US 20100275108A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2010/0275108 A1**

(43) **Pub. Date: Oct. 28, 2010**

Sloan et al.

(54) **ERROR DETECTION IN CRITICAL REPEATING DATA IN A WIRELESS SENSOR SYSTEM**

(75) Inventors: **Mark Kent Sloan**, Redwood City, CA (US); **Martin J. Fennell**, Concord, CA (US)

Correspondence Address:
JACKSON & CO., LLP
6114 LA SALLE AVENUE, #507
OAKLAND, CA 94611-2802 (US)

(73) Assignee: **Abbott Diabetes Care Inc.**, Alameda, CA (US)

(21) Appl. No.: **12/769,633**

(22) Filed: **Apr. 28, 2010**

Related U.S. Application Data

(60) Provisional application No. 61/173,594, filed on Apr. 28, 2009.

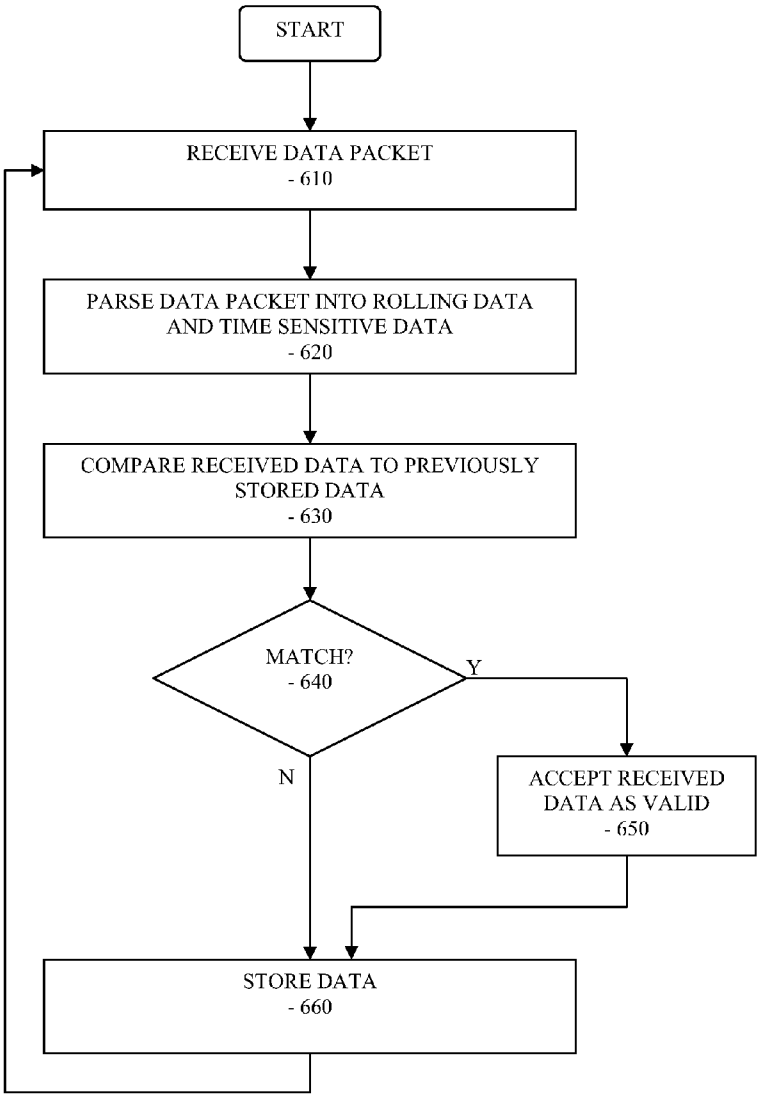
Publication Classification

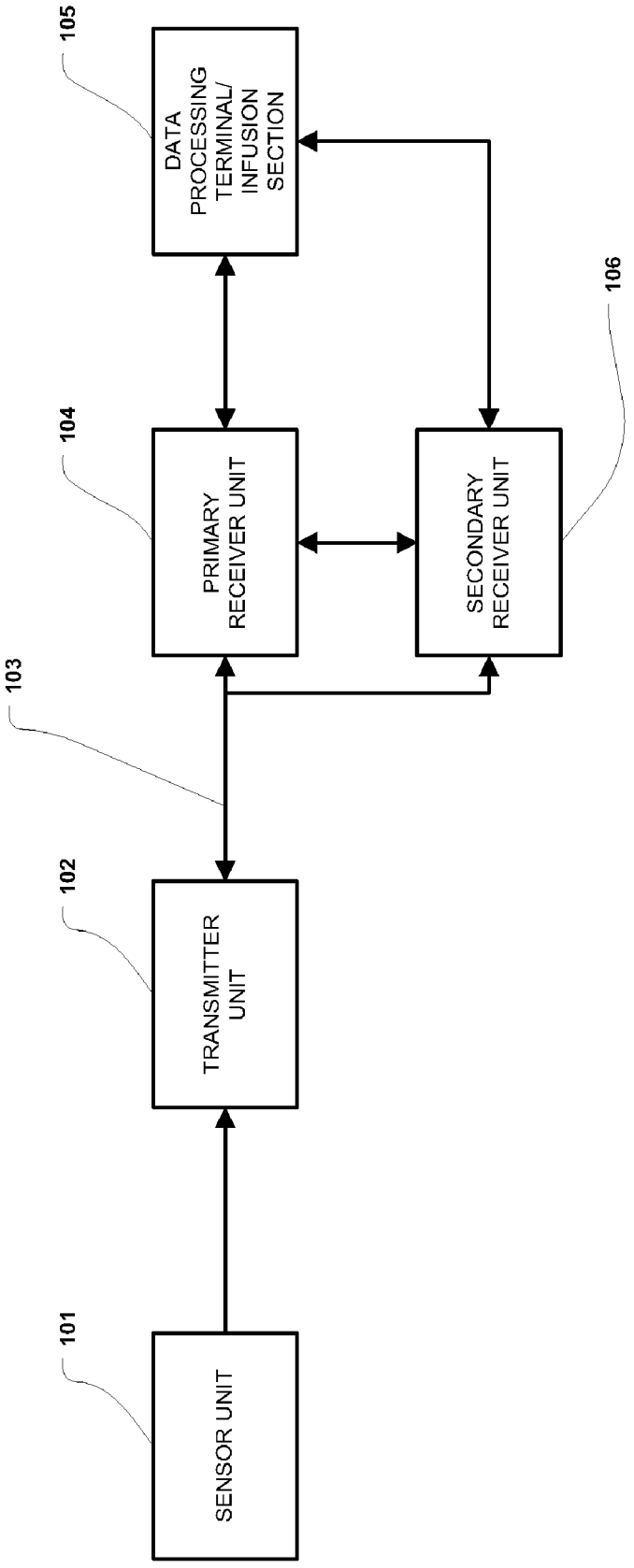
(51) **Int. Cl.**
G06F 7/20 (2006.01)
G06F 11/00 (2006.01)

(52) **U.S. Cl.** **714/819**; 714/E11.002

(57) **ABSTRACT**

Provided are methods, systems, and apparatus for error detection of bits of a data packet received at a receiver unit by detecting corrupted data bits.




105
DATA PROCESSING TERMINAL/ INFUSION SECTION
106
104
PRIMARY RECEIVER UNIT
SECONDARY RECEIVER UNIT
103
102
TRANSMITTER UNIT
101
SENSOR UNIT

100

FIGURE 1

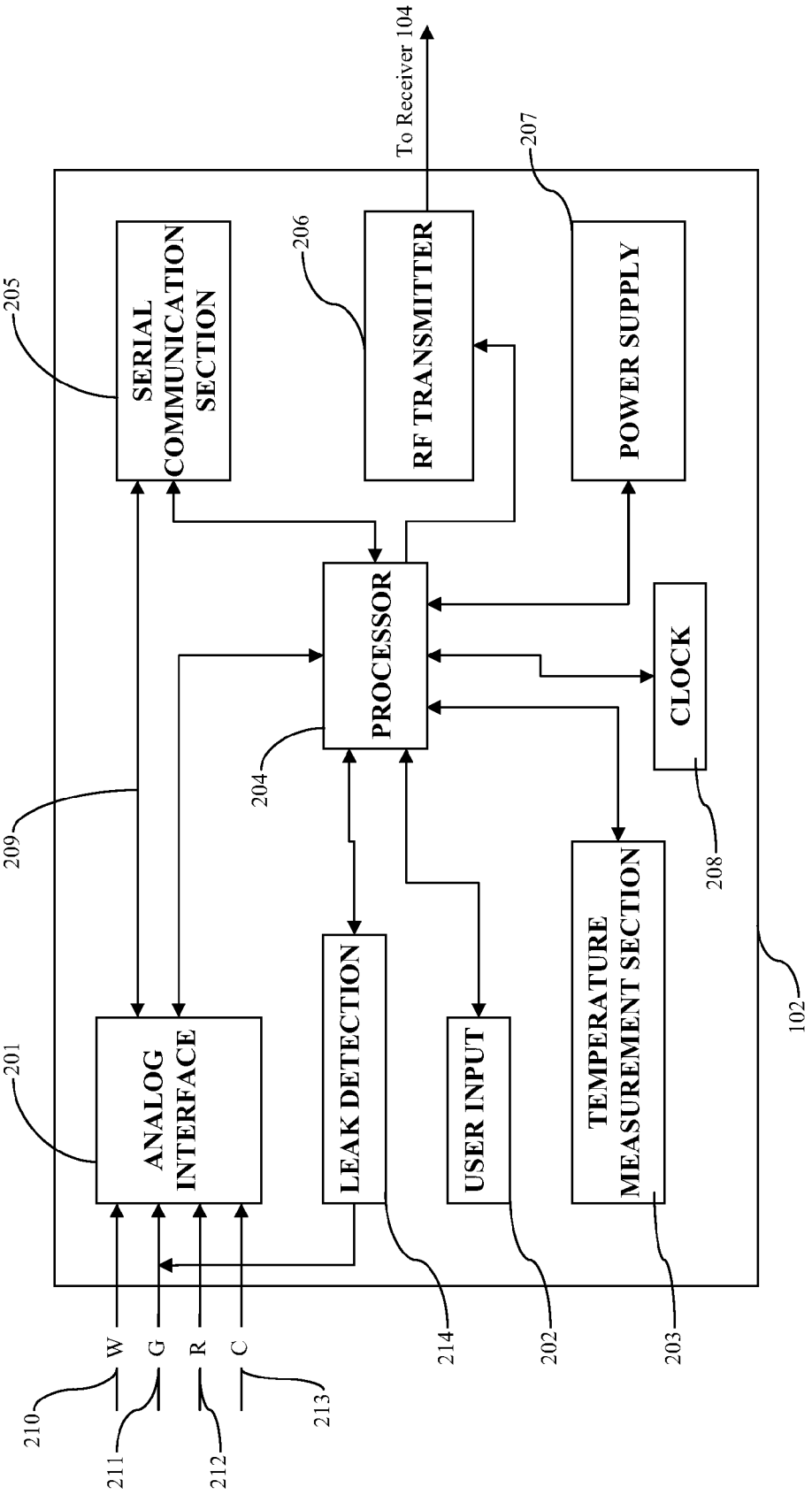

To Receiver 104
SERIAL COMMUNICATION SECTION
RF TRANSMITTER
POWER SUPPLY
PROCESSOR
CLOCK
ANALOG INTERFACE
LEAK DETECTION
USER INPUT
TEMPERATURE MEASUREMENT SECTION
205
206
207
204
208
209
201
214
202
203
102
W
G
R
C
210
211
212
213

FIGURE 2

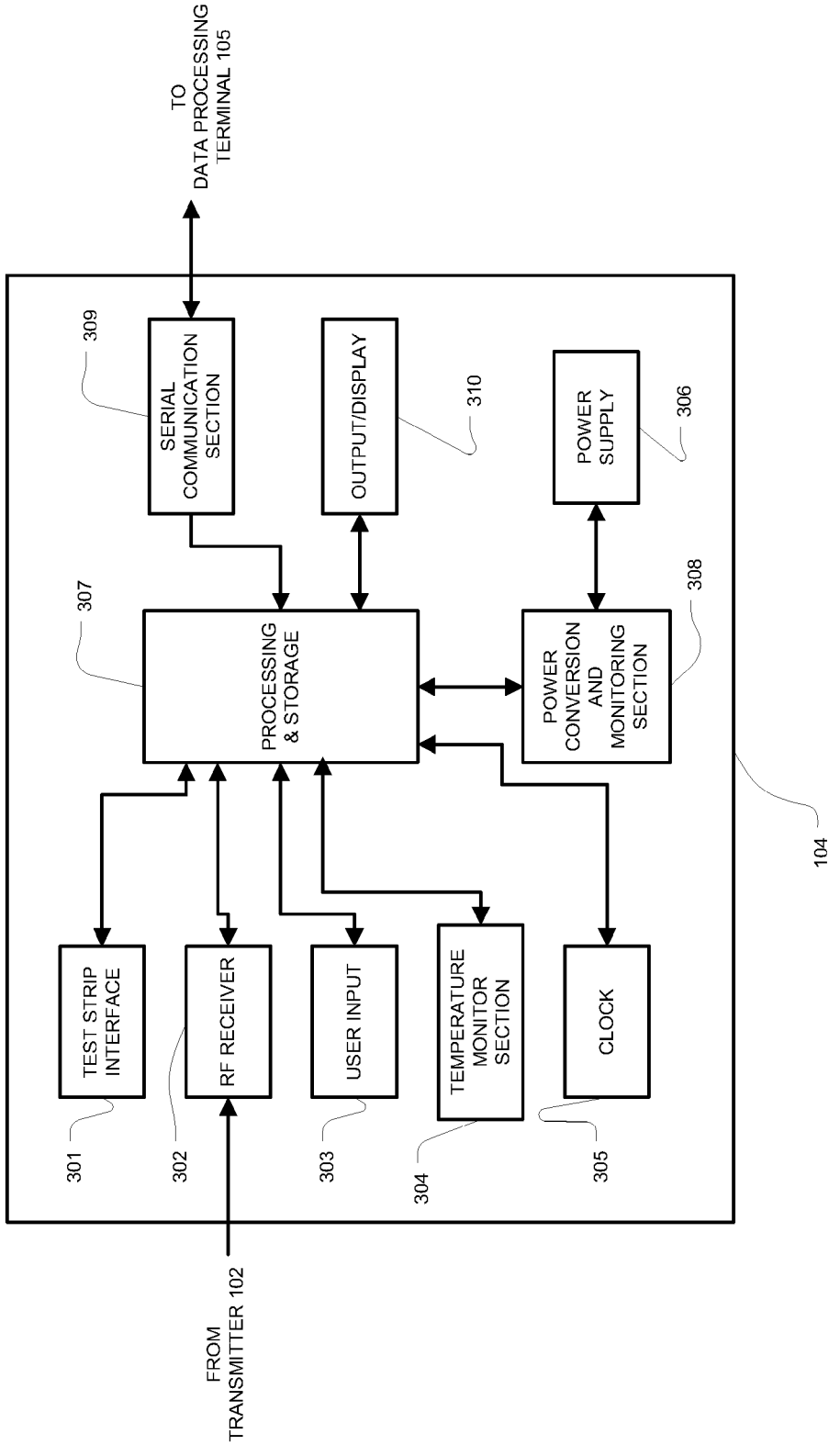

TO
DATA PROCESSING
TERMINAL 105
309
SERIAL
COMMUNICATION
SECTION
OUTPUT/DISPLAY
310
POWER
SUPPLY
306
307
PROCESSING
& STORAGE
POWER
CONVERSION
AND
MONITORING
SECTION
308
104
TEST STRIP
INTERFACE
RF RECEIVER
USER INPUT
TEMPERATURE
MONITOR
SECTION
CLOCK
301
302
303
304
305
FROM
TRANSMITTER 102

FIGURE 3

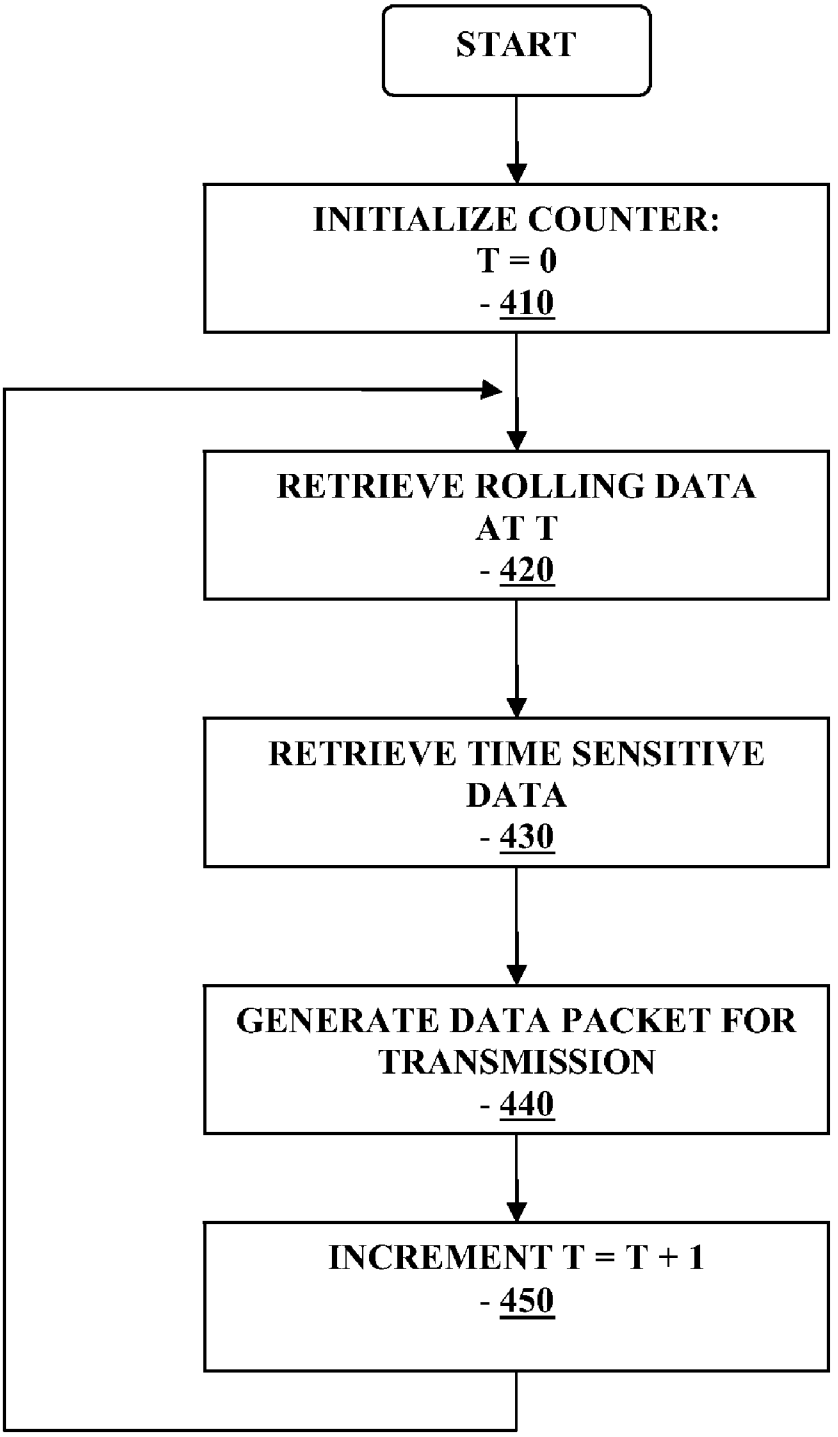

START
INITIALIZE COUNTER:
T = 0
- 410
RETRIEVE ROLLING DATA
AT T
- 420
RETRIEVE TIME SENSITIVE
DATA
- 430
GENERATE DATA PACKET FOR
TRANSMISSION
- 440
INCREMENT T = T + 1
- 450

FIGURE 4

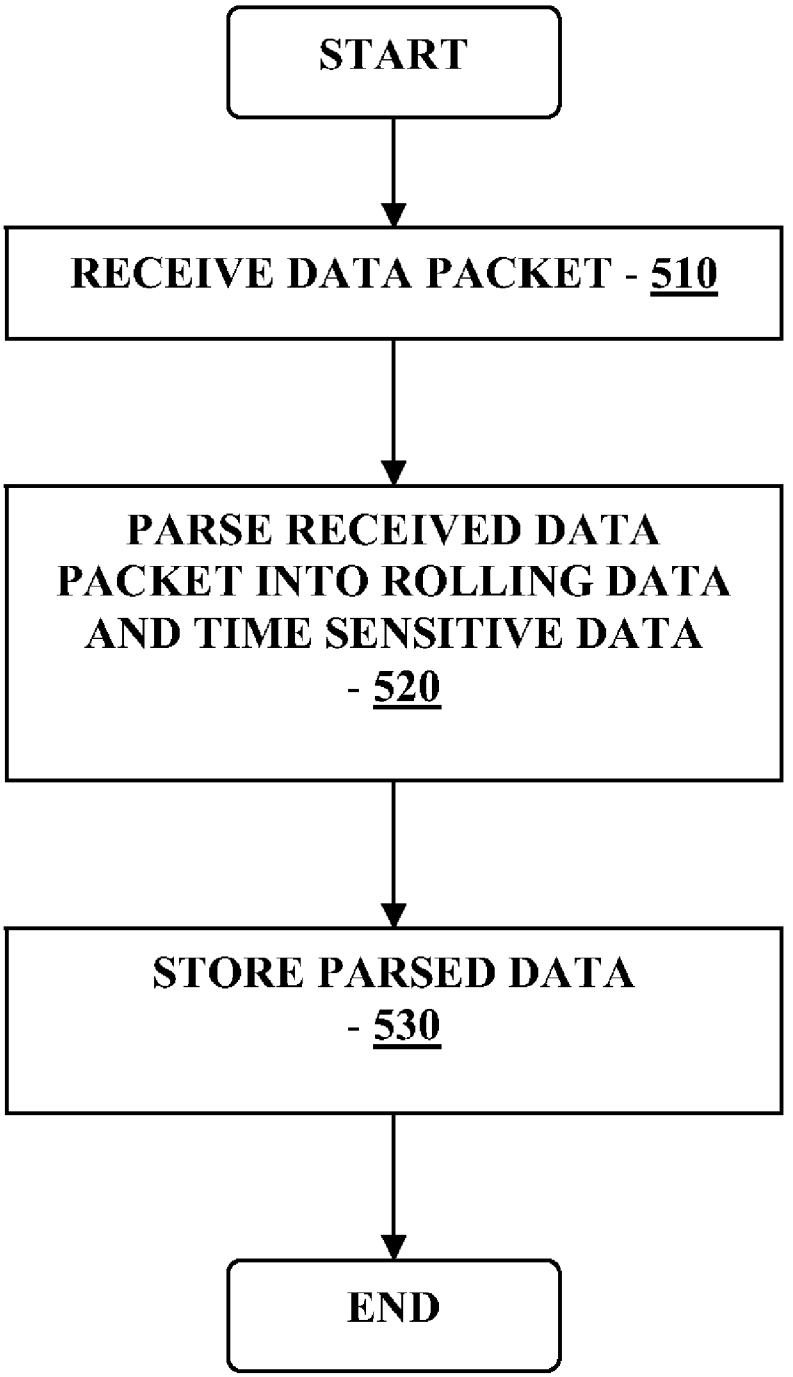

START
RECEIVE DATA PACKET - 510
PARSE RECEIVED DATA PACKET INTO ROLLING DATA AND TIME SENSITIVE DATA - 520
STORE PARSED DATA - 530
END

FIGURE 5

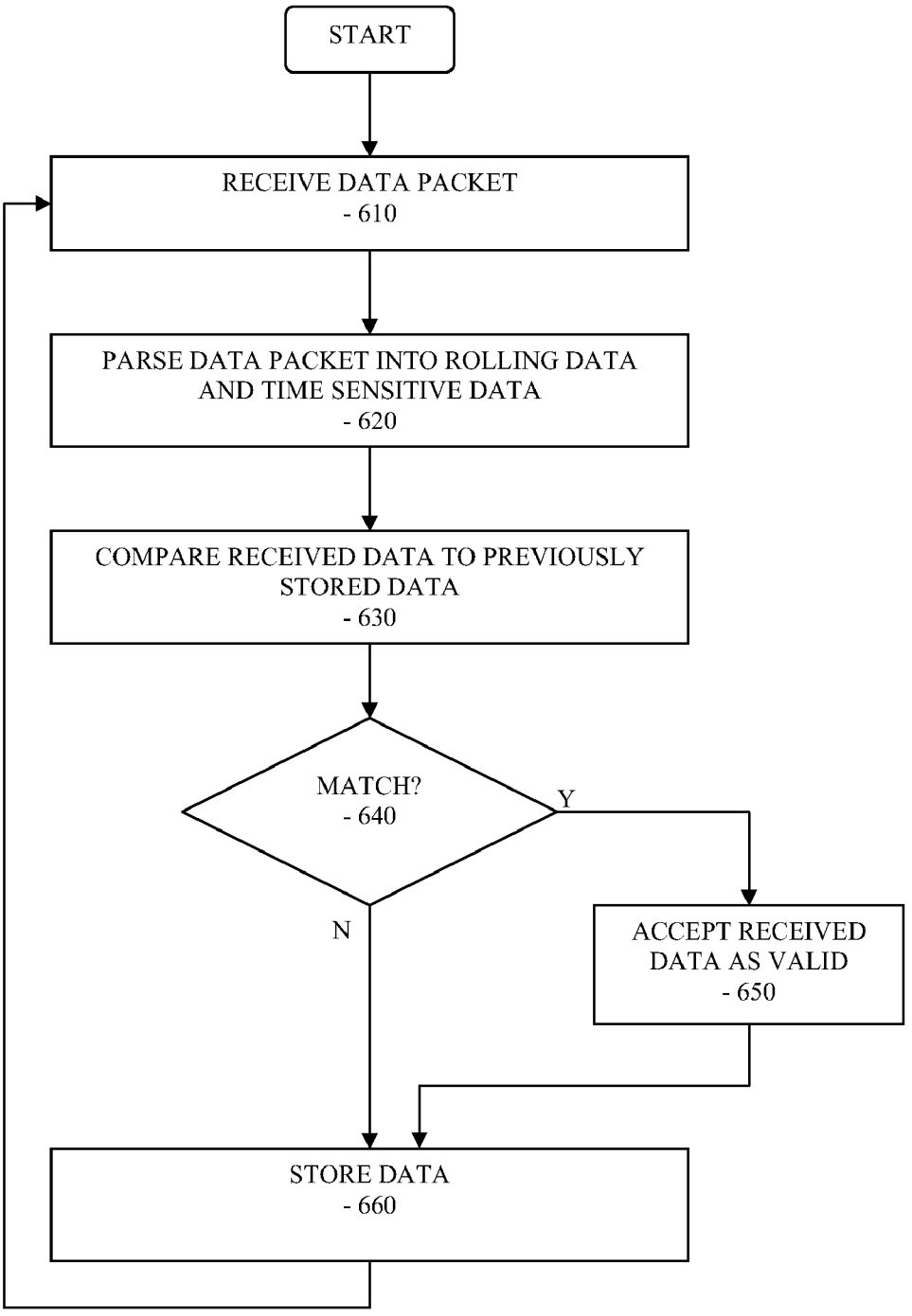

START
RECEIVE DATA PACKET
- 610
PARSE DATA PACKET INTO ROLLING DATA
AND TIME SENSITIVE DATA
- 620
COMPARE RECEIVED DATA TO PREVIOUSLY
STORED DATA
- 630
MATCH?
- 640
Y
N
ACCEPT RECEIVED
DATA AS VALID
- 650
STORE DATA
- 660

FIGURE 6

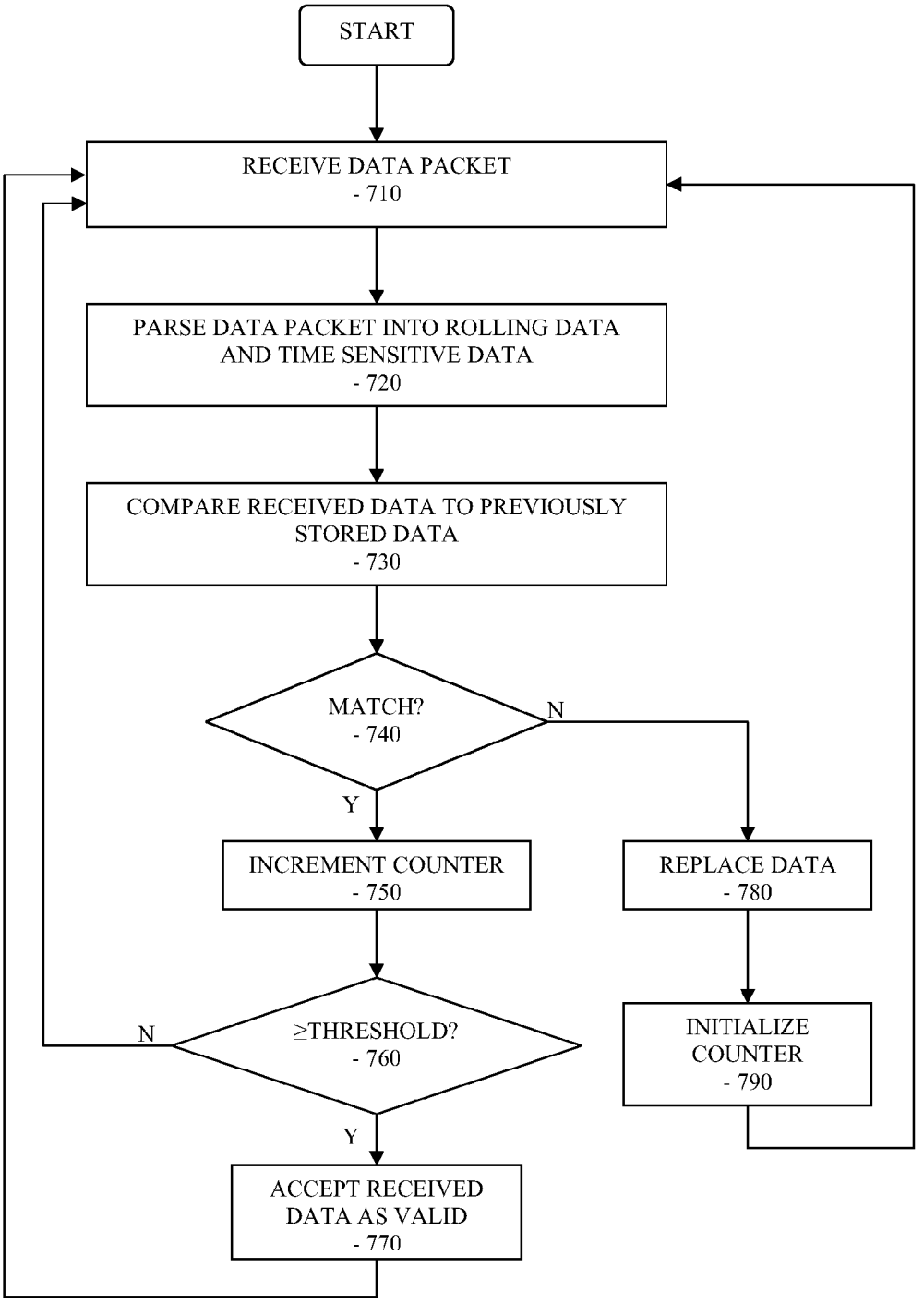

START
RECEIVE DATA PACKET
- 710
PARSE DATA PACKET INTO ROLLING DATA AND TIME SENSITIVE DATA
- 720
COMPARE RECEIVED DATA TO PREVIOUSLY STORED DATA
- 730
MATCH?
- 740
N
Y
INCREMENT COUNTER
- 750
REPLACE DATA
- 780
≥THRESHOLD?
- 760
N
Y
INITIALIZE COUNTER
- 790
ACCEPT RECEIVED DATA AS VALID
- 770

FIGURE 7

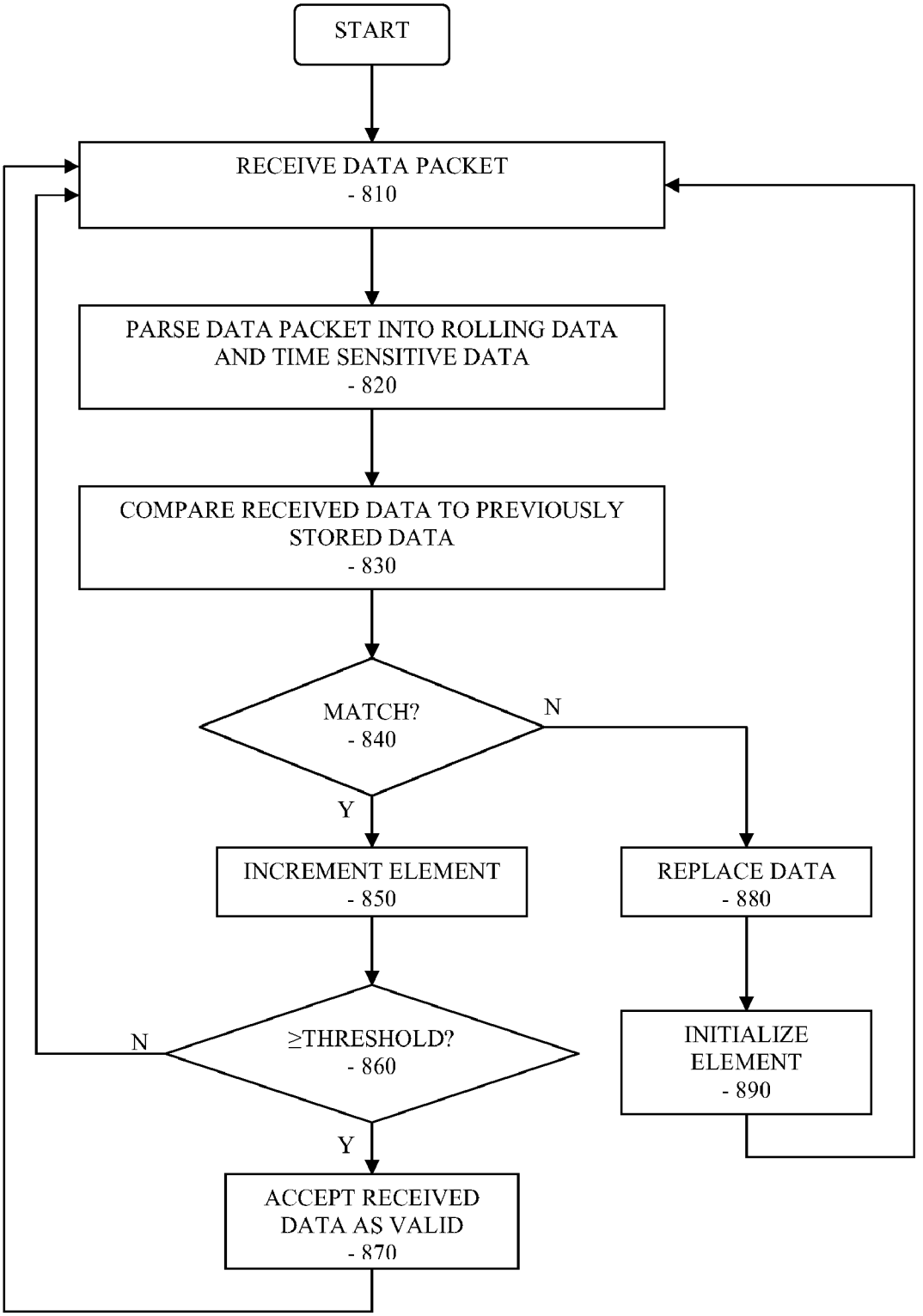

START
RECEIVE DATA PACKET
- 810
PARSE DATA PACKET INTO ROLLING DATA AND TIME SENSITIVE DATA
- 820
COMPARE RECEIVED DATA TO PREVIOUSLY STORED DATA
- 830
MATCH?
- 840
N
Y
INCREMENT ELEMENT
- 850
REPLACE DATA
- 880
≥THRESHOLD?
- 860
N
INITIALIZE ELEMENT
- 890
Y
ACCEPT RECEIVED DATA AS VALID
- 870

FIGURE 8

ERROR DETECTION IN CRITICAL REPEATING DATA IN A WIRELESS SENSOR SYSTEM

RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119(e) to U.S. provisional application No. 61/173,594 filed Apr. 28, 2009, entitled "Error Detection in Critical Repeating Data in a Wireless Sensor System", the disclosure of which is incorporated in its entirety by reference for all purposes.

BACKGROUND

[0002] Analyte, e.g., glucose monitoring systems including continuous and discrete monitoring systems generally include a small, lightweight battery powered and microprocessor controlled system which is configured to detect signals proportional to the corresponding measured glucose levels using an electrometer. RF signals may be used to transmit the collected data. One aspect of certain analyte monitoring systems include a transcutaneous or subcutaneous analyte sensor configuration which is, for example, at least partially positioned through the skin layer of a subject whose analyte level is to be monitored. The sensor may use a two or three-electrode (work, reference and counter electrodes) configuration driven by a controlled potential (potentiostat) analog circuit connected through a contact system.

[0003] An analyte sensor may be configured so that a portion thereof is placed under the skin of the patient so as to contact analyte of the patient, and another portion or segment of the analyte sensor may be in communication with the transmitter unit. The transmitter unit may be configured to transmit the analyte levels detected by the sensor over a wireless communication link such as an RF (radio frequency) communication link to a receiver/monitor unit. The receiver/monitor unit may perform data analysis, among other functions, on the received analyte levels to generate information pertaining to the monitored analyte levels.

[0004] Transmission of control or command data over a wireless communication link is often constrained to occur within a substantially short time duration. In turn, the time constraint in data communication imposes limits on the type and size of data that may be transmitted during the transmission time period.

SUMMARY

[0005] Devices and methods for analyte monitoring, e.g., glucose monitoring, and/or therapy management system including, for example, medication infusion device are provided. Embodiments include transmitting, repeating, providing, relaying or otherwise passing information from a first location to a second, e.g., using a telemetry system such as RF telemetry. Systems herein include continuous analyte monitoring systems, discrete analyte monitoring system, and/or therapy management systems.

[0006] These and other objects, features and advantages of the present disclosure will become more fully apparent from the following detailed description of the embodiments, the appended claims and the accompanying drawings.

INCORPORATION BY REFERENCE

[0007] The following patents, applications and/or publications are incorporated herein by reference for all purposes: U.S. Pat. Nos. 4,545,382; 4,711,245; 5,262,035; 5,262,305; 5,264,104; 5,320,715; 5,509,410; 5,543,326; 5,593,852; 5,601,435; 5,628,890; 5,820,551; 5,822,715; 5,899,855; 5,918,603; 6,071,391; 6,103,033; 6,120,676; 6,121,009; 6,134,461; 6,143,164; 6,144,837; 6,161,095; 6,175,752; 6,270,455; 6,284,478; 6,299,757; 6,338,790; 6,377,894; 6,461,496; 6,503,381; 6,514,460; 6,514,718; 6,540,891; 6,560,471; 6,579,690; 6,591,125; 6,592,745; 6,600,997; 6,605,200; 6,605,201; 6,616,819; 6,618,934; 6,650,471; 6,654,625; 6,676,816; 6,730,200; 6,736,957; 6,746,582; 6,749,740; 6,764,581; 6,773,671; 6,881,551; 6,893,545; 6,932,892; 6,932,894; 6,942,518; 7,167,818; and 7,299,082; U.S. Published Application Nos. 2004/0186365; 2005/0182306; 2007/0056858; 2007/0068807; 2007/0227911; 2007/0233013; 2008/0081977; 2008/0161666; and 2009/0054748; U.S. patent application Ser. Nos. 11/831,866; 11/831,881; 11/831,895; 12/102,839; 12/102,844; 12/102,847; 12/102,855; 12/102,856; 12/152,636; 12/152,648; 12/152,650; 12/152,652; 12/152,657; 12/152,662; 12/152,670; 12/152,673; 12/363,712; 12/131,012; 12/242,823; 12/363,712; 12/393,921; 12/495,709; 12/698,124; 12/699,653; 12/699,844; 12/714,439; 12/761,372; and 12/761,387 and U.S. Provisional Application Ser. Nos. 61/230,686 and 61/227,967.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** illustrates a block diagram of a data monitoring and management system for practicing one or more embodiments of the present disclosure;

[0009] FIG. **2** is a block diagram of the transmitter unit of the data monitoring and management system shown in FIG. **1** in accordance with one embodiment of the present disclosure;

[0010] FIG. **3** is a block diagram of the receiver/monitor unit of the data monitoring and management system shown in FIG. **1** in accordance with one embodiment of the present disclosure;

[0011] FIG. **4** is a flowchart illustrating data packet procedure including rolling data for transmission in accordance with one embodiment of the present disclosure;

[0012] FIG. **5** is a flowchart illustrating data processing of the received data packet including the rolling data in accordance with one embodiment of the present disclosure;

[0013] FIG. **6** is a flow chart illustrating error detection of rolling data of a received data packet in accordance with one embodiment of the present disclosure;

[0014] FIG. **7** is a flow chart illustrating an alternative error detection of rolling data of a received data packet; and

[0015] FIG. **8** is a flow chart illustrating an error detection of rolling data from a plurality of data packets in accordance with one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0016] Before the present disclosure is described in additional detail, it is to be understood that this disclosure is not limited to particular embodiments described, as such may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting, since the scope of the present disclosure will be limited only by the appended claims.

[0017] Where a range of values is provided, it is understood that each intervening value, to the tenth of the unit of the lower limit unless the context clearly dictates otherwise, between

the upper and lower limit of that range and any other stated or intervening value in that stated range, is encompassed within the disclosure. The upper and lower limits of these smaller ranges may independently be included in the smaller ranges is also encompassed within the disclosure, subject to any specifically excluded limit in the stated range. Where the stated range includes one or both of the limits, ranges excluding either or both of those included limits are also included in the disclosure.

[0018] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Although any methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present disclosure, the preferred methods and materials are now described. All publications mentioned herein are incorporated herein by reference to disclose and describe the methods and/or materials in connection with which the publications are cited.

[0019] It must be noted that as used herein and in the appended claims, the singular forms "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

[0020] The publications discussed herein are provided solely for their disclosure prior to the filing date of the present application. Nothing herein is to be construed as an admission that the present disclosure is not entitled to antedate such publication by virtue of prior disclosure. Further, the dates of publication provided may be different from the actual publication dates which may need to be independently confirmed.

[0021] As will be apparent to those of skill in the art upon reading this disclosure, each of the individual embodiments 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 present disclosure.

[0022] The figures shown herein are not necessarily drawn to scale, with some components and features being exaggerated for clarity.

[0023] As summarized above and as described in further detail below, in accordance with the various embodiments of the present disclosure, there is provided a method and system for positioning a controller unit within a transmission range for close proximity communication, transmitting one or more predefined close proximity commands, and receiving a response packet in response to the transmitted one or more predefined close proximity commands. For example, in one aspect, close proximity communication includes short range wireless communication between communication components or devices, where the communication range is limited to about 10 inches or less, about 5 inches or less, or about 2 inches or less, or other suitable, short range distance between the devices. The close proximity wireless communication in certain embodiments includes a bi-directional communication where a command sending communication device, when positioned within the short communication range or in close proximity to the command receiving communication device, is configured to transmit one or more commands to the command receiving communication device (for example, when a user activates or actuates a transmit command button or switch). In response, the command receiving communication device may be configured to perform one or more routines associated with the received command, and/or return or send back a response data packet or signal to the command sending communication device. Example of such functions and or commands may include, but not limted to activation of certain functions or routines such as analyte related data processing, and the like.

[0024] FIG. **1** illustrates a data monitoring and management system such as, for example, analyte (e.g., glucose) monitoring system **100** in accordance with one embodiment of the present disclosure. The subject invention is further described primarily with respect to a glucose monitoring system for convenience and such description is in no way intended to limit the scope of the invention. It is to be understood that the analyte monitoring system may be configured to monitor a variety of analytes, e.g., lactate, and the like.

[0025] Analytes that may be monitored include, for example, acetyl choline, amylase, bilirubin, cholesterol, chorionic gonadotropin, creatine kinase (e.g., CK-MB), creatine, DNA, fructosamine, glucose, glutamine, growth hormones, hormones, ketones, lactate, peroxide, prostate-specific antigen, prothrombin, RNA, thyroid stimulating hormone, and troponin. The concentration of drugs, such as, for example, antibiotics (e.g., gentamicin, vancomycin, and the like), digitoxin, digoxin, drugs of abuse, theophylline, and warfarin, may also be monitored. More than one analyte may be monitored by a single system, e.g. a single analyte sensor.

[0026] The analyte monitoring system **100** includes a sensor unit **101**, a transmitter unit **102** coupleable to the sensor unit **101**, and a primary receiver unit **104** which is configured to communicate with the transmitter unit **102** via a bi-directional communication link **103**. The primary receiver unit **104** may be further configured to transmit data to a data processing terminal **105** for evaluating the data received by the primary receiver unit **104**. Moreover, the data processing terminal **105** in one embodiment may be configured to receive data directly from the transmitter unit **102** via a communication link which may optionally be configured for bi-directional communication. Accordingly, transmitter unit **102** and/or receiver unit **104** may include a transceiver.

[0027] Also shown in FIG. **1** is an optional secondary receiver unit **106** which is operatively coupled to the communication link **103** and configured to receive data transmitted from the transmitter unit **102**. Moreover, as shown in the Figure, the secondary receiver unit **106** is configured to communicate with the primary receiver unit **104** as well as the data processing terminal **105**. Indeed, the secondary receiver unit **106** may be configured for bi-directional wireless communication with each or one of the primary receiver unit **104** and the data processing terminal **105**. As discussed in further detail below, in one embodiment of the present disclosure, the secondary receiver unit **106** may be configured to include a limited number of functions and features as compared with the primary receiver unit **104**. As such, the secondary receiver unit **106** may be configured substantially in a smaller compact housing or embodied in a device such as a wrist watch, pager, mobile phone, PDA, for example. Alternatively, the secondary receiver unit **106** may be configured with the same or substantially similar functionality as the primary receiver unit **104**. The receiver unit may be configured to be used in conjunction with a docking cradle unit, for example for one or more of the following or other functions: placement by bedside, for re-charging, for data management, for night time monitoring, and/or bi-directional communication device.

[0028] In one aspect sensor unit **101** may include two or more sensors, each configured to communicate with trans-

mitter unit **102**. Furthermore, while only one, transmitter unit **102**, communication link **103**, and data processing terminal **105** are shown in the embodiment of the analyte monitoring system **100** illustrated in FIG. **1**. However, it will be appreciated by one of ordinary skill in the art that the analyte monitoring system **100** may include one or more sensors, multiple transmitter units **102**, communication links **103**, and data processing terminals **105**. Moreover, within the scope of the present disclosure, the analyte monitoring system **100** may be a continuous monitoring system, or semi-continuous, or a discrete monitoring system. In a multi-component environment, each device is configured to be uniquely identified by each of the other devices in the system so that communication conflict is readily resolved between the various components within the analyte monitoring system **100**.

[0029] In one embodiment of the present disclosure, the sensor unit **101** is physically positioned in or on the body of a user whose analyte level is being monitored. The sensor unit **101** may be configured to continuously sample the analyte level of the user and convert the sampled analyte level into a corresponding data signal for transmission by the transmitter unit **102**. In certain embodiments, the transmitter unit **102** may be physically coupled to the sensor unit **101** so that both devices are integrated in a single housing and positioned on the user's body. The transmitter unit **102** may perform data processing such as filtering and encoding on data signals and/or other functions, each of which corresponds to a sampled analyte level of the user, and in any event transmitter unit **102** transmits analyte information to the primary receiver unit **104** via the communication link **103**. Examples of such integrated sensor and transmitter units can be found in, among others, U.S. patent application Ser. No. 12/698,124, incorporated herein by reference.

[0030] In one embodiment, the analyte monitoring system **100** is configured as a one-way RF communication path from the transmitter unit **102** to the primary receiver unit **104**. In such embodiment, the transmitter unit **102** transmits the sampled data signals received from the sensor unit **101** without acknowledgement from the primary receiver unit **104** that the transmitted sampled data signals have been received. For example, the transmitter unit **102** may be configured to transmit the encoded sampled data signals at a fixed rate (e.g., at one minute intervals) after the completion of the initial power on procedure. Likewise, the primary receiver unit **104** may be configured to detect such transmitted encoded sampled data signals at predetermined time intervals. Alternatively, the analyte monitoring system **100** may be configured with a bi-directional RF (or otherwise) communication between the transmitter unit **102** and the primary receiver unit **104**.

[0031] Additionally, in one aspect, the primary receiver unit **104** may include two sections. The first section is an analog interface section that is configured to communicate with the transmitter unit **102** via the communication link **103**. In one embodiment, the analog interface section may include an RF receiver and an antenna for receiving and amplifying the data signals from the transmitter unit **102**, which are thereafter, demodulated with a local oscillator and filtered through a band-pass filter. The second section of the primary receiver unit **104** is a data processing section which is configured to process the data signals received from the transmitter unit **102** such as by performing data decoding, error detection and correction, data clock generation, and data bit recovery.

[0032] In operation, upon completing the power-on procedure, the primary receiver unit **104** is configured to detect the presence of the transmitter unit **102** within its range based on, for example, the strength of the detected data signals received from the transmitter unit **102** and/or a predetermined transmitter identification information. Upon successful synchronization with the corresponding transmitter unit **102**, the primary receiver unit **104** is configured to begin receiving from the transmitter unit **102** data signals corresponding to the user's detected analyte level. More specifically, the primary receiver unit **104** in one embodiment is configured to perform synchronized time hopping with the corresponding synchronized transmitter unit **102** via the communication link **103** to obtain the user's detected analyte level.

[0033] Referring again to FIG. **1**, the data processing terminal **105** may include a personal computer, a portable computer such as a laptop or a handheld device (e.g., personal digital assistants (PDAs)), and the like, each of which may be configured for data communication with the receiver via a wired or a wireless connection. Additionally, the data processing terminal **105** may further be connected to a data network (not shown) for storing, retrieving and updating data corresponding to the detected analyte level of the user.

[0034] Within the scope of the present disclosure, the data processing terminal **105** may include an infusion device such as an insulin infusion pump (external or implantable) or the like, which may be configured to administer insulin to patients, and which may be configured to communicate with the receiver unit **104** for receiving, among others, the measured analyte level. Alternatively, the receiver unit **104** may be configured to integrate or otherwise couple to an infusion device therein so that the receiver unit **104** is configured to administer insulin therapy to patients, for example, for administering and modifying basal profiles, as well as for determining appropriate boluses for administration based on, among others, the detected analyte levels received from the transmitter unit **102**.

[0035] Additionally, the transmitter unit **102**, the primary receiver unit **104** and the data processing terminal **105** may each be configured for bi-directional wireless communication such that each of the transmitter unit **102**, the primary receiver unit **104** and the data processing terminal **105** may be configured to communicate (that is, transmit data to and receive data from) with each other via the wireless communication link **103**. More specifically, the data processing terminal **105** may in one embodiment be configured to receive data directly from the transmitter unit **102** via the communication link **103**, where the communication link **103**, as described above, may be configured for bi-directional communication.

[0036] In this embodiment, the data processing terminal **105** which may include an insulin pump, may be configured to receive the analyte signals from the transmitter unit **102**, and thus, incorporate the functions of the receiver **104** including data processing for managing the patient's insulin therapy and analyte monitoring. In one embodiment, the communication link **103** may include one or more of an RF communication protocol, an infrared communication protocol, a Bluetooth® enabled communication protocol, an 802.11x wireless communication protocol, or an equivalent wireless communication protocol which would allow secure, wireless communication of several units (for example, per HIPPA requirements) while avoiding potential data collision and interference.

[0037] FIG. **2** is a block diagram of the transmitter of the data monitoring and detection system shown in FIG. **1** in accordance with one embodiment of the present disclosure. Referring to the Figure, the transmitter unit **102** in one embodiment includes an analog interface **201** configured to communicate with the sensor unit **101** (FIG. **1**), a user input **202**, and a temperature measurement section **203**, each of which is operatively coupled to a transmitter processor **204** such as a central processing unit (CPU). As can be seen from FIG. **2**, there are provided four contacts, three of which are electrodes—work electrode (W) **210**, guard contact (G) **211**, reference electrode (R) **212**, and counter electrode (C) **213**, each operatively coupled to the analog interface **201** of the transmitter unit **102** for connection to the sensor unit **101** (FIG. **1**). In one embodiment, each of the work electrode (W) **210**, guard contact (G) **211**, reference electrode (R) **212**, and counter electrode (C) **213** may be made using a conductive material that is either printed or etched or ablated, for example, such as carbon which may be printed, or a metal such as a metal foil (e.g., gold) or the like, which may be etched or ablated or otherwise processed to provide one or more electrodes. Fewer or greater electrodes and/or contact may be provided in certain embodiments.

[0038] Further shown in FIG. **2** are a transmitter serial communication section **205** and an RF transmitter **206**, each of which is also operatively coupled to the transmitter processor **204**. Moreover, a power supply **207** such as a battery is also provided in the transmitter unit **102** to provide the necessary power for the transmitter unit **102**. In certain embodiments, the power supply **207** also provides the power necessary to power the sensor **101**. In other embodiments, the sensor is a self-powered sensor, such as the sensor described in U.S. patent application Ser. No. 12/393,921, incorporated herein by reference. Additionally, as can be seen from the Figure, clock **208** is provided to, among others, supply real time information to the transmitter processor **204**.

[0039] In one embodiment, a unidirectional input path is established from the sensor unit **101** (FIG. **1**) and/or manufacturing and testing equipment to the analog interface **201** of the transmitter unit **102**, while a unidirectional output is established from the output of the RF transmitter **206** of the transmitter unit **102** for transmission to the primary receiver unit **104** (FIG. **1**). In this manner, a data path is shown in FIG. **2** between the aforementioned unidirectional input and output via a dedicated link **209** from the analog interface **201** to serial communication section **205**, thereafter to the processor **204**, and then to the RF transmitter **206**. As such, in one embodiment, via the data path described above, the transmitter unit **102** is configured to transmit to the primary receiver unit **104**, via the communication link **103** (FIG. **1**), processed and encoded data signals received from the sensor unit **101**. Additionally, the unidirectional communication data path between the analog interface **201** and the RF transmitter **206** discussed above allows for the configuration of the transmitter unit **102** for operation upon completion of the manufacturing process as well as for direct communication for diagnostic and testing purposes.

[0040] As discussed above, the transmitter processor **204** is configured to transmit control signals to the various sections of the transmitter unit **102** during the operation of the transmitter unit **102**. In one embodiment, the transmitter processor **204** also includes a memory (not shown) for storing data such as the identification information for the transmitter unit **102**, as well as the data signals received from the sensor unit **101** (FIG. **1**). The stored information may be retrieved and processed for transmission to the primary receiver unit **104** under the control of the transmitter processor **204**. Furthermore, the power supply **207** may include a commercially available battery, which may be a rechargeable battery.

[0041] In certain embodiments, the transmitter unit **102** is also configured such that the power supply section **207** is capable of providing power to the transmitter for a minimum of about three months of continuous operation, e.g., after having been stored for about eighteen months such as stored in a low-power (non-operating) mode. In one embodiment, this may be achieved by the transmitter processor **204** operating in low power modes in the non-operating state, for example, drawing no more than approximately 1 μA of current. Indeed, in one embodiment, a step during the manufacturing process of the transmitter unit **102** may place the transmitter unit **102** in the lower power, non-operating state (i.e., post-manufacture sleep mode). In this manner, the shelf life of the transmitter unit **102** may be significantly improved. Moreover, as shown in FIG. **2**, while the power supply unit **207** is shown as coupled to the processor **204**, and as such, the processor **204** is configured to provide control of the power supply unit **207**, it should be noted that within the scope of the present disclosure, the power supply unit **207** is configured to provide the necessary power to each of the components of the transmitter unit **102** shown in FIG. **2**.

[0042] Referring back to FIG. **2**, the power supply section **207** of the transmitter unit **102** in one embodiment may include a rechargeable battery unit that may be recharged by a separate power supply recharging unit (for example, provided in the receiver unit **104**) so that the transmitter unit **102** may be powered for a longer period of usage time. Moreover, in one embodiment, the transmitter unit **102** may be configured without a battery in the power supply section **207**, in which case the transmitter unit **102** may be configured to receive power from an external power supply source (for example, a battery) as discussed in further detail below.

[0043] Referring yet again to FIG. **2**, the temperature measurement section **203** of the transmitter unit **102** is configured to monitor the temperature of the skin near the sensor insertion site. The temperature reading is used to adjust the analyte readings obtained from the analog interface **201**. In certain embodiments, the RF transmitter **206** of the transmitter unit **102** may be configured for operation in the frequency band of approximately 315 MHz to approximately 322 MHz, for example, in the United States. In certain embodiments, the RF transmitter **206** of the transmitter unit **102** may be configured for operation in the frequency band of approximately 400 MHz to approximately 470 MHz. Further, in one embodiment, the RF transmitter **206** is configured to modulate the carrier frequency by performing Frequency Shift Keying and Manchester encoding. In one embodiment, the data transmission rate is about 19,200 symbols per second, with a minimum transmission range for communication with the primary receiver unit **104**.

[0044] Referring yet again to FIG. **2**, also shown is a leak detection circuit **214** coupled to the guard electrode (G) **211** and the processor **204** in the transmitter unit **102** of the data monitoring and management system **100**. The leak detection circuit **214** in accordance with one embodiment of the present disclosure may be configured to detect leakage current in the sensor unit **101** to determine whether the measured sensor data are corrupt or whether the measured data from the sensor **101** is accurate. Exemplary analyte systems that may be

employed are described in, for example, U.S. Pat. Nos. 6,134,461, 6,175,752, 6,121,611, 6,560,471, 6,746,582, and elsewhere, the disclosure of each of which are incorporated by reference for all purposes.

[0045] FIG. **3** is a block diagram of the receiver/monitor unit of the data monitoring and management system shown in FIG. **1** in accordance with one embodiment of the present disclosure. Referring to FIG. **3**, the primary receiver unit **104** includes an analyte test strip, e.g., blood glucose test strip, interface **301**, an RF receiver **302**, an input **303**, a temperature monitor section **304**, and a clock **305**, each of which is operatively coupled to a receiver processor **307**. As can be further seen from the Figure, the primary receiver unit **104** also includes a power supply **306** operatively coupled to a power conversion and monitoring section **308**. Further, the power conversion and monitoring section **308** is also coupled to the receiver processor **307**. Moreover, also shown are a receiver serial communication section **309**, and an output **310**, each operatively coupled to the receiver processor **307**.

[0046] In one embodiment, the test strip interface **301** includes a glucose level testing portion to receive a manual insertion of a glucose test strip, and thereby determine and display the glucose level of the test strip on the output **310** of the primary receiver unit **104**. This manual testing of glucose may be used to calibrate the sensor unit **101** or otherwise. The RF receiver **302** is configured to communicate, via the communication link **103** (FIG. **1**) with the RF transmitter **206** (FIG. **2**) of the transmitter unit **102**, to receive encoded data signals from the transmitter unit **102** for, among others, signal mixing, demodulation, and other data processing. The input **303** of the primary receiver unit **104** is configured to allow the user to enter information into the primary receiver unit **104** as needed. In one aspect, the input **303** may include one or more keys of a keypad, a touch-sensitive screen, or a voice-activated input command unit. The temperature monitor section **304** is configured to provide temperature information of the primary receiver unit **104** to the receiver processor **307**, while the clock **305** provides, among others, real time information to the receiver processor **307**.

[0047] Each of the various components of the primary receiver unit **104** shown in FIG. **3** is powered by the power supply **306** which, in one embodiment, includes a battery. Furthermore, the power conversion and monitoring section **308** is configured to monitor the power usage by the various components in the primary receiver unit **104** for effective power management and to alert the user, for example, in the event of power usage which renders the primary receiver unit **104** in sub-optimal operating conditions. An example of such sub-optimal operating condition may include, for example, operating the vibration output mode (as discussed below) for a period of time thus substantially draining the power supply **306** while the processor **307** (thus, the primary receiver unit **104**) is turned on. Moreover, the power conversion and monitoring section **308** may additionally be configured to include a reverse polarity protection circuit such as a field effect transistor (FET) configured as a battery activated switch.

[0048] The serial communication section **309** in the primary receiver unit **104** is configured to provide a bi-directional communication path from the testing and/or manufacturing equipment for, among others, initialization, testing, and configuration of the primary receiver unit **104**. Serial communication section **104** can also be used to upload data to a computer, such as time-stamped blood glucose data. The communication link with an external device (not shown) can be made, for example, by cable, infrared (IR) or RF link. The output **310** of the primary receiver unit **104** is configured to provide, among others, a graphical user interface (GUI) such as a liquid crystal display (LCD) for displaying information. Additionally, the output **310** may also include an integrated speaker for outputting audible signals as well as to provide vibration output as commonly found in handheld electronic devices, such as mobile telephones presently available. In a further embodiment, the primary receiver unit **104** also includes an electro-luminescent lamp configured to provide backlighting to the output **310** for output visual display in dark ambient surroundings.

[0049] Referring back to FIG. **3**, the primary receiver unit **104** in one embodiment may also include a storage section such as a programmable, non-volatile memory device as part of the processor **307**, or provided separately in the primary receiver unit **104**, operatively coupled to the processor **307**. The processor **307** may be configured to synchronize with a transmitter, e.g., using Manchester decoding or the like, as well as error detection and correction upon the encoded data signals received from the transmitter unit **102** via the communication link **103**.

[0050] Additional description of the RF communication between the transmitter **102** and the primary receiver **104** (or with the secondary receiver **106**) that may be employed in embodiments of the subject invention is disclosed in pending application Ser. No. 11/060,365 filed Feb. 16, 2005 entitled "Method and System for Providing Data Communication in Continuous Glucose Monitoring and Management System" the disclosure of which is incorporated herein by reference for all purposes.

[0051] Referring to the Figures, in one embodiment, the transmitter **102** (FIG. **1**) may be configured to generate data packets for periodic transmission to one or more of the receiver units **104**, **106**, where each data packet includes in one embodiment two categories of data—urgent data and non-urgent data. For example, urgent data such as for example glucose data from the sensor and/or temperature data associated with the sensor may be packed in each data packet in addition to non-urgent data, where the non-urgent data is rolled or varied with each data packet transmission.

[0052] That is, the non-urgent data is transmitted at a timed interval so as to maintain the integrity of the analyte monitoring system without being transmitted over the RF communication link with each data transmission packet from the transmitter **102**. In this manner, the non-urgent data, for example the data that is not time sensitive, may be periodically transmitted (and not with each data packet transmission) or broken up into predetermined number of segments and sent or transmitted over multiple packets, while the urgent data is transmitted substantially in its entirety with each data transmission.

[0053] Referring again to the Figures, upon receiving the data packets from the transmitter **102**, the one or more receiver units **104**, **106** may be configured to parse the received data packet to separate the urgent data from the non-urgent data, and also, may be configured to store the urgent data and the non-urgent data, e.g., in a hierarchical manner. In accordance with the particular configuration of the data packet or the data transmission protocol, more or less data may be transmitted as part of the urgent data, or the non-urgent rolling data. That is, within the scope of the present disclosure, the specific data packet implementation such as the number of bits per packet, and the like, may vary

based on, among others, the communication protocol, data transmission time window, and so on.

[0054] In an exemplary embodiment, different types of data packets may be identified accordingly. For example, identification in certain exemplary embodiments may include—(1) single sensor, one minute of data, (2) two or multiple sensors, (3) dual sensor, alternate one minute data, and (4) response packet. For single sensor one minute data packet, in one embodiment, the transmitter **102** may be configured to generate the data packet in the manner, or similar to the manner, shown in Table 1 below.

TABLE 1

Single sensor, one minute of data

Number of Bits	Data Field
8	Rolling-Data-1
12	AUX Thermistor 1
12	AUX Thermistor 2
8	Transmit Time
12	AUX Counter
14	Sensor1 Current Data
14	Sensor1 Historic Data
8	Transmitter Status

[0055] As shown in Table 1 above, the transmitter data packet in one embodiment may include 8 bits of rolling data, 12 bits of auxiliary counter data, 12 bits of auxiliary thermistor **1** data, 12 bits of auxiliary thermistor **2** data, 14 bits of current sensor data, 14 bits of preceding sensor data, 8 bits of transmit time data, and 8 bits of transmitter status data. In one embodiment of the present disclosure, the data packet generated by the transmitter for transmission over the RF communication link may include all or some of the data shown above in Table 1.

[0056] Referring back, the 14 bits of the current sensor data provides the real time or current sensor data associated with the detected analyte level, while the 14 bits of the sensor historic or preceding sensor data includes the sensor data associated with the detected analyte level one minute ago. In this manner, in the case where the receiver unit **104**, **106** drops or fails to successfully receive the data packet from the transmitter **102** in the minute by minute transmission, the receiver unit **104**, **106** may be able to capture the sensor data of a prior minute transmission from a subsequent minute transmission.

[0057] Referring again to Table 1, the auxiliary data in one embodiment may include one or more of the patient's skin temperature data, a temperature gradient data, reference data, and counter electrode voltage. The transmitter status field may include status data that is configured to indicate corrupt data for the current transmission (for example, if shown as BAD status (as opposed to GOOD status which indicates that the data in the current transmission is not corrupt)). Furthermore, the rolling data field is configured to include the non-urgent data, and in one embodiment, may be associated with the time-hop sequence number. In addition, the transmitter time field in one embodiment includes a protocol value that is configured to start at zero and is incremented by one with each data packet. In one aspect, the transmitter time data may be used to synchronize the data transmission window with the receiver unit **104**, **106** (FIG. **1**), and also, provide an index for the rolling data field.

[0058] In a further embodiment, the transmitter data packet may be configured to provide or transmit analyte sensor data from two or more independent analyte sensors. The sensors may relate to the same or different analyte or property. In such a case, the data packet from the transmitter **102** may be configured to include 14 bits of the current sensor data from both sensors in the embodiment in which 2 sensors are employed, as shown in Table 2 below. In this case, the data packet does not include the immediately preceding sensor data in the current data packet transmission. Instead, a second analyte sensor data is transmitted with a first analyte sensor data.

TABLE 2

Dual sensor data

Number of Bits	Data Field
8	Rolling-Data-1
12	AUX Thermistor 1
12	AUX Thermistor 2
8	Transmit Time
12	AUX Counter
14	Sensor1 Current Data
14	Sensor2 Current Data
8	Transmitter Status

[0059] In a further embodiment, the transmitter data packet may be alternated with each transmission between two analyte sensors, for example, alternating between the data packet shown in Table 3 and Table 4 below.

TABLE 3

Sensor Data Packet Alternate 1

Number of Bits	Data Field
8	Rolling-Data-1
12	AUX Thermistor 1
12	AUX Thermistor 2
8	Transmit Time
12	AUX Counter
14	Sensor1 Current Data
14	Sensor1 Historic Data
8	Transmitter Status

TABLE 4

Sensor Data Packet Alternate 2

Number of Bits	Data Field
8	Rolling-Data-1
12	AUX Thermistor 1
12	AUX Thermistor 2
8	Transmit Time
12	AUX Counter
14	Sensor1 Current Data
14	Sensor2 Current Data
8	Transmitter Status

[0060] As shown above in reference to Tables 3 and 4, the minute by minute data packet transmission from the transmitter **102** (FIG. **1**) in one embodiment may alternate between the data packet shown in Table 3 and the data packet shown in Table 4. More specifically, the transmitter **102** may be configured in one embodiment to transmit the current sensor data of the first sensor and the preceding sensor data of the first sensor (Table 3), as well as the rolling data, and further, at the subsequent transmission, the transmitter **102** may be config-

ured to transmit the current sensor data of the first and the second sensor in addition to the rolling data (Table 4).

[0061] In one embodiment, the rolling data transmitted with each data packet may include a sequence of various predetermined types of data that are considered not-urgent or not time sensitive. That is, in one embodiment, the following list of data shown in Table 5 may be sequentially included in the 8 bits of transmitter data packet, and not transmitted with each data packet transmission of the transmitter (for example, with each 60 second data transmission from the transmitter **102**).

TABLE 5

Rolling Data		
Time Slot	Bits	Rolling-Data
0	8	Counter, Ref-R
1	8	Counter
2	8	Counter
3	8	Sensor Count
4	8	Mode
5	8	Glucose1 Slope
6	8	Glucose2 Slope
7	8	Ref-R

[0062] As can be seen from Table 5 above, in one embodiment, a sequence of rolling data are appended or added to the transmitter data packet with each data transmission time slot. In one embodiment, there may be 256 time slots for data transmission by the transmitter **102** (FIG. **1**), and where, each time slot is separated by approximately 60 second interval. For example, referring to the Table 5 above, the data packet in transmission time slot **0** (zero) may include operational mode data (Mode) as the rolling data that is appended to the transmitted data packet. At the subsequent data transmission time slot (for example, approximately 60 seconds after the initial time slot (**0**)), the transmitted data packet may include the analyte sensor **1** calibration factor information (Glucose**1** slope) as the rolling data. In this manner, with each data transmission, the rolling data may be updated over the 256 time slot cycle.

[0063] Referring again to Table 5, each rolling data field is described in further detail for various embodiments. For example, the Mode data may include information related to the different operating modes such as, but not limited to, the data packet type, the type of battery used, diagnostic routines, single sensor or multiple sensor input, or type of data transmission (RF communication link or other data link such as serial connection). Further, the Glucose**1**-slope data may include an 8-bit scaling factor or calibration data for first sensor (scaling factor for sensor **1** data), while Glucose**2**-slope data may include an 8-bit scaling factor or calibration data for the second analyte sensor (in the embodiment including more than one analyte sensors).

[0064] In addition, the Ref-R data may include 12 bits of on-board reference resistor used to calibrate the temperature measurement in the thermistor circuit (where 8 bits are transmitted in time slot **3**, and the remaining 4 bits are transmitted in time slot **4**), and the 20-bit counter data may be separately transmitted in three time slots (for example, in time slot **4**, time slot **5** and time slot **6**) to add up to 20 bits. In one embodiment, the counter may be configured to count each occurrence of the data transmission (for example, a packet transmission at approximately 60 second intervals) and may be incremented by a count of one (1).

[0065] In one aspect, the counter is stored in a nonvolatile memory of the transmitter unit **102** (FIG. **1**) and may be used to ascertain the power supply status information such as, for example, the estimated battery life remaining in the transmitter unit **102**. That is, with each sensor replacement, the counter is not reset, but rather, continues the count with each replacement of the sensor unit **101** to establish contact with the transmitter unit **102** such that, over an extended usage time period of the transmitter unit **102**, it may be possible to determine, based on the count information, the amount of consumed battery life in the transmitter unit **102**, and also, an estimated remaining life of the battery in the transmitter unit **102**.

[0066] Referring to Table 5 above, the transmitted rolling data may also include 8 bits of sensor count information (for example, transmitted in time slot **7**). The 8 bit sensor counter is incremented by one each time a new sensor unit is connected to the transmitter unit. The ASIC configuration of the transmitter unit (or a microprocessor based transmitter configuration or with discrete components) may be configured to store in a nonvolatile memory unit the sensor count information and transmit it to the primary receiver unit **104** (for example). In turn, the primary receiver unit **104** (and/or the secondary receiver unit **106**) may be configured to determine whether it is receiving data from the transmitter unit that is associated with the same sensor unit (based on the sensor count information), or from a new or replaced sensor unit (which will have a sensor count incremented by one from the prior sensor count). In this manner, in one aspect, the receiver unit (primary or secondary) may be configured to prevent reuse of the same sensor unit by the user based on verifying the sensor count information associated with the data transmission received from the transmitter unit **102**. In addition, in a further aspect, user notification may be associated with one or more of these parameters. Further, the receiver unit (primary or secondary) may be configured to detect when a new sensor has been inserted, and thus prevent erroneous application of one or more calibration parameters determined in conjunction with a prior sensor, that may potentially result in false or inaccurate analyte level determination based on the sensor data.

[0067] FIG. **4** is a flowchart illustrating a data packet procedure including rolling data for transmission in accordance with one embodiment of the present disclosure. Referring to FIG. **4**, in one embodiment, a counter is initialized (for example, to T=0) (**410**). Thereafter the associated rolling data is retrieved from memory device, for example (**420**), and also, the time sensitive or urgent data is retrieved (**430**). In one embodiment, the retrieval of the rolling data (**420**) and the retrieval of the time sensitive data (**430**) may be retrieved at substantially the same time.

[0068] Referring back to FIG. **4**, with the rolling data and the time sensitive data, for example, the data packet for transmission is generated (**440**), and upon transmission, the counter is incremented by one (**450**) and the routine returns to retrieval of the rolling data (**420**). In this manner, in one embodiment, the urgent time sensitive data as well as the non-urgent data may be incorporated in the same data packet and transmitted by the transmitter **102** (FIG. **1**) to a remote device such as one or more of the receivers **104**, **106**. Furthermore, as discussed above, the rolling data may be updated at

a predetermined time interval which is longer than the time interval for each data packet transmission from the transmitter **102** (FIG. **1**).

[0069] FIG. **5** is a flowchart illustrating data processing of the received data packet including the rolling data in accordance with one embodiment of the present disclosure. Referring to FIG. **5**, when the data packet is received (**510**) (for example, by one or more of the receivers **104**, **106**, in one embodiment) the received data packet is parsed so that the urgent data may be separated from the not-urgent data (stored in, for example, the rolling data field in the data packet) (**520**). Thereafter the parsed data is suitably stored in an appropriate memory or storage device (**530**).

[0070] In one or more embodiments of the present disclosure, data transmission errors may occur in the data packets received by a receiver unit, for example, by the primary receiver unit **104** (FIG. **1**). In certain aspects, failure to detect a corrupt data packet resulting from, for example, a transmission error, can have a substantial effect. For example, in the case of calibration data, an undetected corrupt data packet may include a value which will be applied to every data point to be calibrated. As such, the effect of the single corrupted data value will be multiplied and thus its undesirable effect magnified. Thus, it is desirable to have an approach to detect corrupt data packets, including data packets related to calibration data, so that subsequent corrective measures may be taken.

[0071] FIG. **6** is a flow chart illustrating error detection of rolling data of a received data packet in accordance with one embodiment of the present disclosure. Referring to FIG. **6**, a receiver unit, for example the primary receiver unit **104** (FIG. **1**) in one embodiment may be configured to receive a data packet (**610**) including rolling data from a transmitter **102** (FIG. **1**). The data packet is parsed into rolling data and time sensitive data (**620**). The received rolling data is then compared to previously stored rolling data (**630**) to check if the received rolling data matches the previously stored rolling data (**640**).

[0072] In one aspect, if the received rolling data matches the stored rolling data, the received rolling data is accepted (**650**) as valid data. The valid received rolling data is stored (**660**) for comparison to the next received rolling data. If the received rolling data does not match the stored rolling data, the data is not accepted as valid, but the received rolling data is nevertheless stored (**660**) for comparison to the next received rolling data in case the received rolling data is not an error, but is a valid change in the rolling data. As such, if the received rolling data is not an error, but is a valid change in the rolling data, the subsequently received rolling data will match the newly stored rolling data, and the receiver unit will determine the rolling data as valid.

[0073] In other embodiments, the error detection of rolling data may require more than two consecutive matching rolling data values before the receiver unit recognizes the rolling data as valid. FIG. **7** is a flow chart illustrating an alternative error detection of rolling data of a received data packet. Referring to FIG. **7**, a receiver unit, for example the primary receiver unit **104** (FIG. **1**) receives a data packet (**710**) including rolling data. The data packet is parsed into rolling data and time sensitive data (**720**). The received rolling data is then compared to previously stored rolling data (**730**) to check if the received rolling data matches the previously stored rolling data (**740**). If the received rolling data matches the stored rolling data, a counter is incremented (**750**) by one. The counter is checked against or compared to a predetermined threshold value (**760**), for example 2, 3, or 4 (or any other suitable value), and if the counter is equal to or greater than the threshold value, the rolling data is accepted as valid (**770**). If the received rolling data does not match the stored rolling data, the stored rolling data value is replaced with the received rolling data value (**780**) and the counter is initialized back to one (**790**).

[0074] The threshold value for the counter indicating the number of consecutive times the rolling data matches the previous value may be any number of values. The higher the threshold, the higher the probability of detecting a corruption in the received rolling data before the received rolling data is accepted as valid. However, if a threshold value is configured as too high a value, then the rolling data may legitimately change before the receiver unit determines the received rolling data is valid.

[0075] The rolling data included in each transmitted data packet, in one or more embodiment, may be only a portion of a set of rolling data. For example, the rolling data may comprise calibration data, wherein the calibration data is comprised of 8 bytes of data. In one embodiment, each data packet contains 1 byte (8 bits) of rolling data and therefore, to transmit the entire 8 bytes of calibration data, 1 byte at a time is transmitted via 8 consecutive data packets. FIG. **8** is a flow chart illustrating an error detection of rolling data from a plurality of data packets in accordance with one embodiment of the present disclosure.

[0076] Referring to FIG. **8**, a receiver unit, for example the primary receiver unit **104** (FIG. **1**) receives a first data packet (**810**) including rolling data, which may be a first byte of calibration data. The data packet is parsed into rolling data and time sensitive data (**820**). The received first byte of calibration data is then compared to previously stored first byte of calibration data (**830**) to check if the received first byte of calibration data matches the previously stored first byte of calibration data (**840**). If the received first byte of calibration data matches the stored first byte of calibration data, a first element or block of a counter array is incremented (**850**) by one. The counter array is comprised of a predetermined number of elements or blocks corresponding to the number of bytes of data associated with the received rolling data. For example, if the rolling data is calibration data, and the calibration data consists of 8 bytes, the counter array includes 8 elements.

[0077] Referring back to FIG. **8**, each element of the counter array is checked against or compared to a predetermined threshold value (**860**), for example 2, 3, or 4 (or any other suitable value), and if each element of the counter array is equal to or greater than the threshold value, the calibration data is accepted as valid (**870**). If not all the elements of the counter array are equal to or greater than the threshold value, the calibration data is not accepted as valid since all bytes of the calibration data must be verified as non-corrupt before the calibration is considered valid. The threshold value for each element of the counter array, which indicates the number of consecutive times each byte of the calibration data matches the previous stored byte of calibration data, may be any number of values. The higher the threshold, the higher the probability of detecting a corruption in the received calibration data before the received calibration data is accepted as valid. However, if a threshold value is configured as too high a value, then the calibration data may legitimately change before the receiver unit determines the received calibration

data is valid. In one aspect, once a received calibration data has been accepted as valid, the receiver unit may use the valid calibration data for comparison with received calibration data.

[0078] Still referring to FIG. **8**, if the received first byte of calibration data does not match the stored first byte of calibration data, the stored first byte of calibration data is replaced with the received first byte of calibration data (**880**) and the first element of the counter array is initialized back to one (**890**). The process is repeated with each consecutive byte of calibration data. Each data packet containing 1 byte of calibration data is transmitted at periodic intervals, for example every 1 minute. In other embodiments, more than 1 byte, for example 2 bytes, of calibration data may be transmitted in each data packet. In still other embodiments, less than 1 byte, for example 4 bits, of calibration data may be transmitted in each data packet and therefore, more than 8 data packets are needed to transmit the entire calibration data. As such, the counter array is configured with enough elements to keep track of all received data bits of calibration data for determination of valid data transmission.

[0079] In other embodiments, if multiple types of rolling data are being transmitted, for example calibration data from a first and second sensors, the receiver unit may include a counter array for each type of rolling data. Alternatively, the receiver unit may include only a single counter array, wherein each element or set of elements is configured for association with each type of rolling data.

[0080] In further embodiments, the received rolling data may only be required to be within a percentage of the stored rolling data. For example, the received rolling data may be considered valid as long as it is ±10% or less of the stored rolling data. In other embodiments, the received rolling data must be within ±5% or less, for example, ±3% or ±1%, of the stored rolling data before being considered as valid.

[0081] In other embodiments, the error detection methods, devices, and systems for detecting error detection in the rolling (non-urgent) data of a received data packet may also be applied to the time sensitive (urgent) data of a received data packet. As such, the time sensitive data may be compared to previously stored time sensitive data, and is only accepted as valid if the received time sensitive data is within a physiologically acceptable range with respect to the stored time sensitive data. For example, the received time sensitive data may only be accepted as valid if it is within ±30% or less, e.g. ±20%, ±10% or ±5%, of a stored time sensitive data.

[0082] In one aspect, the error detection methods described above may reduce the number of undetected errors in data packet transmissions. For example, the number of undetected errors in transmissions may be as few as 50×10^{-6} errors per corrupted data packet or less, such as 3.3×10^{-6} errors per corrupted data packet or less, such as 0.0025×10^{-6} errors per corrupted data packet.

[0083] In the manner described above, in accordance with one embodiment of the present disclosure, there is provided method and apparatus for separating non-urgent type data (for example, data associated with calibration) from urgent type data (for example, monitored analyte related data) to be transmitted over the communication link to minimize the potential burden or constraint on the available transmission time. More specifically, in one embodiment, non-urgent data may be separated from data that is required by the communication system to be transmitted immediately, and transmitted over the communication link together while maintaining a minimum transmission time window. In one embodiment, the non-urgent data may be parsed or broken up in to a number of data segments, and transmitted over multiple data packets. The time sensitive immediate data (for example, the analyte sensor data, temperature data, etc.), may be transmitted over the communication link substantially in its entirety with each data packet or transmission.

[0084] Additional description for transmission of urgent and non-urgent type data can be found in U.S. patent application Ser. No. 11/681,133 filed Mar. 1, 2007, entitled "Method and Apparatus for Providing Rolling Data in Communication Systems" and U.S. patent application Ser. No. 12/130,995 filed May 30, 2008, entitled "Close Proximity Communication Device and Methods", the disclosures of each of which are incorporated herein by reference for all purposes.

[0085] A method in one aspect may include receiving a data packet including time sensitive data and rolling data, comparing the received rolling data to a previously stored corresponding rolling data, incrementing a counter when the received rolling data is within a predetermined percentage of the previously stored rolling data, determining if the counter is greater than or equal to a predetermined threshold, and accepting the received rolling data as valid.

[0086] The data packet may be received via wireless communication.

[0087] The wireless communication may be radio frequency (RF) communication.

[0088] The counter may be incremented only when the received rolling data is equal to the previously stored rolling data.

[0089] The predetermined threshold may be two.

[0090] In one embodiment, the counter is an array.

[0091] Moreover, the received rolling data may be calibration data.

[0092] Calibration data may comprise 8 bytes of data, and the rolling data of the data packet may be 1 byte of the 8 bytes of calibration data.

[0093] In one aspect, each byte of the calibration data may correspond to an element of the counter array.

[0094] Incrementing the counter may comprise incrementing the corresponding element of the counter array.

[0095] In another aspect, determining if the counter is greater than or equal to a predetermined threshold may comprise determining if all the elements of the counter array are greater than or equal to a predetermined threshold.

[0096] Each element of the array may correspond to a type of rolling data.

[0097] Incrementing the counter may comprise incrementing the corresponding element of the counter array.

[0098] Furthermore the method may include replacing the previously stored rolling data with the received rolling data when the received rolling data is not within the predetermined percentage of the previously stored rolling data.

[0099] In one embodiment, an apparatus may include a receiver unit configured to receive a data packet including time sensitive data and rolling data, a memory operatively coupled to the receiver unit and configured to store a previous corresponding rolling data, a component configured to compare the received rolling data with the stored rolling data, and a counter configured to increment when the received rolling data is within a predetermined percentage of the stored rolling data.

[0100] The receiver unit may be a wireless receiver unit.

[0101] Furthermore, the wireless receiver unit may be a radio frequency (RF) communication receiver unit.

[0102] The counter may be configured to increment only when the received rolling data is equal to the stored rolling data.

[0103] The received rolling data may be accepted as valid when the counter is greater than or equal to a predetermined threshold.

[0104] In one aspect, the predetermined threshold may be two.

[0105] In one embodiment, the counter may be an array.

[0106] The received rolling data may be calibration data.

[0107] Calibration data may comprise 8 bytes of data, and the rolling data of the data packet may be 1 byte of the 8 bytes of calibration data.

[0108] Each byte of the calibration data may correspond to an element of the counter array.

[0109] Moreover, the corresponding element of the counter array may be configured to increment when the received rolling data is within a predetermined percentage of the stored rolling data.

[0110] The received rolling data may be accepted as valid when all the elements of the counter array are greater than or equal to a predetermined threshold.

[0111] One aspect may further include replacing the stored rolling data in the memory with the received rolling data when the received rolling data is not within the predetermined percentage of the previously stored rolling data.

[0112] In one embodiment, a data monitoring and management system may include a communication link, a transmitter operatively coupled to the communication link, the transmitter configured to transmit a data packet including time sensitive data and rolling data, and a receiver operatively coupled to the communication link, the receiver configured to receive the transmitted data packet, wherein the receiver is configured to determine if the received rolling data is valid by comparing the received rolling data to a previously stored corresponding rolling data, incrementing a counter when the received rolling data is within a predetermined percentage of the previously stored rolling data, and determining if the counter is greater than or equal to a predetermined threshold.

[0113] In one aspect, the communication link may be a wireless communication link.

[0114] In another aspect, the wireless communication link may be a radio frequency (RF) communication link.

[0115] Various other modifications and alterations in the structure and method of operation of this invention will be apparent to those skilled in the art without departing from the scope and spirit of the invention. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. It is intended that the following claims define the scope of the present disclosure and that structures and methods within the scope of these claims and their equivalents be covered thereby.

What is claimed is:

1. A method, comprising:

receiving a data packet including time sensitive data and rolling data;

comparing the received rolling data to a previously stored corresponding rolling data;

incrementing a counter when the received rolling data is within a predetermined percentage of the previously stored rolling data;

determining if the counter is greater than or equal to a predetermined threshold; and

accepting the received rolling data as valid.

2. The method of claim **1**, wherein the data packet is received via wireless communication.

3. The method of claim **2**, wherein the wireless communication is radio frequency (RF) communication.

4. The method of claim **1**, wherein the counter is incremented only when the received rolling data is equal to the previously stored rolling data.

5. The method of claim **1**, wherein the predetermined threshold is two.

6. The method of claim **1**, wherein the counter is an array.

7. The method of claim **5**, wherein the received rolling data is calibration data.

8. The method of claim **7**, wherein calibration data comprises 8 bytes of data, and the rolling data of the data packet is 1 byte of the 8 bytes of calibration data.

9. The method of claim **8**, wherein each byte of the calibration data corresponds to an element of the counter array.

10. The method of claim **9**, wherein incrementing the counter comprises incrementing the corresponding element of the counter array.

11. The method of claim **10**, wherein determining if the counter is greater than or equal to a predetermined threshold comprises determining if all the elements of the counter array are greater than or equal to a predetermined threshold.

12. The method of claim **11**, wherein the predetermined threshold is two.

13. The method of claim **6**, wherein each element of the array corresponds to a type of rolling data.

14. The method of claim **13**, wherein incrementing the counter comprises incrementing the corresponding element of the counter array.

15. The method of claim **1**, further comprising replacing the previously stored rolling data with the received rolling data when the received rolling data is not within the predetermined percentage of the previously stored rolling data.

16. An apparatus, comprising:

a receiver unit configured to receive a data packet including time sensitive data and rolling data;

a memory operatively coupled to the receiver unit and configured to store a previous corresponding rolling data;

a component configured to compare the received rolling data with the stored rolling data; and

a counter configured to increment when the received rolling data is within a predetermined percentage of the stored rolling data.

17. The apparatus of claim **16**, wherein the receiver unit is a wireless receiver unit.

18. The apparatus of claim **17**, wherein the wireless receiver unit is a radio frequency (RF) communication receiver unit.

19. The apparatus of claim **16**, wherein the counter is configured to increment only when the received rolling data is equal to the stored rolling data.

20. The apparatus of claim **16**, wherein the received rolling data is accepted as valid when the counter is greater than or equal to a predetermined threshold.

21. The apparatus of claim **20**, wherein the predetermined threshold is two.

22. The apparatus of claim **16**, wherein the counter is an array.

23. The apparatus of claim **22**, wherein the received rolling data is calibration data.

24. The apparatus of claim **23**, wherein calibration data comprises 8 bytes of data, and the rolling data of the data packet is 1 byte of the 8 bytes of calibration data.

25. The apparatus of claim **24**, wherein each byte of the calibration data corresponds to an element of the counter array.

26. The apparatus of claim **25**, wherein the corresponding element of the counter array is configured to increment when the received rolling data is within a predetermined percentage of the stored rolling data.

27. The apparatus of claim **26**, wherein the received rolling data is accepted as valid when all the elements of the counter array are greater than or equal to a predetermined threshold.

28. The apparatus of claim **16**, further comprising replacing the stored rolling data in the memory with the received rolling data when the received rolling data is not within the predetermined percentage of the previously stored rolling data.

29. A data monitoring and management system, comprising:

a communication link;

a transmitter operatively coupled to the communication link, the transmitter configured to transmit a data packet including time sensitive data and rolling data; and

a receiver operatively coupled to the communication link, the receiver configured to receive the transmitted data packet;

wherein the receiver is configured to determine if the received rolling data is valid by comparing the received rolling data to a previously stored corresponding rolling data, incrementing a counter when the received rolling data is within a predetermined percentage of the previously stored rolling data, and determining if the counter is greater than or equal to a predetermined threshold.

30. The system of claim **29**, wherein the communication link is a wireless communication link.

31. The system of claim **30**, wherein the wireless communication link is a radio frequency (RF) communication link.

* * * * *