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(54) **APPARATUS AND METHOD FOR DETERMINING LOCATION AND TRACKING COORDINATES OF A TRACKING DEVICE**

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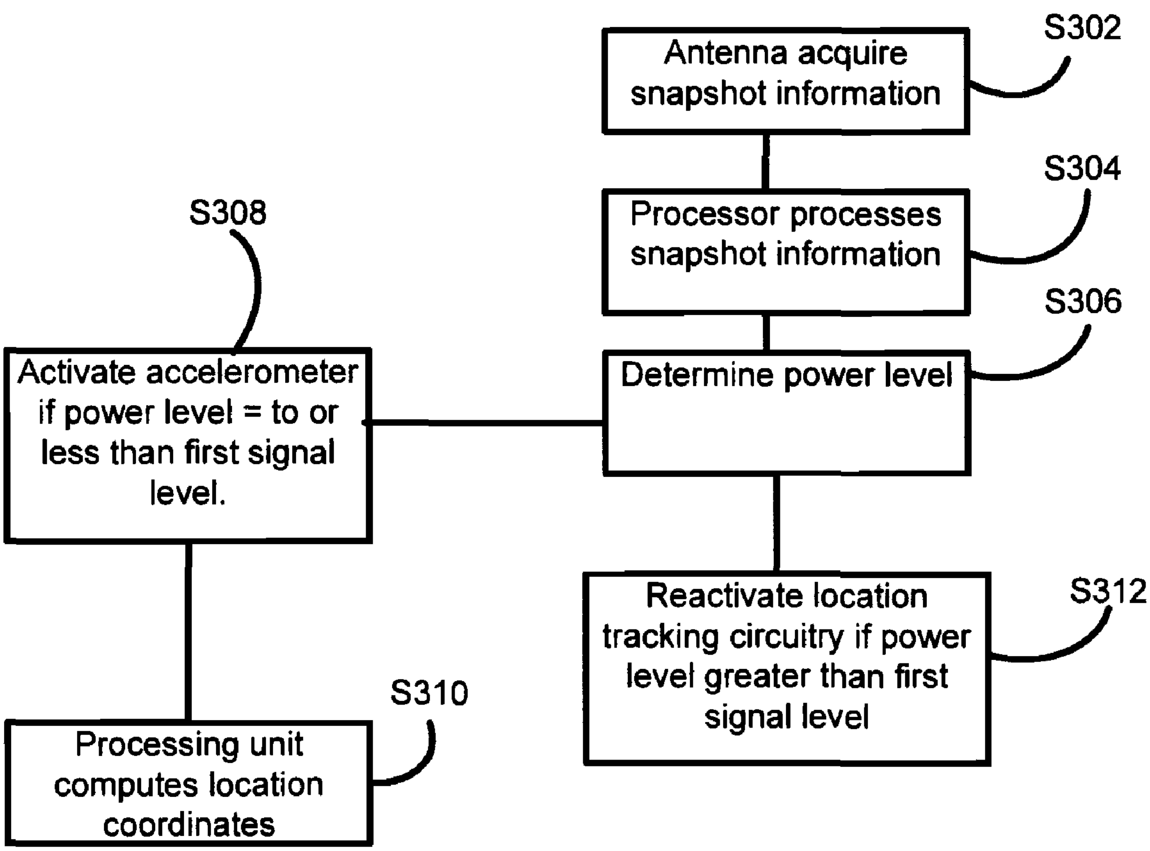
(57) **ABSTRACT**

An apparatus to monitor location coordinates of an electronic tracking device. The apparatus includes a transceiver, a signal processor, an accelerometer, and an antenna. The antenna communicates signal strength, to the signal processor associated with the electronic tracking device. In response to signal strength, a battery power monitor controls battery usage by electronic circuitry associated with the electronic tracking device. An accelerometer provides a supplemental location tracking system to improve tracking accuracy of a primary location tracking system of the electronic tracking device.



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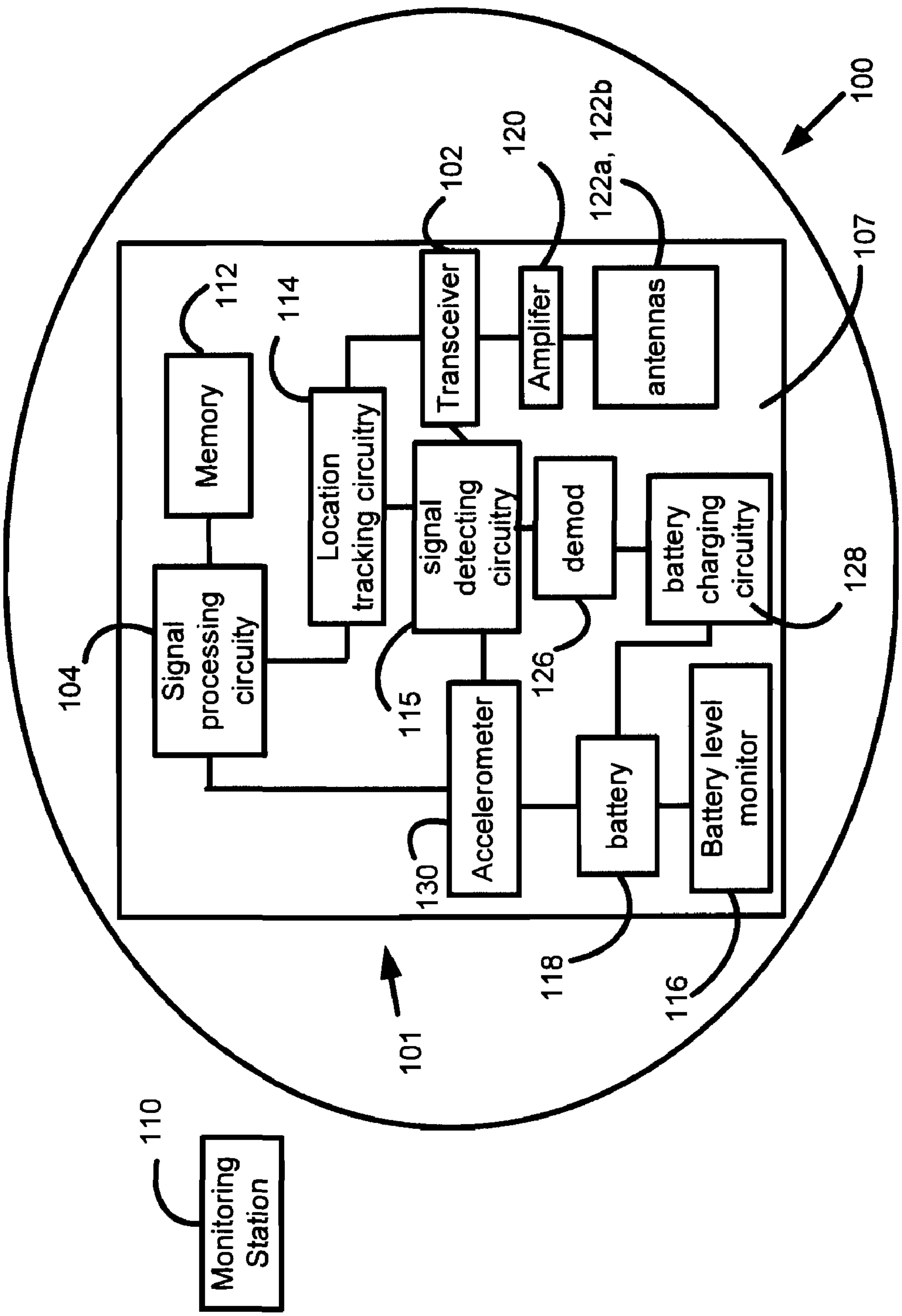

Figure 1

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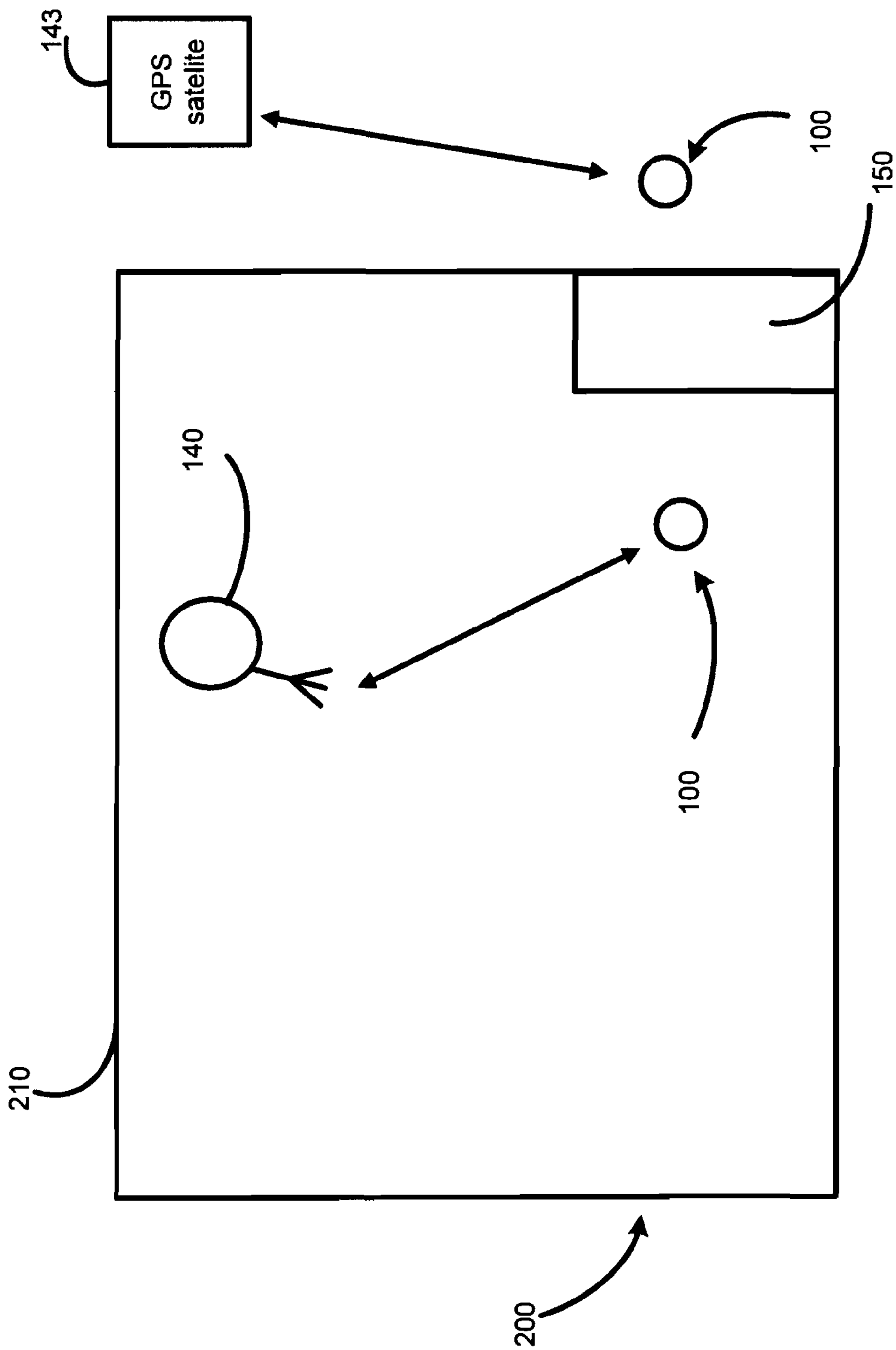

Figure 2

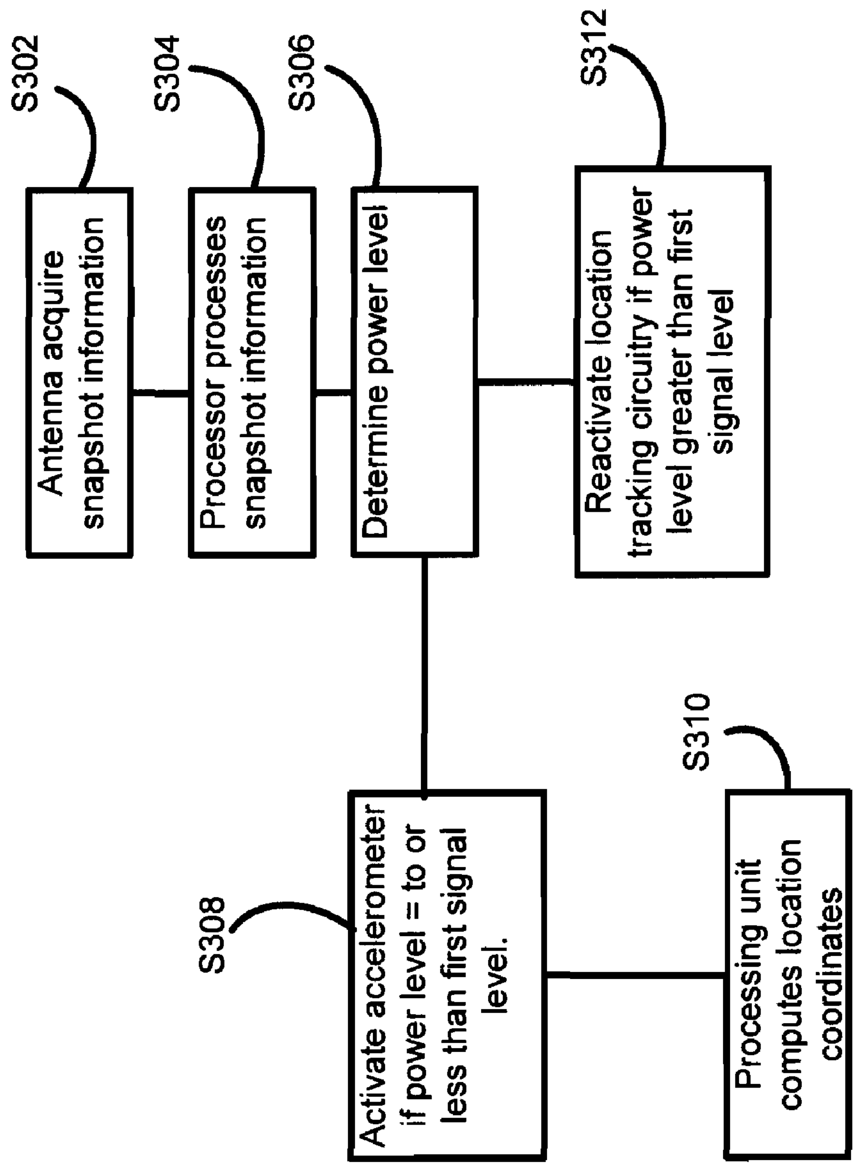

Figure 3

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APPARATUS AND METHOD FOR DETERMINING LOCATION AND TRACKING COORDINATES OF A TRACKING DEVICE

RELATED APPLICATIONS

[0001] This application incorporates by reference in their entirety: U.S. patent application Ser. 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 Ser. No. 11/933,024 filed on Oct. 31, 2007, entitled "Apparatus and Method for Manufacturing an Electronic Package"; U.S. patent application Ser. No. 11/784,400 tiled on Apr. 5, 2007, entitled "Communication System and Method Including Dual Mode Capability"; U.S. patent application Ser. No. 11/784,318 filed on Apr. 5, 2007, entitled "Communication System and Method Including Communication Billing Options"; and U.S. patent application Ser. No. 11/935,901 filed on Nov. 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

[0002] 1. Field of the Invention

[0003] The invention relates generally to the field of location and tracking communication systems. More particularly, the present invention relates in one embodiment to an accelerometer incorporated as part of portable electronic tracking device for individuals and objects to improve monitoring by a wireless location and tracking system and/or wireless communication system (WCS).

[0004] 2. Description of Related Technology

[0005] 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.

[0006] For instance, electronics gaming manufacturers exploit an accelerometers 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.

[0007] 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 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.

[0008] 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.

[0009] 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.

[0010] 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 applicably 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.

[0011] 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,

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