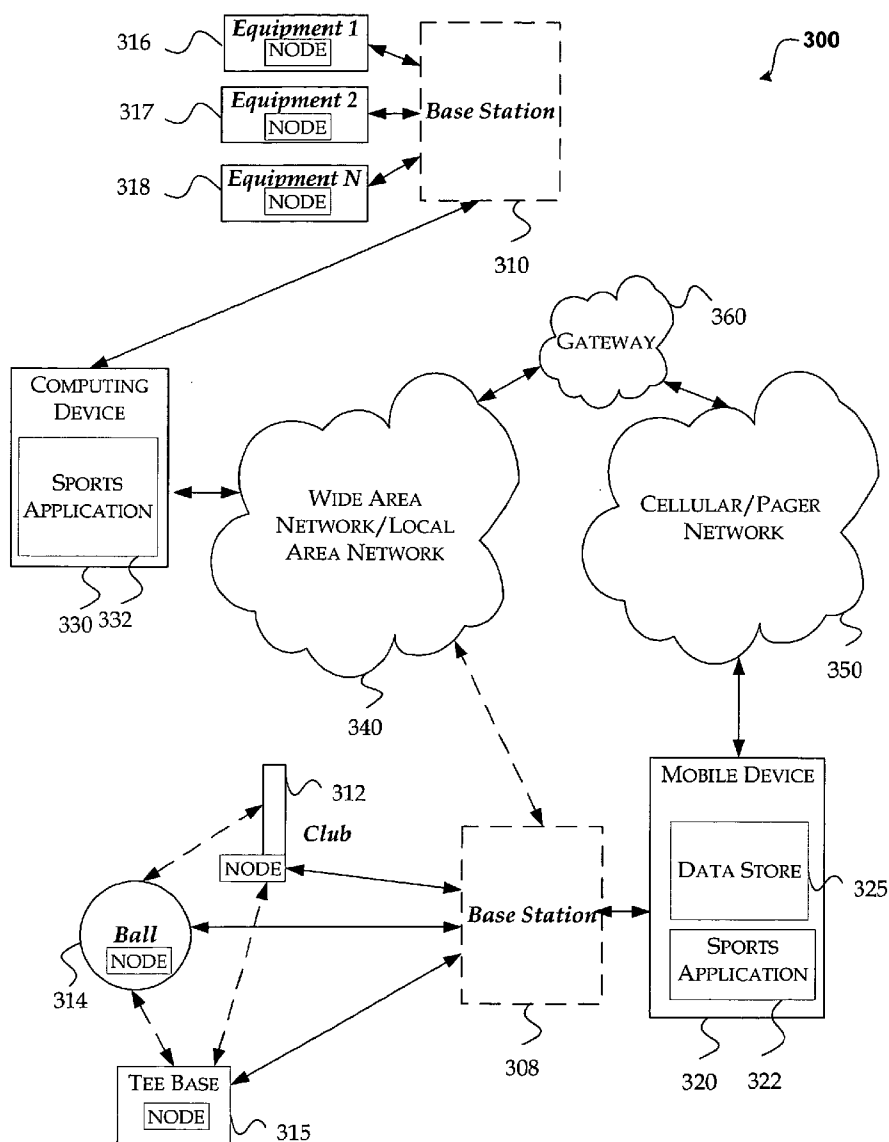




US 20060148594A1

(19) **United States**(12) **Patent Application Publication**  
**Saintoyant et al.**(10) **Pub. No.: US 2006/0148594 A1**(43) **Pub. Date: Jul. 6, 2006**(54) **SMART COMMUNICATING SPORTS  
EQUIPMENT****Publication Classification**(51) **Int. Cl.**  
**A63B 57/00** (2006.01)(52) **U.S. Cl.** ..... **473/405; 473/415**(75) Inventors: **Pierre-Yves Saintoyant**, Aachen (DE);  
**Petri Mahonen**, Aachen (DE)Correspondence Address:  
**MERCHANT & GOULD (MICROSOFT)**  
**P.O. BOX 2903**  
**MINNEAPOLIS, MN 55402-0903 (US)**(73) Assignee: **Microsoft Corporation**, Redmond, CA(21) Appl. No.: **11/030,217**(22) Filed: **Jan. 5, 2005**(57) **ABSTRACT**

Mobile communication devices are interfaced with sports equipment that include at least one embedded sensor. The sensor may be a variety of different sensors, including, but not limited to: 3D acceleration sensors, pressure sensors, temperature sensors; humidity sensors; wind speed sensors; pressure sensors; and the like. Data that relates to the sensor measurements are transmitted wirelessly from the sports equipment to another device that may analyze the data. This device may be a mobile device, such as a mobile phone, or a wired device, such as a desktop computer. The data may be transmitted through one or more networks.



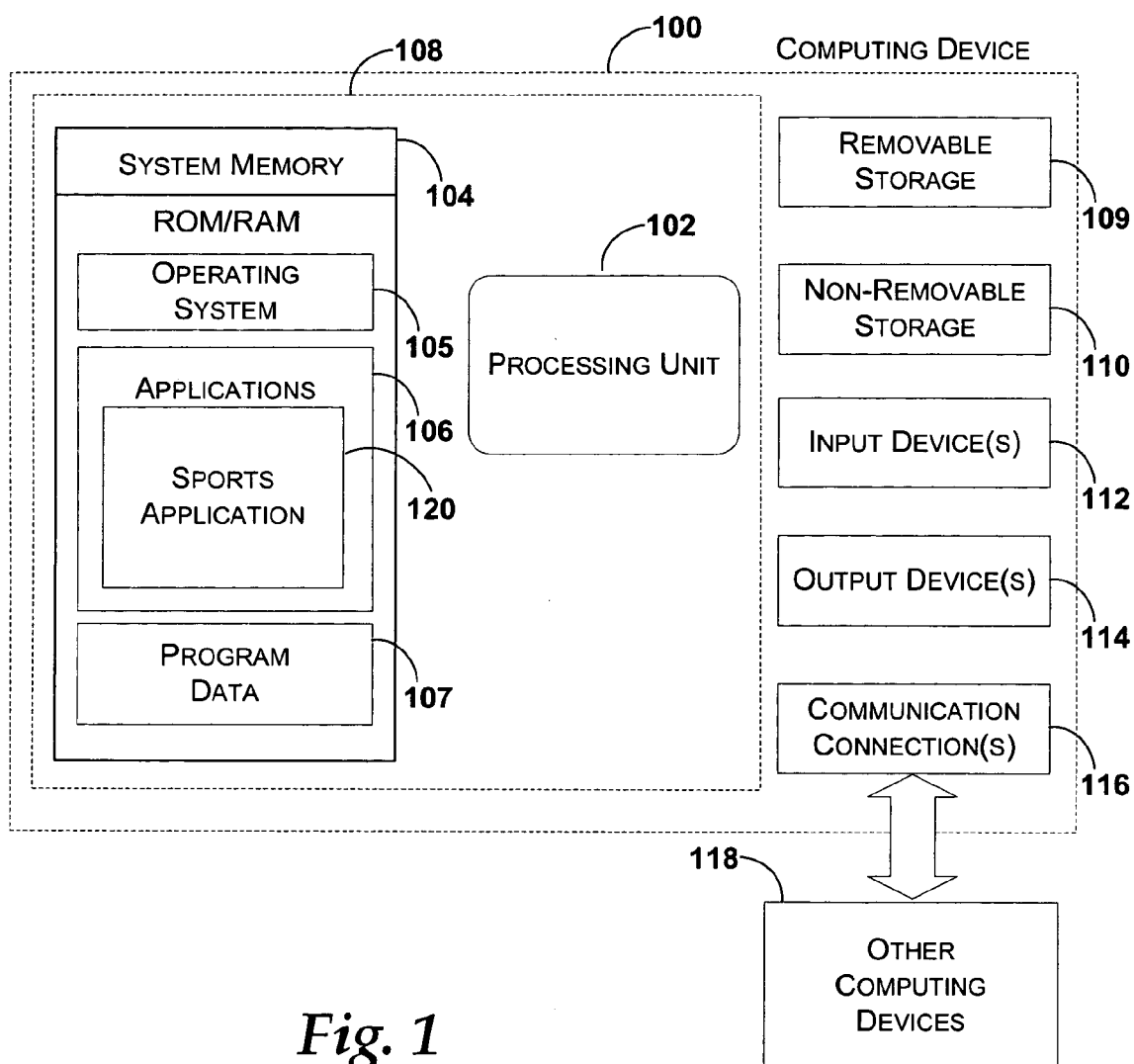


*Fig. 1*

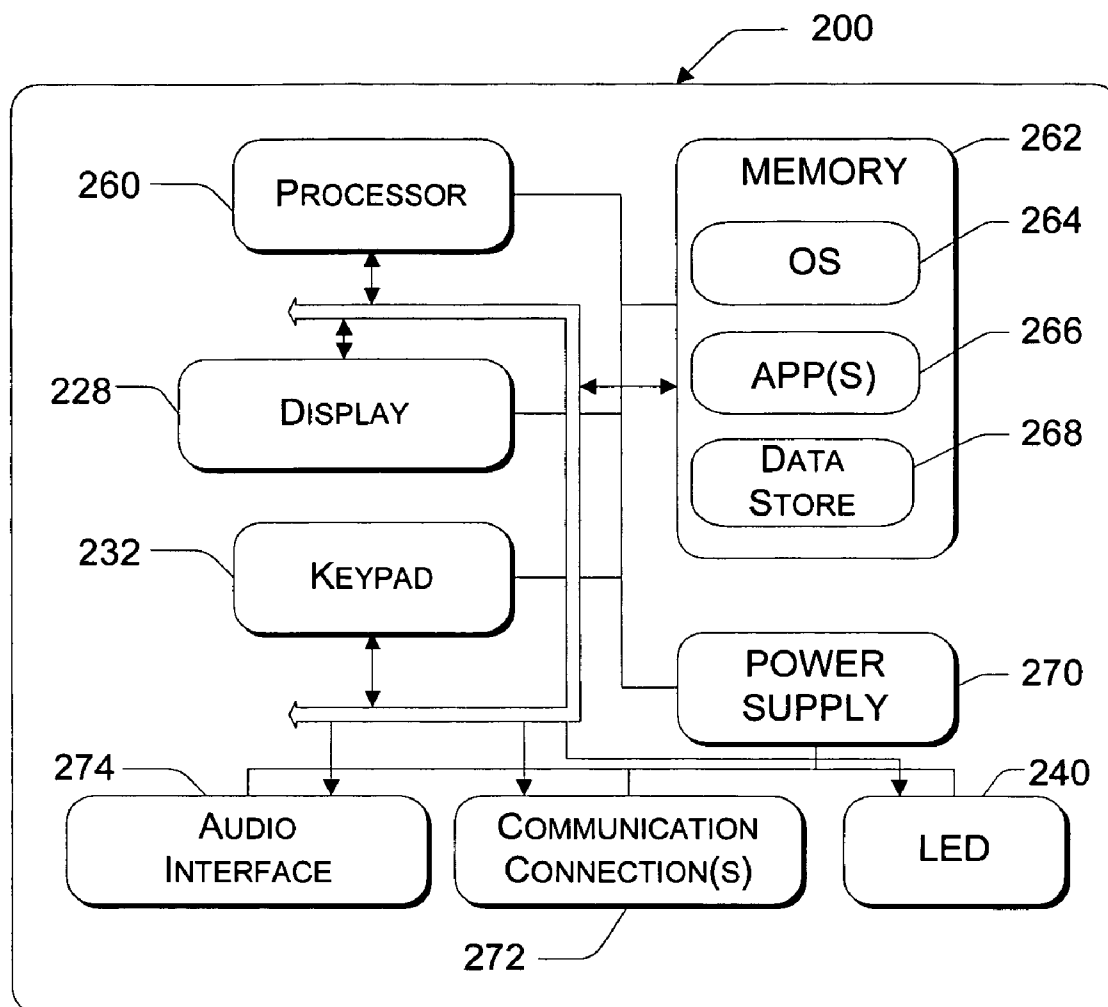


*Fig.2*

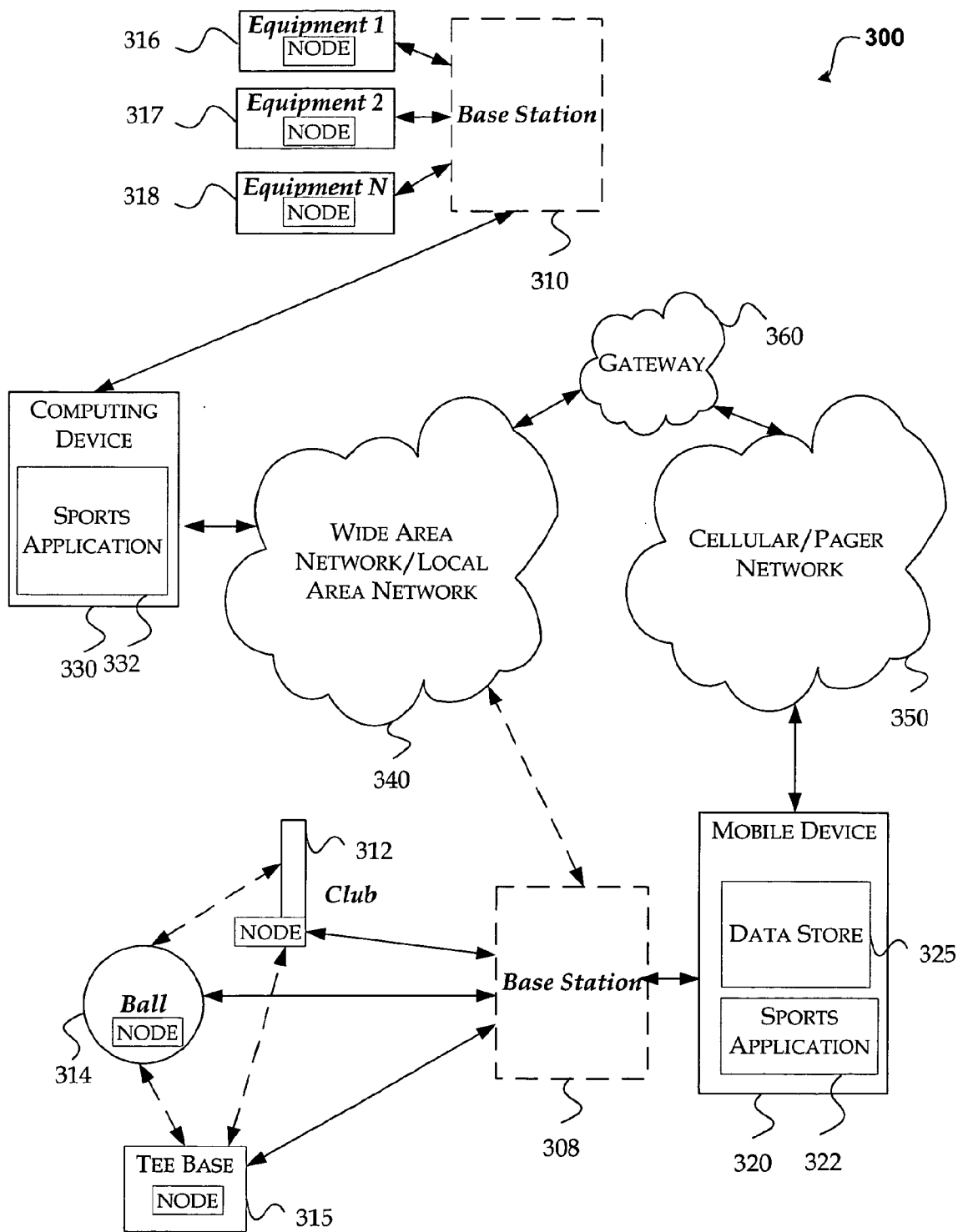


**Fig. 3**

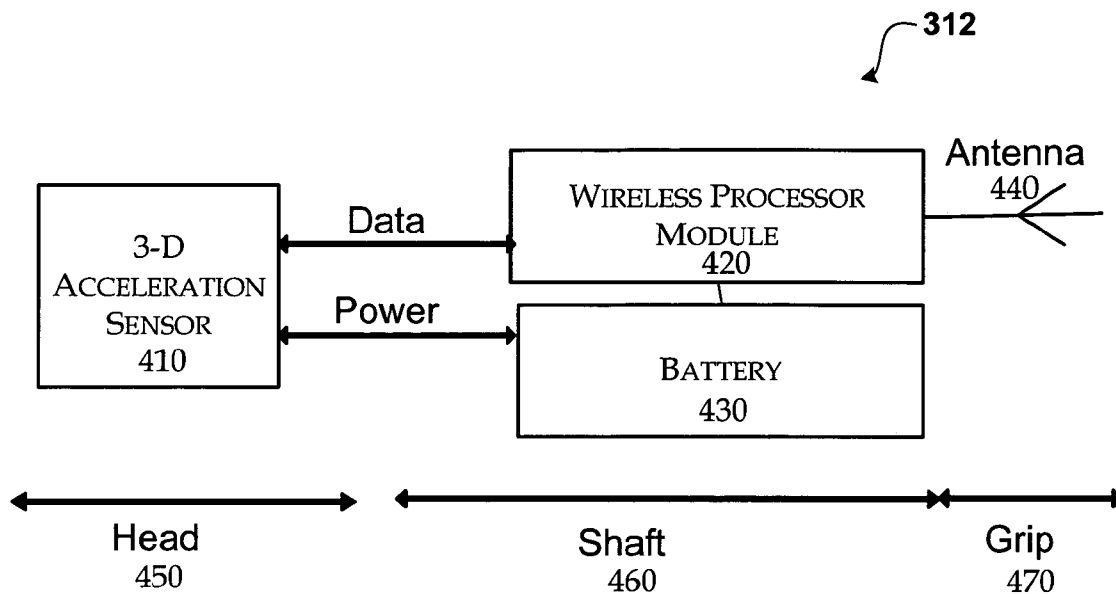
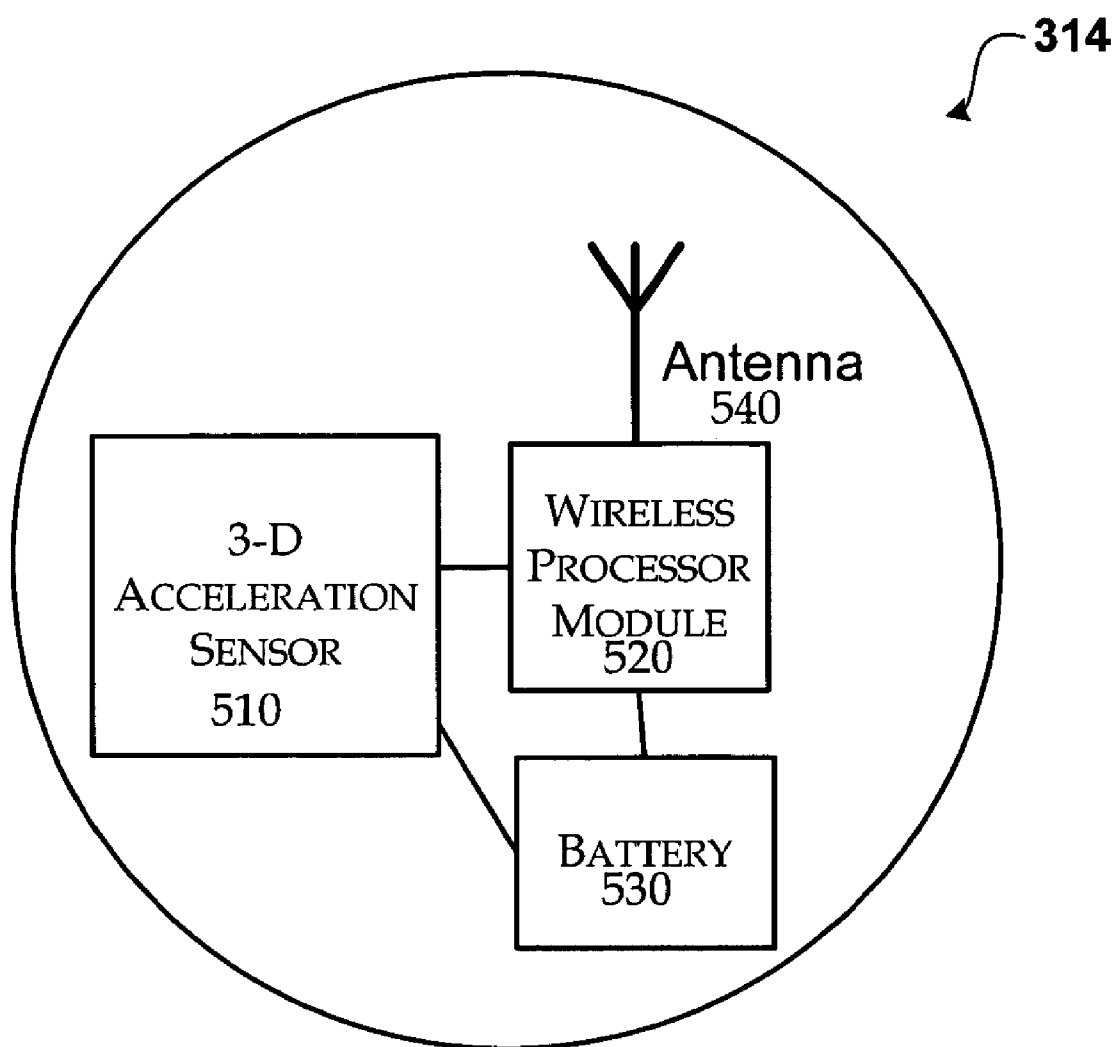


*Fig. 4*



Smart ball

*Fig. 5*

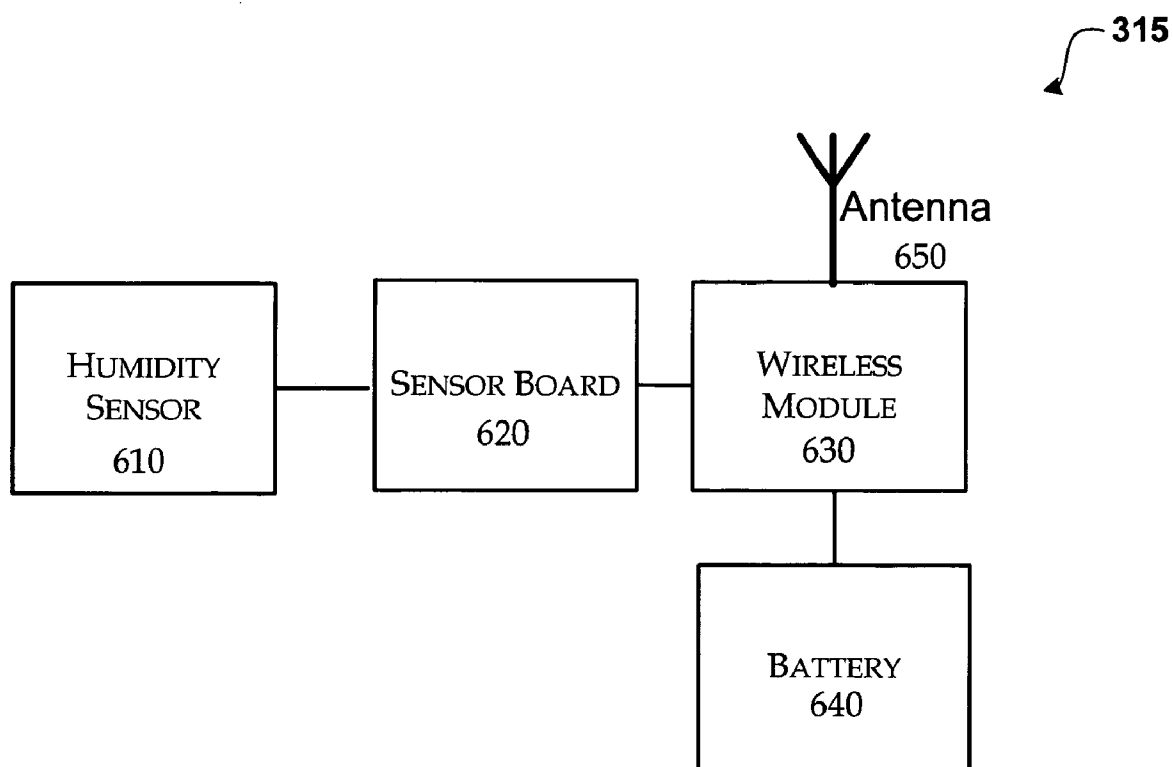


*Fig. 6*

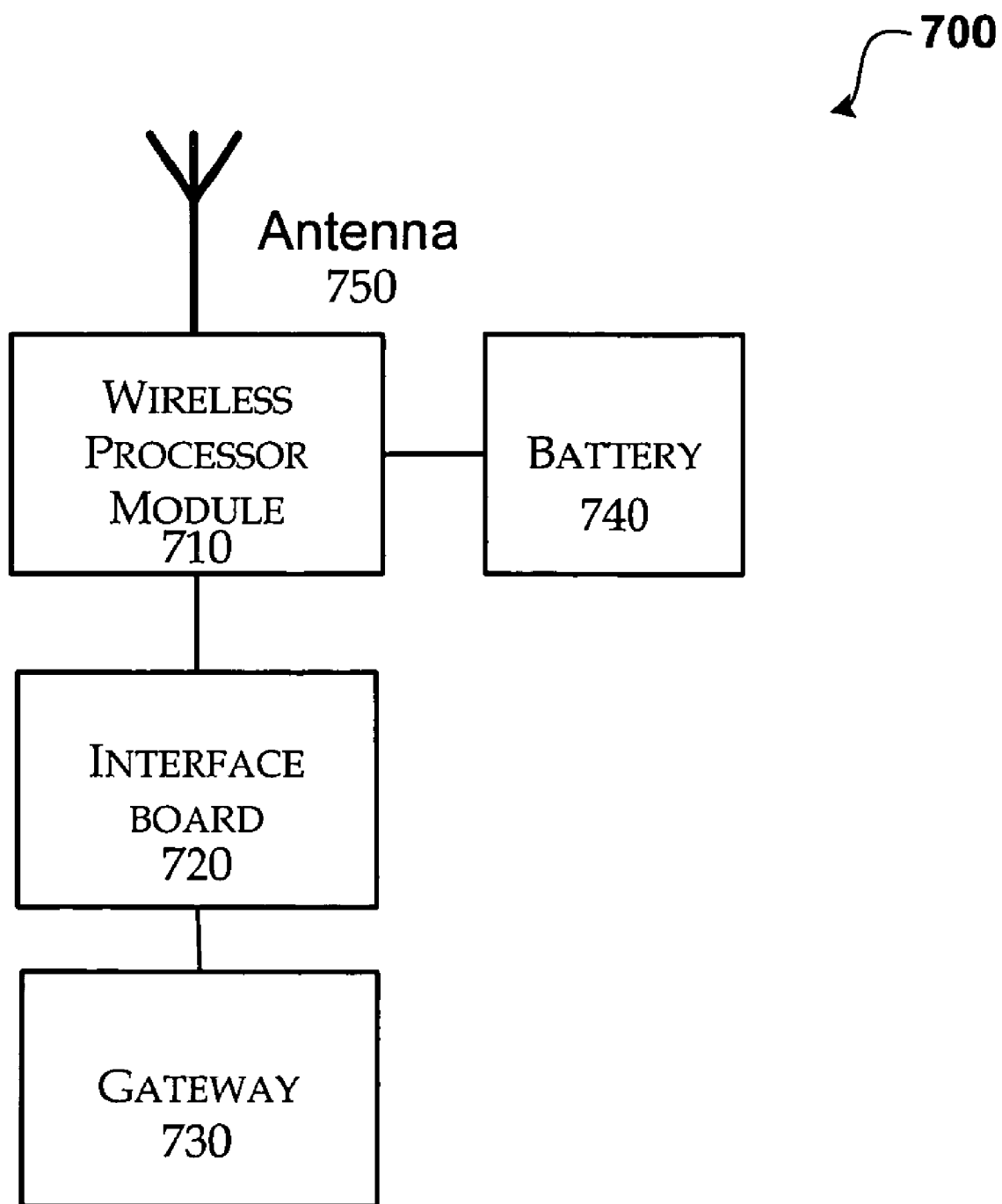
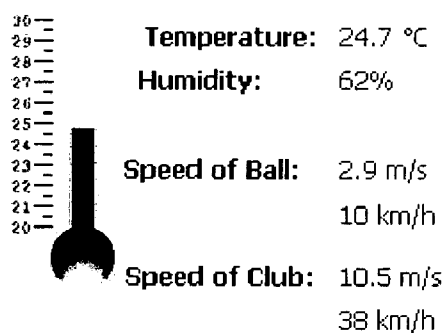
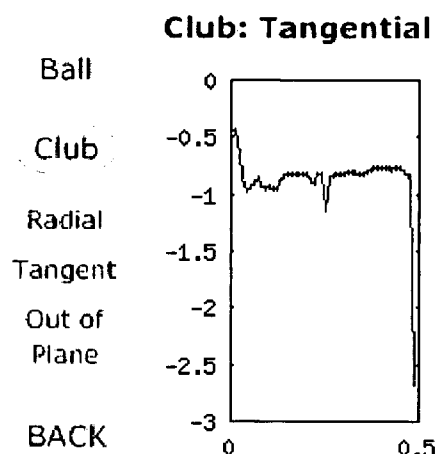
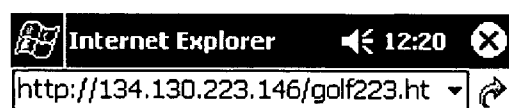
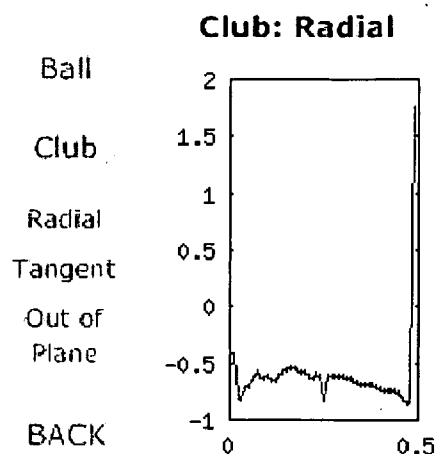


*Fig. 7*



Graphs Hit Reset



**SMART COMMUNICATING SPORTS EQUIPMENT****BACKGROUND OF THE INVENTION**

[0001] The sport equipment market continues to expand. Over the past several years, equipment has been developed to analyze the performance of a user with sports equipment. Some of this equipment includes golf devices to measure the speed of a golf swing, as well as the launch angle, backspin, and sidespin of a golf ball. Other sports equipment has been developed to measure the speed of baseball bats, baseball pitches, as well as equipment to determine the location of a ball within an strike zone or near a foul line. This equipment is typically located in close proximity to the user while they are participating or practicing in their sport. For example, a person measuring the speed of their golf swing may please the measuring device within a short distance from their swing plane. Once the person has swung the club, the device outputs the swing speed. This equipment, however, may be very costly and/or cumbersome to use.

**SUMMARY OF THE INVENTION**

[0002] Embodiments of the present invention relate to a system and method for interfacing mobile communication devices with sports equipment.

[0003] According to one aspect of the invention, the sports equipment has at least one embedded sensor that may wirelessly transmit data. The sensor may be a variety of different sensors, including, but not limited to: 3D acceleration sensors, pressure sensors, temperature sensors; humidity sensors; wind speed sensors; pressure sensors; and the like.

[0004] According to another aspect of the invention, data that relates to the sensor measurements are transmitted wirelessly from the sports equipment to another device, such as a mobile device, that may analyze the data and display the data to the user. The data may also be transmitted through one or more networks to the user and/or other computing devices.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0005] **FIGS. 1 and 2** illustrate an exemplary computing devices that may be used in exemplary embodiments of the present invention;

[0006] **FIG. 3** is a functional block diagram generally illustrating a smart communicating sports equipment system;

[0007] **FIG. 4** illustrates a system diagram of a smart communicating golf club;

[0008] **FIG. 5** shows a system diagram of a smart communicating sports ball;

[0009] **FIG. 6** illustrates a system diagram of a smart communicating tee base;

[0010] **FIG. 7** illustrates a system diagram of a base station; and

[0011] **FIG. 8** illustrates exemplary mobile device screen shots relating to sensor data received from smart communicating sports equipment; in accordance with aspects of the invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

[0012] Generally, the present invention relates to a system and method for interfacing mobile communication devices with sports equipment that includes at least one embedded sensor(s). Sensor data from the smart communicating sports equipment are transmitted wirelessly to a device for further analysis and display. Instead of having to estimate sensor data associated with a piece of equipment, actual sensor data is sent from the piece of equipment to another device, such as a mobile device. Many different types of information may be sensed. For example, 3D-acceleration information, pressure level on a hand grip, bat speed, and the like may be calculated by the embedded sensors.

[0013] **FIG. 3** is a functional block diagram generally illustrating a smart communicating sports equipment system **300**, in accordance with aspects of the invention. Computing device **330** is a computing device such as the one described in conjunction with **FIG. 1** and mobile device **320** is a mobile computing device such as the one described in conjunction with **FIG. 2**.

[0014] Typically a user will perform analysis of the sensor data received from the sports equipment using a sports application, such as sports application **322** and sports application **332**. The sports applications are configured to receive sensor data either through a base station (**308, 310**), through a network coupled to the sports equipment, or directly from the sporting equipment. Application **332** may be configured to communicate with other applications, such as application **322** on mobile device **320**. Once the data is received from the smart communicating sports equipment the user may interact with the data on their device using the sports application. Using a mobile device, the user may interact with the data in almost any location. For example, the user may interact with the golf club sensor data while practicing on the golf course.

[0015] Many different types of sports equipment may be interfaced to mobile device **320** and computing device **330**. For explanatory purposes, only a few explicit types of sports equipment has been illustrated within **FIG. 3**. Club **312**, ball **314**, and tee base **315** are coupled to mobile computing device **320** through base station **308**. Equipment 1-N (**316-318**) are coupled to computing device **330** through base station **308**. The sports equipment may also be coupled to other devices (mobile or fixed) through a network connection. Each piece of sports equipment includes a node that includes one or more embedded sensors. At least one of the embedded sensors is configured to wirelessly transmit sensor data. According to one embodiment, each embedded sensor is coupled wirelessly and each node includes the capability to directly communicate wirelessly with other nodes as well as conform to certain network protocols. According to one embodiment, nodes from Crossbow Technology, Inc. are embedded within the smart communicating sports equipment. According to one embodiment, the sensor data produced by the sports equipment is received by a base station and then provided to the device.

[0016] Generally a node can sense, perform limited computations and wirelessly communicate with other nodes or devices. A node typically includes a microprocessor, a sensor, such as a microelectromechanical systems (MEMS) sensor, and a radio (transceiver) controlled by a small

operating system. The microprocessor processes the sensor data, the MEMS sensor(s) provide an array of sensor inputs, and the radio enables the node to wirelessly transmit their sensor readings throughout the network.

[0017] A node is typically powered by a small battery, such as a 3V battery. Typically, the node may be powered for around six months to a year using a battery. Some nodes may last much longer using a battery. Some nodes are being developed that run on solar power, or that get power from an outside source. To conserve power, the node may be put to sleep and only wake up when a sensor reading is needed.

[0018] According to one embodiment, each node includes an operating system ("TinyOS") which is an open-source operating system designed for wireless embedded sensor networks. TinyOS includes a scheduler, a database, a wireless radio stack, mesh networking software, power management, and encryption technology. TinyOS's component library includes network protocols, distributed services, sensor drivers, and data acquisition tools. TinyOS is an event-driven execution model which enables fine-grained power management yet allows the scheduling flexibility made necessary by the unpredictable nature of wireless communication and physical world interfaces.

[0019] Cellular/pager network 850 is a network responsible for delivering messages to and receiving messages from wireless devices. The cellular/pager network 850 may include both wireless and wired components. For example, cellular/pager network may include a cellular tower that is linked to a wired telephone network. Typically, the cellular tower carries communication to and from cell phones, long-distance communication links, and the like. The wireless devices can also connect directly to WAN's, LANs, etc, using hardware such as Wi-Fi cards that are becoming increasingly available for mobile devices.

[0020] Gateway 360 routes messages between cellular/pager network 850 and WAN/LAN 840. For example, a computer user may send a message that is addressed to a cellular phone. Gateway 360 provides a means for transporting the message from the WAN/LAN 340 to cellular/pager network 350. Conversely, a user with a device connected to a cellular network may be browsing the Web. Gateway 360 allows hyperlink text protocol (HTTP) messages to be transferred between WAN/LAN 340 and cellular/pager network 350.

[0021] FIG. 4 illustrates a system diagram of a smart communicating golf club, in accordance with aspects of the invention. As illustrated, smart communicating golf club 312 includes head 450, shaft 460 and grip 470. Head 450 includes embedded 3-D acceleration sensor 410. Shaft 450 includes wireless processor module 420 powered by battery 430. Antenna 440 is coupled to wireless processor module 420.

[0022] More than one sensor may be embedded within golf club 312. For instance, a pressure sensor (not shown) may be placed in grip 490 to measure the pressure exerted on the golf club during a swing.

[0023] Each wireless processor module is coupled to a sensor and data acquisition board. In this example, the sensor and data acquisition board includes 3-D acceleration sensor 410. The nodes formed by the sensor and the wireless processor module may communicate with other similar

nodes and may form their own network. To connect with a Host PC, LAN, or the Internet the processor/radio board is coupled with a gateway and network interface (See FIG. 3).

[0024] The gateway may connect to the RS-232 port, an Ethernet port, or wirelessly using 802.11a/b protocols. Sample sensors that may be coupled to the wireless processor module include, accelerometers, barometers, light, sound, magnetometer, photo-sensitive light, relative humidity and temperature sensors.

[0025] According to one embodiment of the invention, the wireless module is a Mica2 Dot produced by Crossbow Technology. 3-D acceleration sensor 410 is model number ACH04-08-05 produced by Measurement Specialties.

[0026] Club 312 may be used to provide the user with 3-D acceleration data. Many uses of this data may be determined. For example, the user may review this data to see the speed of their club as well as whether their club is on or off of the target line.

[0027] An example will be used to clarify the use of the smart communicating sports equipment. A golf application may be running on the smart phone that is enhanced with low-power local radio technology. The golf club and tee base (See FIG. 6) includes several sensors for environmental data (such as temperature, humidity) and sporting data (such as 3D-acceleration information) that can be sent in near real-time to a mobile device for post-processing and viewing. Other data may also be sent by the golf club. For instance, the wind-speed and direction, humidity at the ground level etc. Also the a practice golf ball (See FIG. 5 for an exemplary smart ball) could include sensors for speed, acceleration, or even locality of the ball. The same is applicable, e.g. to tennis and squash, where monitor the spin of ball could be monitored, and locality information (e.g. is the ball was within or outside of the playing area).

[0028] FIG. 5 shows a system diagram of a smart communicating sports ball, in accordance with aspects of the invention. As illustrated, smart ball 314 includes 3-D acceleration sensor 510, wireless processor module 520, and battery 530. 3-D acceleration sensor 510 is coupled to wireless module 520 and battery 530. Wireless Module is coupled to antenna 540, 3-D acceleration sensor 510, and battery 530.

[0029] The components illustrated in FIG. 5 may be included in many different types of balls. For example, the components may be included in a golf ball, a tennis ball, a basketball, a baseball, a tennis ball, a soccer, a football, and the like. When the ball is caused to move, 3-D acceleration sensor 510 senses the 3-D acceleration and provides the sensor measurements to wireless module 520. Wireless module 520 may then transmit the sensor data using antenna 540 to some other device on the network.

[0030] According to one embodiment of the invention, the wireless module is a Mica2 Dot produced by Crossbow Technology. 3-D acceleration sensor 410 is model number ACH04-08-05 produced by Measurement Specialties.

[0031] FIG. 6 illustrates a system diagram of a smart communicating tee base, in accordance with aspects of the present invention. As illustrated, smart tee base 315 includes humidity sensor 610, sensor board 620, wireless module 630, battery 640, and antenna 650.

[0032] Sensor board 620 is coupled to humidity sensor 610 and wireless module 630. Wireless module 630 is coupled to battery 640 and antenna 650. Smart tee base 315 is configured to measure the relative humidity and temperature of the environment.

[0033] According to one embodiment, the humidity sensor is a C5M3 by Sensorbase Technologig; the wireless module is a Mica2 by Crossbow Technology; and the sensor board is a MTS310CA sensor board by Crossbow Technology.

[0034] FIG. 7 illustrates a system diagram of a base station, in accordance with aspects of the present invention. As illustrated, base station 700 includes wireless processor module 710, interface board 720, gateway 730, battery 740, and antenna 750.

[0035] Base station 700 is configured to receive sensor data from smart communicating sports equipment and then pass the data to a host computing device. According to embodiments of the invention, the interface board is a Mica2 by Crossbow Technology, and the wireless module is an MIB510CA or MIB500CA interface/programming board by Crossbow Technology, and the gateway can be a computing device such as the mobile device or computing device illustrated in FIG. 3.

[0036] Interface board 720 may couple to gateway device 730 either wirelessly or through a wired connection. For example, an RS-232 serial interface could be used, a hard-wired Ethernet connection, or a wireless network connection may be used.

[0037] FIG. 8 illustrates exemplary mobile device screen shots relating to sensor data received from smart communicating sports equipment, in accordance with aspects of the invention. Screen shot 910 illustrates the radial component of a golf club. Screen shot 920 illustrates a tangential component of a golf club. The radial component and tangential component were received from an accelerometer sensor. Screen shot 930 shows the temperature and relative humidity as measured by the tee base as described in FIG. 6, and the speed of the ball and speed of the club. In this particular embodiment, the golf club is a putter. The speed of the ball is measured as discussed in relation to the smart ball as described in FIG. 5. Many types of displays may be configured to show the user sensor data in a meaningful way.

#### Illustrative Operating Environment

[0038] With reference to FIG. 1, one exemplary system for implementing the invention includes a computing device, such as computing device 100. In a very basic configuration, computing device 100 typically includes at least one processing unit 102 and system memory 104. Depending on the exact configuration and type of computing device, system memory 104 may be volatile (such as RAM), non-volatile (such as ROM, flash memory, etc.) or some combination of the two. System memory 104 typically includes an operating system 105, one or more applications 106, and may include program data 107. In one embodiment, application 106 may include a sports application 120 that is used in processing and displaying sensor data received from smart communicating sports equipment. This basic configuration is illustrated in FIG. 1 by those components within dashed line 108.

[0039] Computing device 100 may have additional features or functionality. For example, computing device 100

may also include additional data storage devices (removable and/or non-removable) such as, for example, magnetic disks, optical disks, or tape. Such additional storage is illustrated in FIG. 1 by removable storage 109 and non-removable storage 110. Computer storage media may include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, program modules, or other data. System memory 104, removable storage 109 and non-removable storage 110 are all examples of computer storage media. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by computing device 100. Any such computer storage media may be part of device 100. Computing device 100 may also have input device(s) 112 such as keyboard, mouse, pen, voice input device, touch input device, etc. Output device(s) 114 such as a display, speakers, printer, etc. may also be included.

[0040] Computing device 100 may also contain communication connections 116 that allow the device to communicate with other computing devices 118, such as over a network. Communication connection 116 is one example of communication media. Communication media may typically be embodied by computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. The term computer readable media as used herein includes both storage media and communication media.

[0041] FIG. 2 illustrates a mobile computing device that may be used in one exemplary embodiment of the present invention. With reference to FIG. 2, one exemplary system for implementing the invention includes a mobile computing device, such as mobile computing device 200. Mobile computing device 200 includes processor 260, memory 262, display 228, and keypad 232. Memory 262 generally includes both volatile memory (e.g., RAM) and non-volatile memory (e.g., ROM, Flash Memory, or the like). Mobile computing device 200 includes operating system 264, such as the Windows CE operating system from Microsoft Corporation, or another operating system, which is resident in memory 262 and executes on processor 260. Keypad 232 may be a push button numeric dialing pad (such as on a typical telephone), a multi-key keyboard (such as a conventional keyboard). Display 228 may be a liquid crystal display, or any other type of display commonly used in mobile computing devices. Display 228 may be touch-sensitive, and would then also act as an input device.

[0042] One or more application programs, such as sports application 266, are loaded into memory 262 and run on the operating system 264. Sports application 266 on mobile

computing device **200** is programmed to process sensor data received from smart communicating sports equipment. The sports application may reside in the hardware or software of the device. Mobile computing device **200** may also include volatile and non-volatile storage within memory **262**. Memory **262** also includes sports data store **268** that is used to store sensor data and data related to the sports application. Data store **268** may be a global facility for storing sports related data for applications on the device.

[0043] Mobile computing device **200** includes power supply **270**, which may be implemented as one or more batteries. Power supply **270** might further include an external power source, such as an AC adapter or a powered docking cradle that supplements or recharges the batteries.

[0044] Mobile computing device **200** is shown with two types of optional external notification mechanisms: LED **240** and audio interface **274**. These devices may be directly coupled to power supply **270** so that when activated, they remain on for a duration dictated by the notification mechanism even though processor **260** and other components might shut down to conserve battery power. Audio interface **274** is used to provide audible signals to and receive audible signals from the user. For example, audio interface **274** may be coupled to a speaker for providing audible output and to a microphone for receiving audible input, such as to facilitate a telephone conversation.

[0045] Mobile computing device **200** also includes communications connection(s), such as a wireless interface layer, that performs the function of transmitting and receiving communications. Communications connection **272** facilitates wireless connectivity between the mobile computing device **200** and the outside world. According to one embodiment, transmissions to and from communications connection **272** are conducted under control of the operating system **264**.

[0046] The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

What is claimed is:

1. A system for smart communicating sports equipment, comprising:

a first piece of sports equipment, comprising:

an embedded sensor that is configured to produce sensor data;

a wireless processor module coupled to the embedded sensor that is configured to receive the sensor data and send data over a wireless link, wherein the data relates to the sensor data;

an antenna that is coupled to the wireless processor module; and

at least one power source configured to provide power to the embedded sensor and wireless processor module; and

a computing device, comprising:

a data store;

a network interface configured to communicate with the first piece of sports equipment and that is configured to receive the data from the wireless processor module;

a display configured to display data relating to the data obtained by the wireless sensor; and

an application configured to perform the following actions, including:

receiving the data;

processing the data; and

instructing the display to display the processed data.

2. The system of claim 1, further comprising a base station that is wirelessly coupled to the first piece of sports equipment and that is configured to receive the data over the wireless link and provide the data to the computing device.

3. The system of claim 1, wherein the embedded sensor is a sensor that is configured to measure at least one of the following: acceleration, temperature, humidity, spin, location, and pressure.

4. The system of claim 3, wherein the first piece of sports equipment comprises a club, wherein the embedded sensor comprises at least one of: a 3-D acceleration sensor and an embedded pressure sensor that is coupled to the wireless processor module.

5. The system of claim 3, wherein the first piece of sports equipment comprises a ball, wherein the embedded sensor comprises at least one of: a 3-D acceleration sensor and a location sensor that is coupled to the wireless processor module.

6. The system of claim 3, wherein first the piece of sports equipment comprises a tee base, wherein the embedded sensor comprises an environmental sensor that is coupled to the wireless processor module and that is configured to measure at least one of: temperature; humidity; and wind speed.

7. The system of claim 3, further comprising a second piece of sports equipment that includes a second embedded sensor and is configured to communicate with the first piece of sports equipment.

8. The system of claim 3, wherein the wireless processor module includes an operating system that includes a wireless radio stack and a scheduler and that is configured to perform operations relating to the sensor data.

9. A computer-readable medium having computer-executable instructions for processing sensor data received from a piece of smart communicating sports equipment, the instructions comprising:

receiving sensor data from the piece of smart communicating sports equipment, wherein the sensor data is produced from an embedded sensor and the sensor data is sent over a wireless link;

processing the sensor data; and

displaying the sensor data to a user.

10. The computer-readable medium of claim 9, wherein receiving the sensor data comprises receiving the sensor data on a mobile computing device.

11. The computer-readable medium of claim 10, wherein the sensor data relates to at least one of the following: acceleration, temperature, humidity, spin, location, and pressure.

**12.** The computer-readable medium of claim 11, wherein the sports equipment comprises a club and wherein the sensor data is data from at least one of: a 3-D acceleration sensor and a pressure sensor.

**13.** The computer-readable medium of claim 11, wherein the sports equipment comprises a ball and wherein the sensor data is data from at least one of: a 3-D acceleration sensor and a location sensor.

**14.** The computer-readable medium of claim 11, wherein the sports equipment comprises a tee base and wherein the sensor data is data from an environmental, wherein the environmental sensor is configured measure at least one of: temperature; humidity; and wind speed.

**15.** A method for communicating between a smart communicating piece of sports equipment and a computing device, comprising:

obtaining sensor data from an embedded sensor on the smart communicating piece of sports equipment;

sending the sensor data from the smart communicating piece of sports equipment over a wireless link to the computing device;

wherein the computing device is configured to perform the following actions:

receiving the sensor data from the piece of smart communicating sports equipment;

processing the sensor data; and

displaying the sensor data to a user.

**16.** The method of claim 15, wherein the computing device is a mobile computing device.

**17.** The method of claim 16, wherein the sensor data relates to at least one of the following: acceleration, temperature, humidity, spin, location, and pressure.

**18.** The method of claim 16, wherein the smart communicating piece of sports equipment comprises a club and wherein the sensor data is data from at least one of: a 3-D acceleration sensor and a pressure sensor.

**19.** The method of claim 16, wherein the sports equipment comprises a ball and wherein the sensor data is data from at least one of: a 3-D acceleration sensor and a location sensor.

**20.** The method of claim 16, wherein the sports equipment comprises a tee base and wherein the sensor data is data from an environmental, wherein the environmental sensor is configured measure at least one of: temperature; humidity; and wind speed.

\* \* \* \* \*