first sensor of a disposable article, an occurrence of an event, wherein the event corresponds to an excretion of bodily waste;
in response to detecting the occurrence of an event, activate a second sensor of the disposable article, wherein the second sensor is different from the first sensor;
capture, using the second sensor, color information associated with the bodily waste;

based on the captured color information, identify an event type from a plurality of predefined event types; and
provide an output indicative of the identified event type.

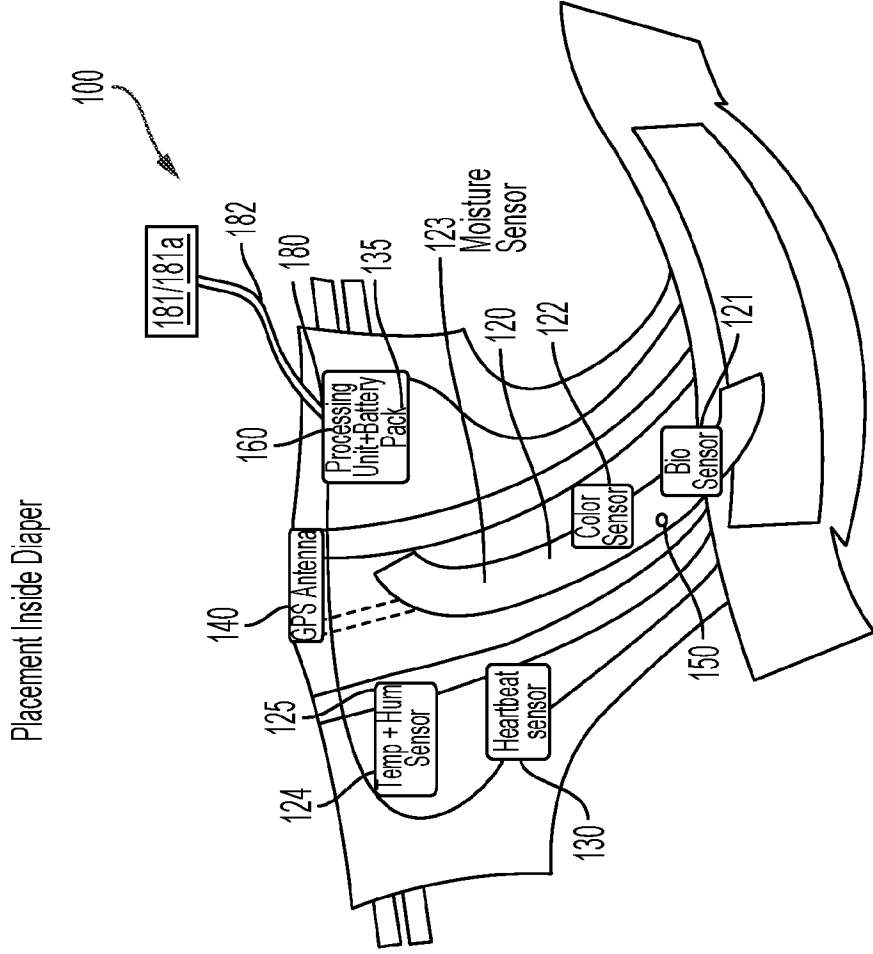
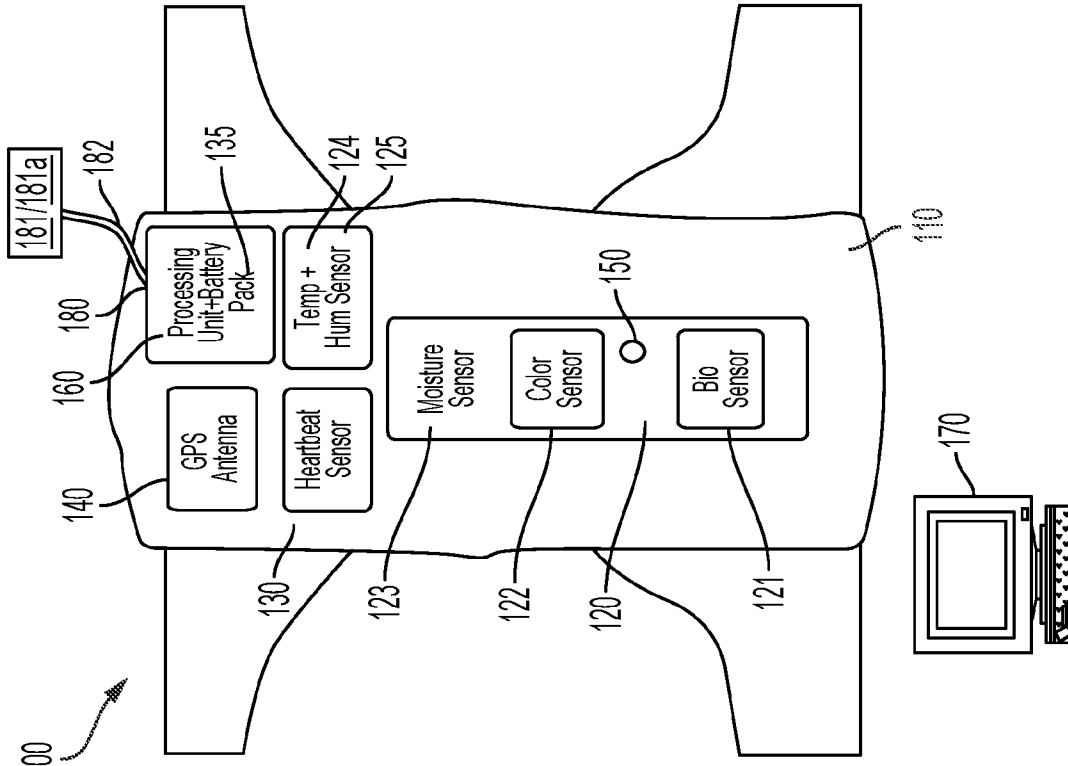


FIG. 1

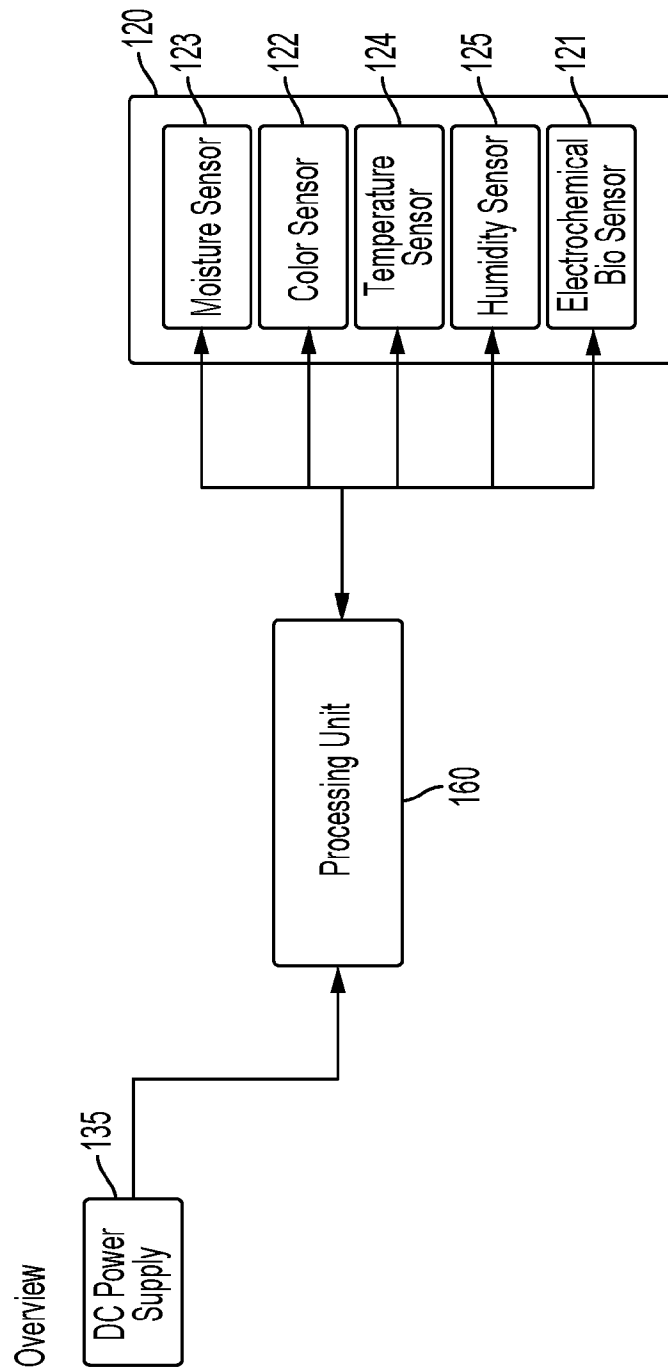


FIG. 2

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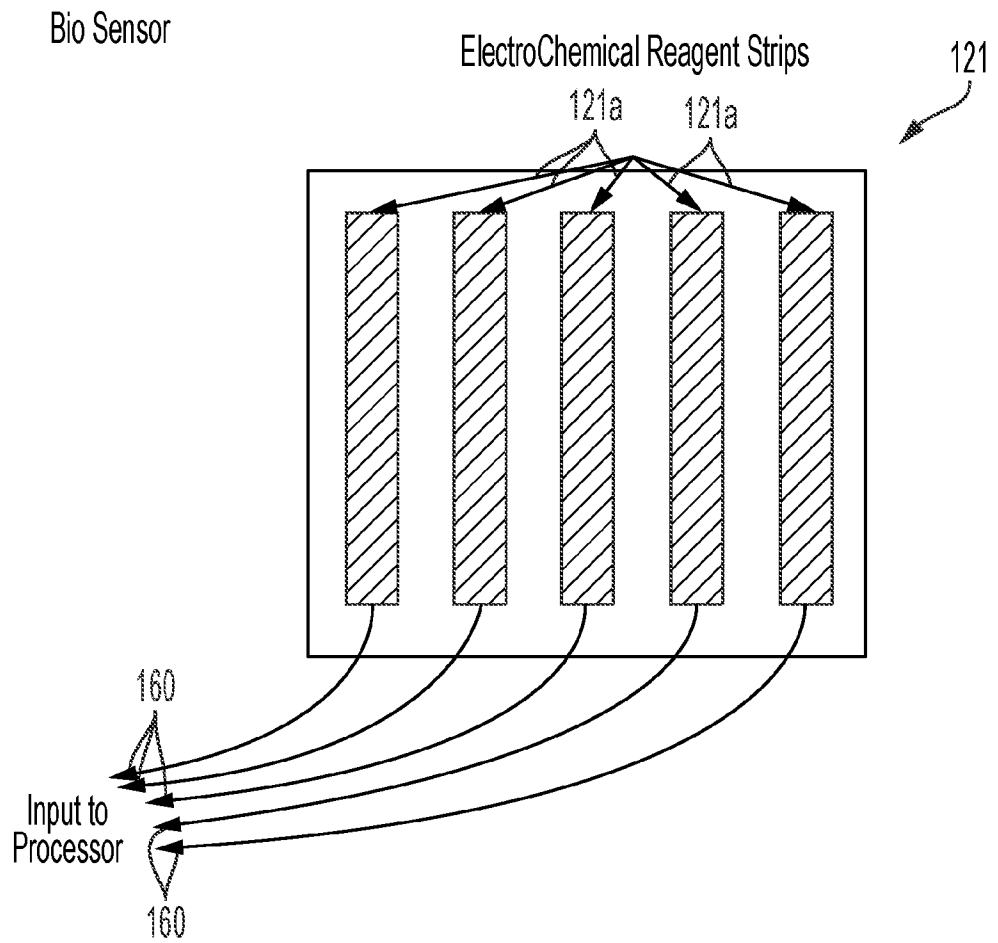


FIG. 3

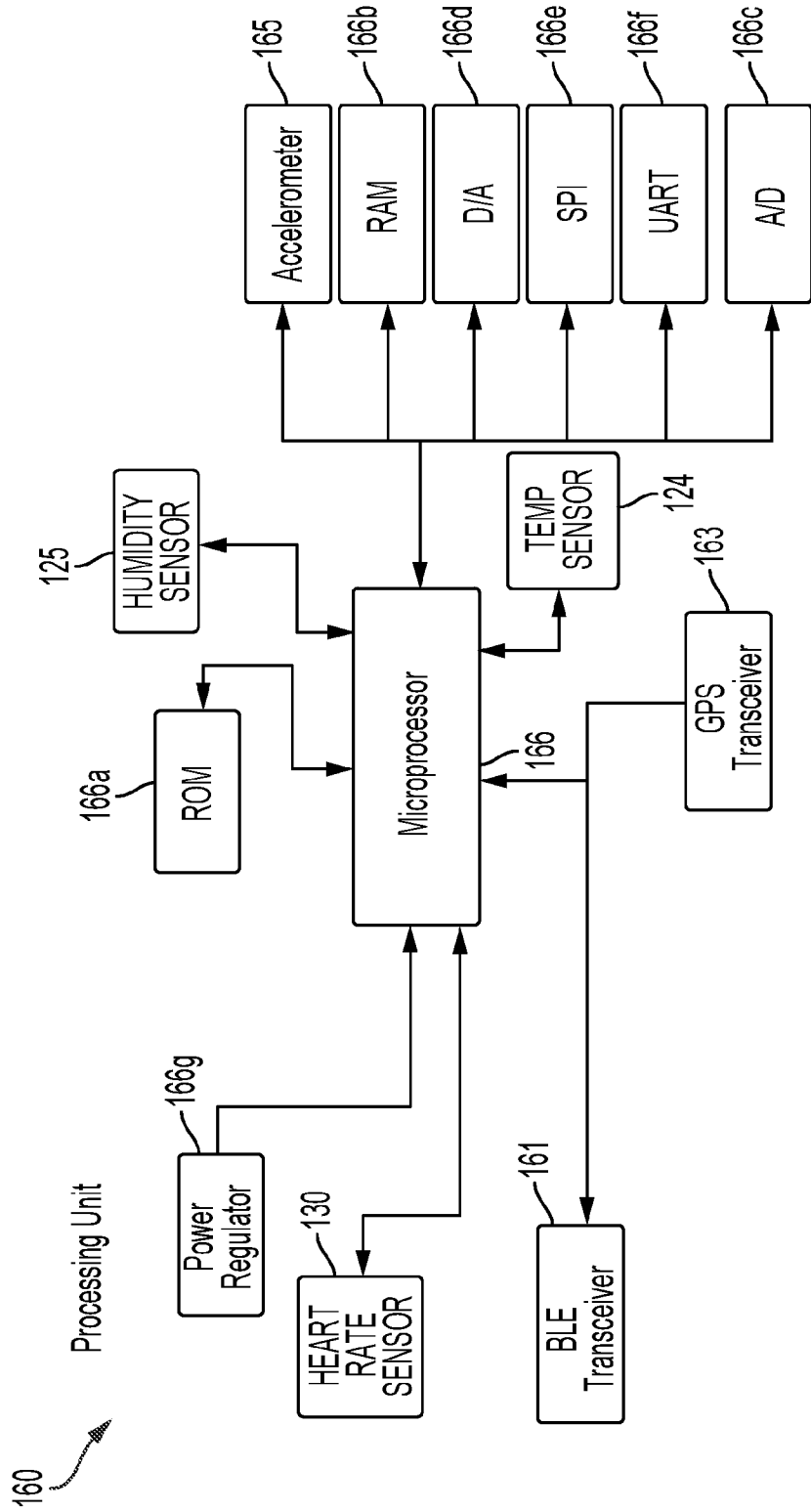


FIG. 4A

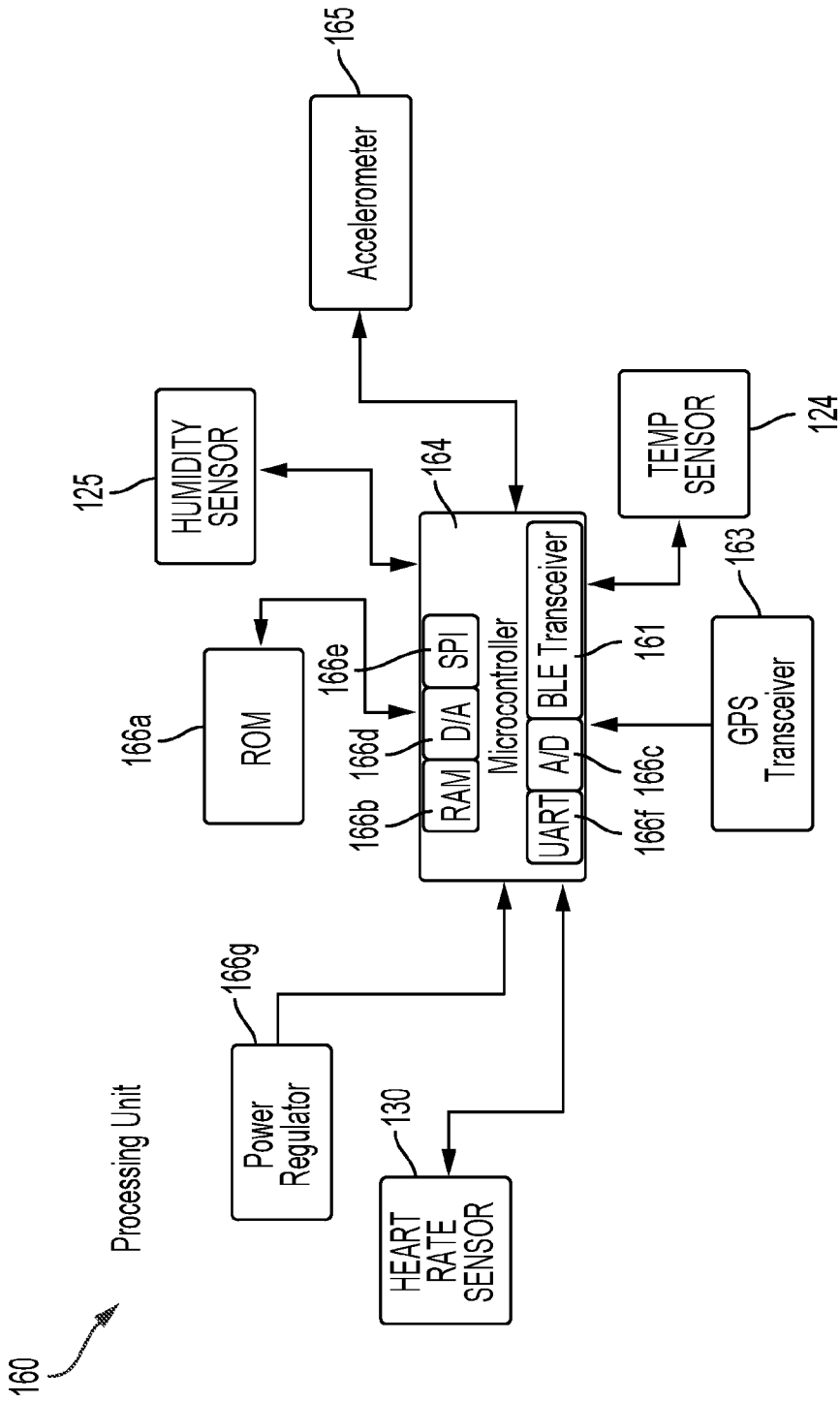


FIG. 4B

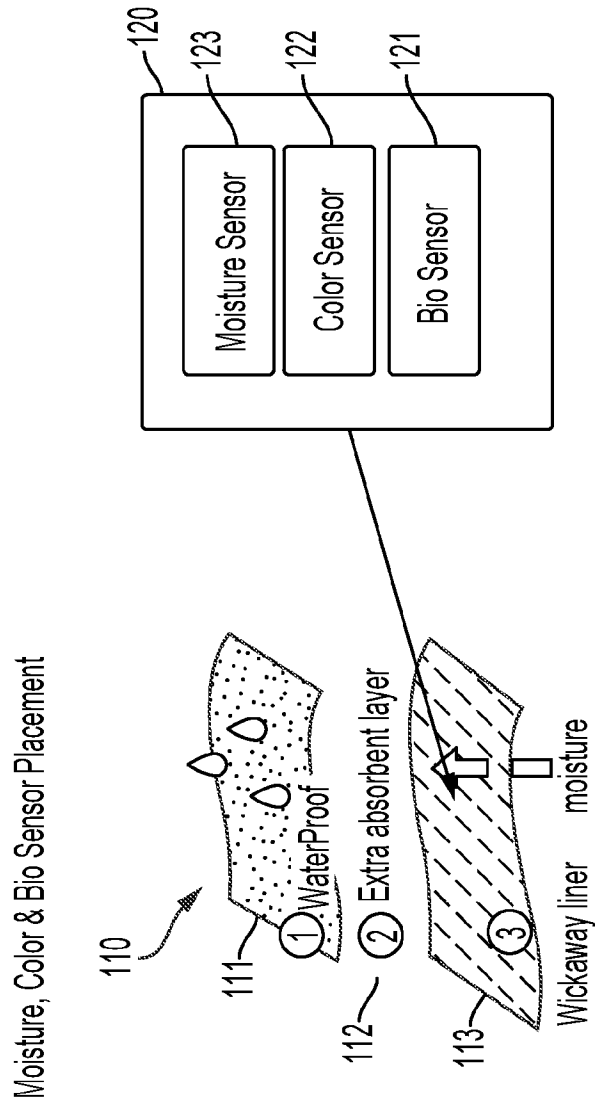


FIG. 5

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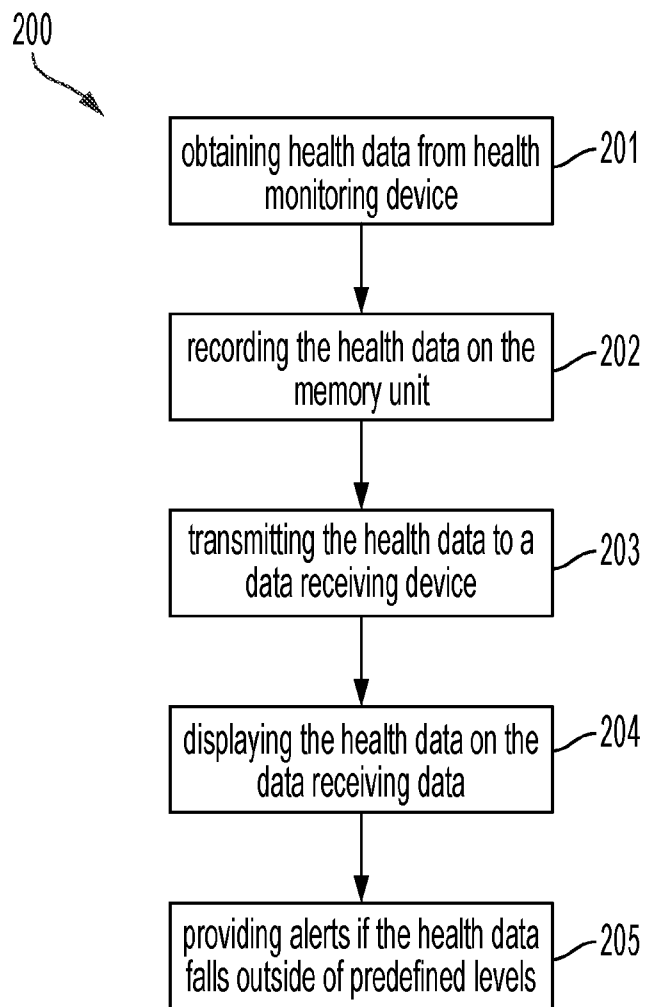


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/049793

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61F 13/44; A61B 5/00; G01N 27/12 (2018.01)

CPC - A61F 13/42; A61B 5/14532; A61F 2013/421; A61F 2013/422; A61F 2013/423; A61F 2013/424; A61F 2013/425; A61F 2013/426; A61F 2013/427; A61F 2013/428; A61F 2013/429; G01N 27/121 (2018.08)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 324/694; 604/361; 604/364 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014/0200538 A1 (EULIANO et al) 17 July 2014 (17.07.2014) entire document	1-43
Y	US 2016/0095758 A1 (HAIRE et al) 07 April 2016 (07.04.2016) entire document	1-43
Y	US 2015/0180355 A1 (ADVANCED CHARGING TECHNOLOGIES, LLC) 25 June 2015 (25.06.2015) entire document	12-22
A	US 2008/0167572 A1 (STIVORIC et al) 10 July 2008 (10.07.2008) entire document	1-43
A	US 2007/0179356 A1 (WESSEL) 02 August 2007 (02.08.2007) entire document	1-43

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

08 December 2018

Date of mailing of the international search report

07 JAN 2019

Name and mailing address of the ISA/US

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Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/049793

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.: 47-51
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See extra sheet(s).

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-43

- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

Continued from Box No. III Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-43, are drawn to a health monitoring device comprising: a flexible circuit, wherein the flexible circuit comprises: an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes.

Group II, claims 44-46 and 55, are drawn to a computer-implemented method for monitoring a health condition of an individual comprising detecting, using a first sensor of a disposable article, an occurrence of an event, wherein the event corresponds to an excretion of bodily waste.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: a flexible circuit, wherein the flexible circuit comprises: an electrochemical biosensor, wherein the electrochemical biosensor comprises a plurality of reference electrodes: a color sensor; an LED; and, a moisture sensor; an absorbent product; and, a processing unit, wherein the processing unit comprises: a GPS antenna; a power unit: a Bluetooth low energy transceiver; a GPS transceiver; a microcontroller; and, an accelerometer; wherein the processing unit is electronically coupled to the flexible circuit as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: detecting, using a first sensor of a disposable article, an occurrence of an event, wherein the event corresponds to an excretion of bodily waste; in response to detecting the occurrence of an event, activating a second sensor of the disposable article, wherein the second sensor is different from the first sensor; capturing, using the second sensor, color information associated with the bodily waste; based on the captured color information, identifying an event type from a plurality of predefined event types; and providing an output indicative of the identified event type as claimed therein is not present in the invention of Group I.

Groups I and II lack unity of invention because even though the inventions of these groups require the technical feature of a health monitoring device, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2007/0179356 to Wessel teaches a health monitoring device (Para. [0007]).

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.