

APPARATUS AND METHOD FOR ADJUSTING REFRESH RATE OF LOCATION COORDINATES OF A TRACKING DEVICE

5 Priority and Related Applications

This application is a continuation-in-part and claims priority to U.S. patent application number 11/969,905 entitled “Apparatus and Method for Determining Location and Tracking Coordinates of a Tracking Device” that was filed on January 6, 2008, and incorporates by reference in their entirety and claims priority to U.S. patent application Serial No. 11/753,979 filed on May 25, 2007, entitled “Apparatus and Method for Providing Location Information on Individuals and Objects Using Tracking Devices”; U.S. patent application Serial No. 11/933,024 filed on October 31, 2007, entitled “Apparatus and Method for Manufacturing an Electronic Package”; US patent application Serial No. 11/784,400 filed on April 5, 2007, entitled “Communication System and Method Including Dual Mode Capability”; US patent application Serial No. 11/784,318 filed on April 5, 2007, entitled “Communication System and Method Including Communication Billing Options”; and US patent application Serial No. 11/935,901 filed on November 6, 2007, entitled “System and Method for Creating and Managing a Personalized Web Interface for Monitoring Location Information on Individuals and Objects Using Tracking Devices.”

Background of the Invention

1. Field of the Invention

The invention relates generally to the field of location and tracking communication systems. More particularly, the present invention relates in one embodiment to a power conservation methodology and apparatus incorporated as part of portable electronic tracking device for individuals and objects to improve battery life by a wireless location and tracking system and/or wireless communication system (WCS).

2. Description of Related Technology

Accelerometers are conventionally integrated into electronics systems that are part of a vehicle, vessel, and airplane to detect, measure, and monitor deflections, vibrations, and acceleration. Accelerometers, for example, may include one or more Micro Electro-Mechanical System (MEMS) devices. In particular, MEMS devices include one or more suspended cantilever beams (e.g., single-axis, dual-axis, and three-axis models), as well as deflection sensing circuitry. Accelerometers are utilized by a multitude of electronics manufacturers.

For instance, electronics gaming manufacturers exploit an accelerometer's deflection sensing capability, for instance, to measure device tilt and control game functionality. In another instance, consumer electronics manufacturers, e.g., Apple, Ericsson, and Nike, incorporate accelerometers in personal electronic devices, e.g., Apple iPhone to provide a changeable screen display orientation that toggles between portrait and landscape layout window settings; to manage human inputs through a human interface, e.g., Apple iPod® touch screen interface; and to measure game movement and tilt, e.g., Wii gaming remotes. Still others including automobile electronics circuitry manufacturers utilize MEMS accelerometers to initiate airbag deployment in accordance with a detected collision severity level by measuring negative vehicle acceleration.

Other electronics manufacturer products, e.g., Nokia 5500 sport, count step motions using a 3D accelerometer, and translate user information via user's taps or shaking motion to select song titles and to enable mp3 player track switching. In another instance, portable or laptop computers include hard-disk drives integrated with an accelerometer to detect displacement or falling incidents. For instance, when a hard-disk accelerometer detects a low-g condition, e.g., indicating free-fall and expected shock, a hard-disk write feature may be temporarily disabled to avoid accidental data overwriting and prevent stored data corruption. After free-fall and expected shock, the hard-disk write feature is enabled to allow data to be written to one or more hard-disk tracks. Still others including medical product manufacturers utilize accelerometers to measure depth of Cardio Pulmonary Resuscitation (CPR) chest compressions. Sportswear manufacturers, e.g., Nike sports watches and footwear, incorporate accelerometers to feedback speed and distance to a runner via a connected iPod® Nano.

Still others including manufacturers of conventional inertial navigation systems deploy one or more accelerometers as part of, for instance, on-board electronics of a vehicle, vessel, train and/or airplane. In addition to accelerometer measurements, conventional inertial navigation systems integrate one or more gyroscopes with the on-board electronics to assist tracking including performing various measurements, e.g., tilt, angle, and roll. More specifically, gyroscopes measure angular velocity, for instance, of a vehicle, vessel, train, and/or airplane in an inertial reference frame. The inertial reference frame, provided, for instance, by a human operator, a GPS receiver, or position and velocity measurements from one or more motion sensors.

More specifically, integration of measured inertial accelerations commences with, for instance, original velocity, for instance, of a vehicle, vessel, train, and/or airplane to yield updated inertial system velocities. Another integration of updated inertial system velocities yields an updated inertial system orientation, e.g., tilt, angle, and roll, within a system limited positioning accuracy. In one instance to improve positioning accuracy, conventional inertial navigation systems utilize GPS system outputs. In another instance to improve positioning accuracy, conventional inertial navigation systems intermittently reset to zero inertial tracking velocity, for instance, by stopping the inertial navigation system. In yet other examples, control theory and Kalman filtering provide a framework to combine motion sensor information in attempts to improve positional accuracy of the updated inertial system orientation.

Potential drawbacks of many conventional inertial navigation systems include electrical and mechanical hardware occupying a large real estate footprint and requiring complex electronic measurement and control circuitry with limited applicability to changed environmental conditions. Furthermore, many conventional inertial navigation system calculations are prone to accumulated acceleration and velocity measurement errors. For instance, many conventional inertial navigation acceleration and velocity measurement errors are on the order of 0.6 nautical miles per hour in position and tenths of a degree per hour in orientation.

In contrast to conventional inertial navigation systems, a conventional Global Positioning Satellite (GPS) system uses Global Positioning Signals (GPS) to monitor and track location coordinates communicated between location coordinates monitoring

satellites and an individual or an object having a GPS transceiver. In this system, GPS monitoring of location coordinates is practical when a GPS transceiver receives at least a minimal GPS signal level. However, a minimal GPS signal level may not be detectable when an individual or object is not located in a skyward position. For instance, when an
5 individual or object carrying a GPS transceiver enters a covered structure, e.g., a garage, a parking structure, or a large building, GPS satellite communication signals may be obstructed or partially blocked, hindering tracking and monitoring capability. Not only is a GPS transceiver receiving a weak GPS signal, but also the GPS transceiver is depleting battery power in failed attempts to acquire communication signals from one or more
10 location coordinates monitoring satellites, e.g., GPS satellites, or out-of-range location coordinates reference towers. Furthermore, weak GPS communication signals may introduce errors in location coordinates information.

In addition during the acquisition of signaling and or other information, a conventional GPS transceiver has limited functionality or capabilities associated with
15 control and monitoring of battery power usage. For instance, a conventional GPS transceiver may have some indication battery charge level such as a power level bar but have very few or any ability or capability to control or reduce power usage. Furthermore, often users do not realize or are only alerted when their GPS transceiver is using reserve power or about to suddenly involuntarily shut-down to prevent data loss and loss of other
20 user information such as personal GPS settings, screen color displays, and user recreational or pleasure settings.

More specifically, users of conventional GPS transceivers typically are unprepared for such a sudden loss of GPS transceiver service. Generally, within minutes of an initial warning indication, e.g., beeping, vibration, voice, alarms or combination
25 thereof, the GPS transceiver shuts off. As such, a user may suddenly experience loss of location determination or location based capabilities or monitoring or being monitored capabilities and not prepared for such sudden outage. Furthermore, even if a user could reduce battery power usage, a result, within the last few minutes of battery power, a user has little or no incentive or capability to alter battery usage of a conventional GPS
30 transceiver due to low power level GPS transceivers may suddenly become non-operational without any warning to or recourse to a user. Thus, when a conventional

GPS transceiver is low in power level, a user's most viable alternative would be locating an electrical outlet to recharge their conventional GPS transceiver.

In summary, electronic tracking device and methodology that provides additional advantages over conventional systems such as improved power management, e.g.,
5 efficient use of battery power and provide other improvements include supplementing conventional electronic tracking device monitoring, e.g., increased measurement accuracy of location coordinates of objects and individuals traveling into and/or through a structure, e.g., a partially covered building, a parking structure, or a substantially enclosed structure, such as a basement or a storage area in a high-rise office building.

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Summary of the Invention

In a first aspect of the present invention, a portable electronic apparatus for a tracking device is disclosed. In one embodiment, the tracking device includes a battery having a battery charge level, transceiver circuitry, processor circuitry, and a battery power monitor. In one embodiment, the battery power monitor measures in real-time the battery charge level and makes a prediction of an estimated remaining battery charge level in response to the battery charge level.
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In one variant, a local battery power adjustment mechanism generates in substantially real-time an updated set of network communication signaling protocols associated with at least one of a request rate of location coordinate packets to be communicated to a target host and a listen rate of the location coordinate packets. In yet another variant, the updated set of network communication signaling protocols has a value that is responsive to a user input request. In yet another embodiment, the local battery power adjustment mechanism activates or deactivates one or more portions of the
20 transceiver circuitry to conserve the battery charge level. In yet another embodiment, the local battery power adjustment mechanism activates or deactivates the processor to conserve the battery charge level in response to the value having the value responsive to a user input request.
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In a second aspect of the present invention, a local charging management device
30 is disclosed to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device. In one embodiment, local charging

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