DISTANCE DETERMINATION METHOD AND SYSTEM FOR A GOLF COURSE

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ABSTRACT

The present invention provides a system for updating mobile distance determination units on a golf course that includes a first mobile unit that determines a new location for a point-of-interest defined for a golf course. The first mobile unit wirelessly transmits update data to identify the new location to a base station computer. The base station computer processes the updated data for broadcasting to activated second mobile distance determination units. The base station computer then wirelessly broadcasts the updated data from the base station computer to the second mobile distance determination units. The second mobile distance determination units update their point-of-interest location data and use this updated data to determine distances between the second mobile distance determination units and the new locations. The mobile distance determination units may operate in a golfer mode to provide distance measurements to golfers, may operate in the greenskeeper mode to update the pin positions, or may operate in a surveyor mode to define new points of interests and their locations on the golf course.
Fig. 5
**Fig. 6**

Hole: 9

The Green Slopes Toward the Front. Play Shot to the Left Front of the Green to avoid Right Side Bunker. See for Previous Screen.

**Fig. 7**

Hole: 10

Fig. 8a

Hole: 2
Select Point of Interest
from List to Range
- Pin Position
- Back of Green
- Front of Green
- Front Left Bunker
- Right Fairway Bunker
- Creek

Fig. 8b

Hole: 2
Position Unit over “Front Left Bunker” & Press YARDAGE to Set
Select SEL for Help
Hole:

Page Alert

"Please Report to the first Tee"

Indicate receipt by pressing SEL
Receive Signal from user to Provide Yardage Measurement to PIN Position

Determine Distance to PIN for Golfer Relevant Points-of-Interest

Display Distances to PIN for Golfer Relevant Points-of-Interest & Option for Pro-Tip

1420
Pro-Tip Selected

Yes

Fig. 14a
1434 | Receive Yardage Request from User

1431 | Indicate to user that Hole Selected is Incorrect & Request Entry of New Hole

1430 | Is Latitude Longitude Altitude Specified Range of Indicated Hole

1432 | Calculate Distances to Points-of-Interest (POI)

1436 | Determine whether POI are behind Golfer OR W/O Max & Min Range Values for Golfer Specific Parameters

1438 | Eliminate from Display POI behind Golfer & Outside of Golfer Specific Parameters

Fig. 14b
Calculate Sample G.P.S. Position Reading

Compare Sample to Average of past Readings

Average New Sample with Past Readings for Position Measurement

Yes

Is Sample within certain Range of Average?

No

Calculate B New Position Measurements

Average New Position Measurements for Position Measurement

Fig. 14c
Select Hole # 1502

Position HHU over Hole 1504

Receive signal from Greens Keeper to determine location of new hole 1508

Process GPS signals to determine HHU location 1510

Indicate that hole selected is incorrect and request entry of new hole 1514

Latitude/Longitude within range of hole? 1512

Yes

Wirelessly transmit updated pin position, unit ID, and other distance calculation parameters to base station 1518

Wirelessly broadcast updated PIN positions from base station to golfer's HHU's 1524

Store new PIN position to base station unit database 1522
Select Hole

Provide & Display List of Point-of-Interest Types for Golf Course

Determine Point-of-Interest Type Selected by User

Position HU over Selected POI Type

Receive Signal from Surveyor to Determine HU Location

Determine Location of HU

Wirelessly Transmit Selected Point-of-Interest Type and Determined Location to Base Station

Store New POI in Base Station Database

Fig. 16
DISTANCE DETERMINATION METHOD AND SYSTEM FOR A GOLF COURSE

FIELD OF THE INVENTION

[0001] The present invention relates to systems for determining distances on golf courses, and particularly to systems which determine the distances to points-of-interest using electronic means.

BACKGROUND OF THE INVENTION

[0002] Whether a person is a professional, seasoned, or novice golfer, one of the key concerns of the golfer on the golf course is determining the distance from the current ball position to various points-of-interest. These points-of-interest often include, the pin position, the front or back of the green, sand traps, trees, creeks, lakes, etc. Over time, various methods for determining the distance to these points-of-interest have been devised. Such methods include techniques as simple as walking off the distance between the ball and the points-of-interest, guessing based on vision, or a combination of walking off the distance from yardage markers positioned on the golf course and guessing. While these methods have served golfers for a number of years, other more technologically advanced systems have been devised. These advanced systems include binoculars with a laser distance device, electronic point identifier units, and global positioning satellites. Some of these systems may be limited due to distance limitations on the golf course. Moreover, in some cases, the systems may be inaccurate due to the golf course environment.

[0003] The binocular system requires the user to see the points-of-interest for which the distance measurement is to be determined. Being able to see the points-of-interest is not always possible particularly when the golfer has poor vision or in the morning time when the golf course is foggy. With the point identifier units, these units require the positioning of an electronic unit on a point-of-interest. Positioning an electronic unit on a flag pole is not always practical because the flag pole is frequently moved which may cause physical damage to the unit or the unit may be exposed to inclement weather. Additionally, in order to avoid wear and tear on such a unit, the golf course personnel may be required to remove the units each day. This can be a very time consuming task.

[0004] In a global positioning system (GPS), the location of a golfer or mobile unit associated with the golfer may be determined using position signals received from satellites. Many of these systems include a fixed, central base station at the golf course club house and numerous mobile units positioned on golf carts. Mobile units typically include a GPS receiver and a radio communications transceiver. The mobile units contain a database of records that include the locations of various points-of-interest on the golf course. The mobile unit has a GPS receiver and determines its location on the golf course and the base station unit typically has a GPS receiver which determines its location on the golf course. The base station unit calculates its GPS position from the signals and compares the calculated position signal to the known fixed location of the base station to compute a differential position correction. These differential position corrections are transmitted to the mobile units to enable the mobile units to determine a more accurate position estimate.

[0005] The GPS system is a satellite-based radio navigational system capable of determining continuous position, velocity and time information for an unlimited number of users. The GPS is funded and controlled by the U.S. Department of Defense and the constellation of GPS satellites includes 24 satellites, 21 operational navigational satellites, and three (3) active spares, in 12-hour orbits around the earth. The satellite orbits repeat the same ground track and configuration approximately every 24 hours (four minutes earlier each day). To cover the earth, six orbital planes with nominally four satellites each are equally spaced 60° apart and are inclined at approximately 55° with respect to the equator. A user tracking GPS signals typically can receive signals from five to eight satellites from any location on the earth.

[0006] A GPS receiver converts the various satellite signals into position, velocity, and time estimates. Signals from four satellites are typically required to determine relative position as a function of latitude, longitude, altitude, and time. The GPS receiver processes the multiple signals from the available satellites simultaneously to achieve these position measurements. A GPS receiver at a known surveyed location can be used to compute error corrections which are transmitted to other nearby receivers. These receivers use these error corrections in combination with their satellite data to produce a more accurate differential GPS (DGPS) position correction. DGPS systems are frequently implemented to achieve a higher degree of accuracy than possible with absolute (single receiver) measurements. Some common-mode errors include selective availability (SA) and bias errors, such as satellite clock errors, ephemeris data errors and tropospheric delay effects. DGPS does not correct errors due to multi-path or noise detected at the receiver.

[0007] While using GPS to provide position estimates to conventional mobile distance units operated by golfers are useful, pin changes and the associated updates must be completed before the golfer begins the round so that the mobile unit can be updated with the correct positions. Because the pin positions on a golf course are routinely changed in the morning after some golfers begin to play, the mobile units operated by the golfers will not have the most recent pin positions information. In other GPS mobile distance systems for golf courses, the pin positions are determined by basing distance calculations on a pre-determined daily pin area position. With the day of week identified, the distance to the pin position area for the day of the week can be determined. However, these estimates may not be as accurate as a golfer would like. Furthermore, although DGPS systems are accurate, some golfers, particularly
Expert golfers, Prefer that the system yield a better margin of error than these systems typically provide. Additionally, in many of the golf distance determination systems, points-of-interest are displayed to a golfer that are not relevant to the golfer's particular shot. Displaying irrelevant points-of-interest can be distracting to a golfer who is evaluating his options presented on a display screen of a mobile distance determination unit.

[0008] Thus, there is a need in the art for a distance determination system which enables efficient updating of databases of mobile distance units and that there is a need in the art for a distance determination unit which accurately measures distances to points-of-interest and provides only relevant information to the golfer for use in evaluating the golfer's options.

SUMMARY OF THE INVENTION

[0009] Generally described, the present invention provides a distance determination system that enables efficient updating of databases of mobile distance units and that accurately measures distances to points-of-interest.

[0010] More particularly described, an embodiment of the present invention provides a system for updating mobile distance determination units on a golf course that includes a first mobile unit that determines a new location for a point-of-interest defined for a golf course. The first mobile unit wirelessly transmits update data to identify the new location to a base station computer. The base station computer processes the updated data for broadcasting to activated second mobile distance determination units. The base station computer then wirelessly broadcasts the updated data from the base station computer to the second mobile distance determination units. The second mobile distance determination units update their point-of-interest location data and use this updated data to determine distances between the second mobile distance determination units and the new locations.

[0011] Another embodiment of the present invention provides a mobile distance determination unit that operates in one of five modes of operation. In the first mode of operation the mobile distance determination unit can determine a first location of the mobile distance determination unit, calculate the distances between the first location and predefined points-of-interest locations stored in the mobile distance determination unit, and display the distances calculated between the first location and the predefined points-of-interest. In the second mode of operation, the mobile distance determination unit can determine a second location of the mobile distance determination unit and associate the second location with a point-of-interest on a golf course, thereby defining a point-of-interest/second location association. Also, in the second mode of operation, the mobile distance determination unit can transmit the point-of-interest/second location association to a central operating station for communication to mobile distance determination units. In a third mode of operation the mobile distance determination unit can be used to locate the pin positions on the green. In a fourth mode of operation the mobile distance determination unit can be used to test the system and assess the GPS and RF signal coverage available on the golf course. In a fifth mode of operation the mobile distance determination unit can be used to track assets on the golf course.

[0012] A first software module may be downloaded from an activation station to the unit when the user indicates that the unit is to operate in a first mode of operation. Similarly, a second, third, fourth and fifth software module may be downloaded from the activation station to the unit when the user indicates that the unit is to operate in the second, third, fourth or fifth mode of operation, respectively.

[0013] In the second and third modes of operation, a user may define points of interest on the golf course to be stored for use in determining distances to these points of interest. Specifically, the unit provides a list of point-of-interest types available to be defined for the golf course. The mobile unit then transmits the point-of-interest type selected by the user and the location of the selected point-of-interest type in association with each other to define the position of the point-of-interest data in the database for communication to mobile units. In the fourth mode of operation, the unit may be used to assess GPS and RF coverage of the golf course. In the fifth mode of operation, the unit may be used to track the location of movable assets such as a mower to establish time standards.

[0014] Another embodiment of the present invention provides a method of alerting a user that a distance measurement request contains inaccurate data in the mobile distance determination system. In this method, an indication is received from a mobile distance determination unit that a distance measurement is to be made for a user identified point-of-interest. The location of the mobile distance determination unit is determined based on global positioning system satellite signals and the user is alerted that the newly calculated position of the point-of-interest identified by the user is not correct if the location determined is not within a predefined range of known location coordinates for the point-of-interest. This process when modified can also alert a user that the unit has been taken into an unacceptable or prohibited area.

[0015] Another embodiment of the present invention includes a mobile distance determination unit for use in determining distances on golf courses that has a processor that is used to determine a first location of the unit, to calculate the distances between the first location and predefined points-of-interest locations stored in the mobile distance unit, and to display the distances calculated between the first location and the predefined points-of-interest. This mobile distance unit also includes a paging unit located in the mobile distance unit for providing an pager message signal to a golfer. For example, the message signal may indicate to a golfer that the golfer is to report to the first tee or that the golfer has taken the unit into a prohibited area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a diagram of the overall distance determination system of the present invention.

[0017] FIG. 2 is a diagram of a base station computer system and point of sale terminal used for activating a hand-held unit.

[0018] FIG. 3 is a diagram of a screen of the point of sale terminal used to receive golfer specific parameters.

[0019] FIG. 4 is a block diagram of the components of the base station computer system.
FIG. 5 is a diagram of the hand-held unit and the golfer mode display screen.

FIG. 6 is a diagram of the pro tips screen presented in the golfer mode of the hand-held distance unit.

FIG. 7 is a diagram of the screen displayed in the greenskeeper mode of the hand-held distance unit.

FIG. 8 is a diagram of the points-of-interest type selection screen of the surveyor mode of the hand-held distance unit.

FIG. 9 is a diagram of the distance determination screen for the surveyor mode of the hand-held distance unit.

FIG. 10 is a diagram of the test mode of the hand-held distance unit.

FIG. 11 is a block diagram of the components of the hand-held distance unit.

FIG. 12 is a diagram of the components of the auxiliary unit of the base station system.

FIG. 13 is a flow diagram of the activation processes of the present invention.

FIGS. 14a-14c are flow diagrams of the processes implemented in the greenskeeper mode of the present invention.

FIG. 15 is a flow diagram of the operation of the processes of the greenskeeper mode.

FIG. 16 is a diagram of the processes implemented in the surveyor mode on the hand-held distance unit.

DETAILED DESCRIPTION OF THE INVENTION

A description of the preferred embodiment of the present invention is provided in connection with the accompanying Figures. Aspects of the invention provide an improved system and method for determining the distance between the golfer and various points-of-interest on a golf course. Advantagesously, a distance determination and communications system 10 of the present invention enables changes in golf hole or pin locations to be communicated in real-time to a central base station, and the central base station may transmit the pin location updates in real-time to hand-held distance determination units carried by golfers on the golf course. The position of a golf hole on a golf course is often referred to as the pin position because a flag or pin extends up from the hole. The transmission of location updates in real-time ensures that golfers have accurate pin location information and saves time by not requiring the hand-held distance unit to be returned to the club house or central base station for updates.

As used herein the terms "hand-held distance unit," "mobile distance determination unit," "HIDU," "hand-held distance determination unit," and "distance determination unit" are used interchangeably.

A hand-held distance determination unit operating according to the principles of the present invention may serve multiple functions within the distance determination and communication system 10. Specifically, the distance determination unit may operate in five different modes: a golfer mode, a greenskeeper mode, a surveyor mode, a test mode and a asset tracking mode. Each of these modes provides a different functionality within the distance determination and communication system 10. In addition to providing operational efficiency advantages over prior systems, the present invention also incorporates modules that display golf course information to a golfer based upon specific parameters entered in the system about the golfer. Other features of the system increase the accuracy of determining position fixes or locations for the golfer and includes features that increase the operational life of the battery-powered mobile unit. These features are described in more detail in connection with the Figures.

Referring to FIG. 1, an overall diagram of the distance determination and communication system 10 of the present invention is illustrated. A system 10 of the present invention includes a central base station 14 located at club house 15, navigational satellites 16A-16D and numerous mobile distance units, such as hand-held distance unit 18. The navigational satellites 16A-16D transmit global position system (GPS) position signals 28 that are detected at a central base station via a base station GPS antenna 22 and the position signals 28 are also detected at the hand-held distance unit 18 by a hand-held distance unit GPS antenna 26. With this information, the hand-held distance unit 18 and the central base station 14 can determine their respective locations. The base station unit 14 at the club house 15 may determine the amount of error in the GPS position signals and transmit radio frequency (RF) signals 30 to the hand-held distance unit 18 to provide a correction signal to the hand-held distance unit 18 so that accurate distance measurements can be provided to the golfer 34. The radio frequency signals 30 are transmitted between the base station and the hand-held distance unit 18 via a base station RF antenna 36 and a hand-held distance unit RF antenna 38. With the correction signal information, the hand-held distance unit 18 can determine a more accurate distance to a point-of-interest, such as the distance to the flag or pin 42, and display this information to the golfer 34. Other information may be transmitted between the base station 14 and hand-held distance unit 18 via RF signals 30 and the radio antennas 36 and 38. The base station 14 comprises means for receiving and processing GPS signals, means for receiving and transmitting RF signals, means for communicating data, instructions and messages to an operator, means for receiving inputs from the operator for processing by the base station 14, and means for downloading at least one of a plurality of operating mode modules to the mobile distance determination unit 18.

The mobile distance determination unit 18 comprises means for receiving and processing an operating mode module downloaded from the base station 14, means for receiving and processing GPS signals, means for receiving and transmitting RF signals, means for communicating data, instructions and messages to a user, and means for receiving inputs from said user for processing by the mobile distance determination unit. The mobile distance determination unit 18 is operable in at least one of a plurality of modes in accordance with the information and data contained in the downloaded operating mode module.

Other operations of the hand-held distance unit 18 include wirelessly transmitting pin position updates to a central base station, as well as defining points-of-interest on
the golf course which may also be wirelessly transmitted to the base station. The update information and newly defined points-of-interest are transmitted from the hand-held distance 18 unit via the hand-held unit RF antenna 38 to the base station RF antenna 36. This information may be wirelessly transmitted to all golfers on the golf course immediately after the updated or new location has been received and processed at the base station. Depending on the mode of operation the hand-held distance unit 18 can receive pin position updates or transmit points-of-interest updates.

[0039] Referring to FIG. 2, a base station 14 that is maintained at a fixed location at the club house 15 is illustrated. The base station in the preferred embodiment comprises a base station computer 50, a point of sale terminal 54 and an activation socket 56 for receiving a hand-held distance unit 18. The base station computer 50 has a database, recorded tables for the different points of interest on the golf course, and operational parameters for the hand-held units 18. The points-of-interest include the location of pins, the locations of sand traps, the location of other landmarks on the golf course, or the location of the pins or markers on the practice areas of the course such as the driving range. The base station 14 is the central point of communication for mobile distance units 18 on the golf course and the base station computer 50, in conjunction with a point of sale terminal 54, activates hand-held distance units 18 for use in connection with the system 10. The base station computer 50 and the point of sale terminal 54 communicate the points-of-interest data via a bi-directional serial link 58. An activation socket 56, which is connected to the point of sale terminal 54, is used in activating the hand-held distance unit 18. Alternatively, the base station computer can be programmed to provide the functionality found in the point of sale terminal 54. This would eliminate the need for the point of sale terminal allowing the activation socket 56 to be connected directly to the base station computer 50. The specific points-of-interest data, software, or other information downloaded from the base station computer 50 to the hand-held distance unit 18 is determined based on which mode of operation is selected for the hand-held distance unit 18. As illustrated, five modes of operation are available for the hand-held distance unit 18. These modes are the golfer mode 60, a greenskeeper mode 62, a surveyor mode 64, a test mode 66, and an asset tracking mode 68.

[0040] When hand-held distance determination unit 18 is to be activated, the hand-held distance unit 18 is placed in the activation socket 56 where the base station unit can establish a direct serial communication with the hand-held distance unit 18. This direct serial communication occurs via link 58 and point of sale terminal 54. When the hand-held distance unit 18 senses a charge voltage that is present in the activation socket 56, the hand-held distance unit 18 will power-up for activation. The point of sale terminal 54 then verifies proper authorization or payment for the user selected mode of operation and initializes several parameters for the hand-held distance unit. The operational parameters initialized are the current time, position, almanac and ephemeris data for the GPS satellites (16A-16D), UHF transmit and receive (TX/RX) frequencies, coordinate conversion scale factors, and other software variables. Also, depending upon the selected mode of operation a points-of-interest table, pro tip table, or personality parameters are initialized. The hand-held distance unit 18 may also utilize a power cycling circuit. When a duty cycling program is used, a particular power cycling mode or operational mode as discussed above is also initialized. Advantageously, this download of parameters and course data permits the hand-held distance unit 18 to be used on a different golf course without the need to retrofit the unit.

[0041] As generally noted above, when the hand-held distance unit 18 is in the golfer mode 60, the distances between points-of-interest and the golfer are displayed on a display screen of the unit 18. For example, when a golfer desires to know the distances to the points-of-interest, the golfer inputs information identifying the golfer’s local area (typically the hole the golfer is playing) and activates a button on the hand-held unit. The location of the golfer is determined using the GPS receiver of hand-held distance unit 18 and the hand-held distance unit 18 calculates the distances between the golfer and pre-defined points-of-interest based on information stored in the unit. In the preferred embodiment of the present invention, only the points-of-interest data that are relevant to the particular golfer is displayed. That is, only selected points-of-interest data from the total points-of-interest stored in association with the hole is displayed. For example, the present invention takes into account the distance that a golfer is able to hit a golf ball or the skill of the golfer (these items are personality parameters). For example, distances more than 270 yards away, except for the pin position which is always displayed, or points-of-interest behind the golfer are not displayed. Thus, to ensure installation or activation of the proper software version for a golfer in the hand-held distance unit 18 a person operating the point of sale terminal 54 selects the golfer mode 60, and a golfer mode screen is displayed for obtaining golfer specific parameters.

[0042] Referring to FIG. 3, the golfer mode display screen 70 is illustrated. When the golfer mode screen 70 is displayed, data entry fields are presented for a user to enter the golfer’s specific skill data. For example, the golfer mode display screen 70 may have an input field 72 for the golfer’s handicap and an input field 74 for the driving distance of the golfer. These golfer specific parameters are correlated or matched with information in the base station computer 50 (FIG. 2) to select the specific software or initialize parameters in the software to define which selected points-of-interest data are to be displayed based upon the golfer’s skill level.

[0043] Referring to FIG. 4, a more detailed view of the base station computer 50 which maintains and processes point-of-interest data is illustrated. A golf information database 80 is located within or accessible by the base station computer 50. The golf information database 80 includes golfer modules 78A and 78B and includes a points-of-interest/pro tip database 82. The golfer modules cause different points-of-interest to be displayed on a hand-held distance unit 18 depending on the golfer’s identified handicap, driving distance or other parameters. It should be appreciated that independent golfer modules 78 may be associated with a specific set of golfer specific parameters for use in determining which points-of-interest are to be displayed or a single golfer mode module may contain adjustable parameters within the module golfer specific points-of-interest. The golfer information database 80 also includes a greenskeeper module 84, a surveyor module 86, a test mode module 87 and an asset tracking module 85. The
greenskeeper module 84, surveyor module 86, the test module 87 and the asset tracking module 85 may also be downloaded to the hand-held distance unit 18 to provide the respective functionality as discussed herein. The golfer information database 80 also contains operational parameters (not shown) used by the hand-held distance units 18. The operations of the base station computer 50 are controlled and managed by a base station processor 88.

The base station computer 50 also contains a paging unit 90 and an auxiliary unit 92. The auxiliary unit 92 contains the primary circuitry for establishing wireless remote communication with GPS satellites 16A-16D and hand-held distance units 18. The paging unit 90 enables golf course personnel to page golfers via the hand-held distance units 18. The paging unit 90 can be used to notify golfers of their tee time, delays in play, or other information. The paging unit utilizes the radio transceiver in the auxiliary unit 92 to transmit the page messages to the hand held distance unit 18.

The base station computer 50 is connected to and communicates with the point-of-sale terminal 54 by a serial link 58 and a base station unit-POS link 57. The POS terminal 54 includes a processor 93 and an activation unit 94. The combination of the base station computer 50, POS terminal 54 and activation socket 56 comprises the base station 14 for the system 10. The processor 93 manages and controls the operations of the POS terminal 54. The processor 93 and the activation unit 94 activate a hand-held distance unit 18 for the appropriate mode of operation in conjunction with the base station computer 50. Alternatively, the hand-held distance unit 18 can be activated using a wireless transmission from the base station 14 using RF signals 30 and antennas 36 and 38.

When a hand-held distance unit 18 is being activated for the golfer mode 60, the base station computer 50 downloads the appropriate operating module that includes operating parameters for the distance unit 18, the points-of-interest data, pro tip data, and the appropriate golfer mode module 78 to the hand-held distance unit 18. With the downloaded information, the hand-held distance unit 18 is now equipped for operation and to display golf course information pertinent to the individual golfer. The surveyor mode module 86 includes a list of possible points-of-interest types that may be defined for the golf course when the hand-held unit 18 is activated in the surveyor mode. The surveyor module computes and wirelessly communicates points-of-interest positions defined by a user to the base station unit for storage. The greenskeeper module module 84 computes updated pin positions and wirelessly communicates these updates to the base station unit 14. The asset tracking module 85 computes current position of the asset and wirelessly communicates this to the base station 14. The test mode module 87 computes various RF, GPS, and other hand held unit 18 operational data and wirelessly communicates that data to the base station 50.

Referring to FIG. 5, the hand-held distance unit 18 is shown in more detail. The screen 96 of the hand-held distance unit 18 is displayed when the hand-held distance unit 18 is operating in the golfer mode 60. As illustrated, various points-of-interest are displayed on the display screen 96. Particularly, for the hole shown, a hole field 98 giving the number of the hole being played is displayed along with the pin distance field 100, back of the green distance field 102, front of the green distance field 104, and the right bunker position field 105. Additional fields providing other points-of-interest may also be displayed depending on the hole being played. The hand-held distance unit display screen 96 also has an option 108 for selecting a pro tip.

The operation of the hand-held distance unit 18 is simple and may be controlled by the use of only four input pushbuttons which are used to initiate varied operations in each of the different modes. Particularly, the hand-held distance unit 18 contains a next hole button (NEXT) 110, a previous hole button (PREV) 112, a yardage request button (YARDAGE) 114, and a soft-key button (SEL) 116. The golfer defines which hole the golfer is playing by pressing the next hole button 112 or the previous hole button 110. When the golfer presses the previous hole button 110, the golf hole number decrements. When hole “1” is displayed and the previous hole button is pressed, the 18th hole appears. Alternatively, if use of the hand held distance unit 18 on the practice range is desired, the location for the range targets and other points of interest on the practice range can be entered in hole “0” or hole “19” and this “hole” would display when the golfer stepped through the holes, however instead of the label hole “0” or hole “19” the hand-held distance unit 18 would display “Driving Range” in the hole field 98. The next hole button 112 performs the opposite function of the previous hole button 110 and causes the next golf hole after the currently displayed golf hole to be displayed in the hole field 98. Alternatively, the hand held distance unit 18 can be configured when in the golfer mode 60 to automatically advance holes that are displayed as the golfer plays his or her round of golf based on the hand held distance unit’s current position in relation to known positions on the golf course or to automatically determine its position on the course when it is in a relatively static position.

When a golfer desires to obtain yardage information, the golfer stands near his ball and presses the yardage button 114. Although the GPS receiver within the hand-held distance unit 18 is continuously on and determining the current position of the hand-held unit, the yardage information for the particular hole is not displayed until the yardage button 114 is pressed. When the yardage button 114 is pressed, the system determines the current location of the golfer and then utilizes the known location of other points-of-interest on a hole to calculate the distance from the user’s current location to these points-of-interest. These points-of-interest are displayed in the fields 100, 102, 104, and 106 as discussed above. As discussed above, software routines have been incorporated to eliminate points-of-interests on a particular hole which are too far away to be of concern for the particular golfer (maximum range value) or too close, such as less than 25 yards away (minimum range value). These software routines for the displaying the points-of-interest data preferably do not display points-of-interests for the hole that are behind a golfer. Therefore, the hand-held distance unit of the present invention only displays information that is truly relevant for the golfer’s current golf shot. Preferably, the distance to the pin field 100 is always displayed. After the yardages are displayed to the various points-of-interest, the golfer can press the soft key button 116 to obtain a pro tip.
In FIG. 6, the information displayed on the display screen 96 when the pro tip 108 is selected is illustrated. When the pro tip 108 is selected in the golfer mode 60, a pro tip 130 for the hole and the current shot that the golfer is playing is provided. For example, the pro tip 130 displayed in FIG. 6 advises the golfer that “The green slopes toward the front. Play shot to the left front of the green to avoid right side bunker.” The pro tip 130 is one of many pro tips stored in the database of the hand-held distance unit 18. The pro tips stored in the databases used with the present invention may correlate the pro tips to the golfer’s particular handicap and to the distance to the pin and/or various points-of-interest. The user may press the SEL button 116 to return to the previous screen where the distances to points-of-interest based on the user’s last yardage request are displayed. Additionally, from the pro tip screen 130, the user may press the yardage button 114 to obtain a new set of distances for the hole display.

Referring to FIG. 7, the information displayed on screen display 96 when the hand-held distance unit 18 is operated in the greenskeeper mode 62 is shown. When the hand-held distance unit 18 is operating in the greenskeeper mode 62, a greenskeeper or user is able to define new pin locations on the golf course and these locations may be wirelessly transmitted in real-time to the base station 14 for updating. As known, the pin positions on golf courses are typically moved on a daily basis. When the pin positions are moved, the system of the present invention provides an improved method for tracking the new pin positions and provides pin updates to all users of the system 10 when the updates are made to ensure that all users have the latest updates for the pin positions. The system could be said to have four modes of operation in that the greenskeeper mode can be viewed as a subset of the survey mode in that the points-of-interest to be determined is limited to the pin locations on the greens.

When the greenskeeper or user moves the pin to a new position on the green, the new pin position is measured and transmitted back to the base station 14 for storage and processing. The greenskeeper selects the appropriate hole with the previous hole button 110 or the next hole button 112 (or the hole can be automatically determined as previously discussed previously). The greenskeeper then positions the hand-held distance unit over the hole and presses the yardage button 114 to obtain measurements for the new hole location. Several measurements are calculated when the user presses the yardage button and these measurements are compared to determine whether an accurate measurement for the hole has been obtained. The accuracy of the measurement is verified by two criteria. First, several sets of GPS readings are obtained after the user presses the yardage button 114 and are compared to determine if the all are within a small error range of each other. Also, GPS parameters may be compared and weighted. If the readings are all within the selected error criteria of each other, the measurements are averaged to produce the location for the current hole position, which is the longitude, latitude, and altitude for the position where the golfer pressed the yardage button is obtained.

The latitude, longitude and altitude measurement obtained for the hole is compared to the known latitude, longitude and altitude for the hole selected by the user. A latitude, longitude and altitude obtained when the user presses the yardage button is evaluated to determine if the greenskeeper currently measured latitude, longitude and altitude fall within a specified radius of the known latitude, longitude and altitude stored for the hole. If the greenskeeper latitude, longitude and altitude are not within the specified sphere of the known latitude, longitude, and altitude the hand-held distance unit 18 indicates to the user that the user has selected an incorrect hole. However, if the latitude, longitude and altitude obtained for the hole fall within the specified sphere, the updated pin position is wirelessly transmitted by the radio antenna 38 to the base station 14 where the base station 14 stores the new pin position for transmission to other golfers on the golf course. The base station 14 wirelessly broadcasts in real-time the new pin position to all golfers on the golf course. The hand-held distance units 18 receive the broadcast signals 30 via the radio antennas 36 and 38 of the system and these new pin positions are stored into the hand-held distance units 18. Therefore, the hand-held distance units are updated in real-time when the pin positions are obtained and transmitted to the base station unit. By wirelessly transmitting updates to the hand-held distance units 18 after the units are fully activated for use on the golf course, the golfers receive updated pin locations via the hand-held unit in real-time without having to return to the club house.

FIG. 8a illustrates the information displayed on a display screen 96 when the hand-held distance unit 18 is operating in the surveyor mode 64. In the surveyor mode 64, a user or surveyor may identify and define new points-of-interest on the golf course, obtain the location for these new points-of-interest, and transmit these new points-of-interest back to base station 14 for storage. The base station 14 may transmit these pin positions immediately to other golfers on the course or store these pin positions for use or transmission to a hand-held distance unit 18 when the hand-held distance unit 18 is activated. These hand-held distance units operating in a mode that can use this information will do so, for example, a hand-held unit operating in the test mode would not have need of this information and would not use it whereas a unit in the golfer mode would. Typically, the surveyor mode 64 is only used when a golf course is being initially configured. Because points-of-interest other than the pin position do not routinely change, the surveyor mode 64 is less frequently used than the other modes of operation. As in the greenskeeper mode 62, the surveyor mode 64 also has the capability of wirelessly transmitting updates for points-of-interest in real-time to the base station 14 for transmission to users or for storage. Therefore, the most recent information for points-of-interest is available on demand immediately after points-of-interest have been defined or redefined.

In the surveyor mode 64, display screen 96 displays information on the various points-of-interest to the user for selection to define the points-of-interest on the golf course. For example, the hand-held distance unit 18 may display a pin position label 140, a back of green label 142, a front of green label 144, front left bunker label 146, a right fairway bunker label 148, and a creek label 150. Each of the labels 140-150 are points-of-interest that are defined in the points-of-interest database 82 stored in connection with the present invention. As discussed in connection with the other modes of the hand-held distance unit 18, the user selects the hole that the user is on by using the previous hole button 110 and the next hole button 112. After selecting the hole that the user is on, the user moves a cursor 160 using the NEXT...
button 112 and PREV button 110 to the points-of-interest label that the user desires to define for the system 10. The user may select the label by pushing the SEL button 116 to match the cursor to the desired points-of-interest. After the user has selected the point-of-interest label for which measurement is desired, the user presses the yardage button 114 to indicate that a yardage measurement is desired.

[0056] FIG. 8b illustrates the surveyor mode screen displayed when the user selects a point-of-interest to be calibrated for the golf course. Similar to the greenskeeper mode 62, when the user desires to calibrate or measure the distance for the points-of-interest variable selected, the user positions the hand-held distance unit 18 over the position of the points-of-interest to obtain distance measurements or position fixes for the points-of-interest. As illustrated in FIG. 8b, the hand-held distance unit displays at 162 the points-of-interest label that was selected by the user. Here, the front left bunker label 146 was selected. This field of the surveyor mode 64 will vary depending upon the points-of-interest variable selected by the user when the screen of FIG. 8a is displayed.

[0057] To obtain a measurement for the surveyor mode 64, the surveyor positions the hand-held distance unit 18 over the points-of-interest and presses the yardage button 114. The hand-held distance unit 18 calculates several readings over a short period of time and compares these readings to determine if the readings are consistent. If the readings are consistent, the hand-held distance unit 18 transmits the points-of-interest selected and the position location to the base station unit 14 for storage. The base station unit 14 may then wirelessly broadcast the positions obtained in the surveyor mode 64 to hand-held distance units 18.

[0058] FIG. 9 illustrates information displayed on display screen 96 when the hand-held distance unit 18 is operating in the test mode 66. In this mode various operating parameters are displayed on the hand-held unit 18. These include, battery voltage 910, a GPS counter 914 (that indicates that the GPS receiver is generating new positions), the current latitude 922, longitude 924, current X 916, Y 918 and Z 920 positions relative to the base station location at coordinates 0, 0, 0, a UHF counter 912 (indicating that data communicated over the UHF link is being received), distance in yards from the base station 938, number of satellites used in the current position location 928, type of GPS fix 930—2D or 3D, whether the GPS fix is a differential fix 932, current Doppler 934 (dilution of precision, a relative figure of satellite geometry) and a RSSI (relative signal strength indicator) 936 displaying current signal level of UHF receive signal along with a measurement of the noise level. Using this information, a field survey can be performed to assess RF coverage and GPS coverage. This information can be transmitted back to the base station unit 14 for storage and later analysis.

[0059] In the asset tracking mode 68, the hand-held distance unit 18 presents a fixed display indicating that it is in the asset tracking mode. In this mode the hand-held unit 18 continually reports its position to the base station unit 14 for tracking its current position. Data is stored for later analysis of asset movement or to establish time standards to perform a task such as mowing a given area.

[0060] Referring to FIG. 10, as discussed above, the system of the present invention also provides paging capability in the communications system 10. Specifically, the base station unit 14 and the hand-held distance unit 18 have paging capabilities. Particularly, the base station unit 14 and the hand-held distance unit 18 used the RF transceivers 1150 and 1222, respectively, to act as a paging unit which enables communication between the two devices. Paging capabilities are convenient because a golf course covers a large area of land and it is often difficult for the golf course personnel to track golfers or to convey important information to the golfers. However, the system of the present invention provides a method of communication between the golfer and the golf course personnel.

[0061] As illustrated in the example of FIG. 10, when a golfer is on the driving range or putting green warming up before a round of golf, the club house personnel may send a page to the golfer’s hand-held distance unit 18 to notify the golfer that it is time to report to the first tee. For example, in FIG. 10, a page alert 200 is issued to the golfer. The page alert may include an audible sound, a flashing message or vibration to alert the golfer that the golf course personnel are trying to communicate with the golfer. The page alert may display a message 210 such as “Please report to the first tee” to ensure that all golfers report to the tees on time to keep play on the golf course moving. The user is instructed by a message on the display screen 96 to press the SEL button 116 to indicate to the golf course personnel that the golfer has received the page from the golf course personnel. It should be appreciated by those skilled in the art that the message displayed to the golfer may vary. For example, the club house personnel may input a message for the golfer to “return to the club house”, “report to the 10th tee”, “speed up your pace of play” or some other message. Club house personnel are able to identify particular golfers because each hand-held distance unit 18 has a unique identification number stored therein. This unique identification number is used to identify hand-held distance unit 18 to the club house personnel for tracking purposes, paging purposes, or for other purposes.

[0062] Referring to FIG. 11, a block diagram of the components of the hand-held distance unit 18 is illustrated. The hand-held distance unit 18 has an activation interface 1102, a data and communications bus 1104 interconnecting the components, a memory module 1106, a processor 1120, an input device 1130, e.g. pushbuttons, a paging alert circuit 1140, a radio transceiver 1150, a GPS receiver 1160, a display screen 96, such as an LCD display, and a low noise amplifier 1165, a GPS antenna 26 and a RF antenna 38. The hand-held distance unit 18 contains many of the components contained in the base station unit 14 however on a smaller scale. As indicated above, the hand-held distance unit 18 performs a number of functions. The hand-held distance unit 18 has a hardware platform whose functionality is determined on a variable basis depending on the particular software module downloaded to the hand-held distance unit 18 at the time of activation of the unit. The hand-held distance units 18 may serve as measuring devices for individual golfers when operating in the golfer mode 60 and as points-of-interest defining and locating devices when operating in the surveyor mode 64. The surveyor mode 64 is most commonly used when a new golf course is being configured and the database 82 of the base station computer 50 are being configured. The test mode 66 is used for
analyzing the GPS and RF coverage of the golf course, again particularly useful in the initial configuration process of a golf course.

[0063] The various software modules for providing the functionality of different modes of operations for the hand-held distance unit are downloaded through the activation interface 1102. The activation interface 1102 couples to the activation socket 56 (FIG. 2) of the point of sale terminal 54 to receive the software modules. When the hand-held distance unit 18 is activated, the appropriate modules are downloaded through the activation interface 1102 to the memory 1106 of the hand-held distance unit 18. The downloaded module 1108 and the points-of-interest data 1110 and personality parameters 1112 are stored in the memory 1106. The activation interface 1102 also includes connection points for a battery charger to allow the battery of the hand-held distance unit to be charged without removing it from the enclosure. Charging can be accomplished using a charging cradle provided in the golf cart or at the clubhouse.

[0064] As discussed above, the position of the hand-held distance unit 18 is determined by interpreting GPS satellite signals received via the GPS antenna 26. The position signals received are processed by a GPS low noise amplifier 1165. The low noise amplifier 1165 provides sufficient gain to the signals so that the GPS receiver 1160 can properly detect and process the GPS signals received. Differential position error signals are received via the RF antenna 38 and inputted to the GPS receiver 1160. The GPS receiver 1160 processes and outputs its position estimates to the hand-held distance unit processor 1120. The processor 1120 uses the position of the hand-held distance unit 18 to determine the distances to the various points-of-interest stored in memory 1106. The processor 1120 also performs other routines such as determining what display screen to display and monitors the input device to determine the next the function to be performed and what information is displayed. The processor 1120 also determines the mode of duty cycling to be used. The radio transceiver 1150 and the hand-held unit radio antenna 36 enable two-way communications between the hand-held unit 18 and the auxiliary unit 92 of the base station 14.

[0065] The hand-held distance units 18 also receive messages from the base station 14 and these messages are decoded and responded to by the hand-held distance unit 18 as required. The information received at the radio receiver 1150 is communicated to the processor 1120 for processing. The processor 1120 sends the message response back to the auxiliary unit 92 of the base station 14 through the radio transceiver 1150. The hand-held distance unit 18 processor 1120 decodes the messages and monitors the hand-held units four-button keypad, i.e. input device 1130, for input and transmits the appropriate display text or graphics to the display screen 96.

[0066] Referring to FIG. 12, a diagram of the base station auxiliary unit 92 is illustrated. The base station auxiliary unit 92 works in conjunction with the base station processor to receive and transmit data within the communication system 10. GPS signals are continuously received via the GPS antenna 22 of the auxiliary unit 92. The auxiliary unit 92 transmits signals to the hand-held distance units 18 and receives signals from the hand-held units 18 via the radio antenna 36. The auxiliary unit 92 includes a GPS receiver 1212, a GPS low noise amplifier 1214, an auxiliary control processor 1220, a radio transceiver 1222, a data transceiver 1226, and a display device 1230. The GPS low noise amplifier 1214 amplifies the GPS signals received for processing by the GPS receiver 1212. When the GPS receiver 1212 receives a position signal from the GPS satellites 16A-16D, the processor 1220 in auxiliary unit 92 calculates the difference between the known surveyed location of the GPS antenna 22 and the measured GPS position value. The differential correction signal is transmitted to all the hand-held distance units 18 via radio transceiver 1222 and the radio antenna 36. To maintain a high degree of accuracy, differential correction signals should be transmitted every 20 seconds. The differential correction transmission rate is once per second; however, the rate may be programmed as desired. The data transceiver 1226 receives information from the databases 82 of the base station computer 50 and transmits the data to the auxiliary control processor 1220 for transmission via the radio transceiver 1222 and radio antenna 36. Additionally, the data transceiver 1226 receives data transmitted from the hand-held units 18 that are processed by the auxiliary control processor 1220 for communication to the base station central processing unit 88. Operational data for the system 10, similar to that shown in the test mode, is presented on the display 1230.

[0067] Referring to FIG. 13, the processes performed during the activation process of the hand-held distance unit 18 are described. At step 1302, the activation screen of the point of sale terminal 54 is initiated when the hand-held distance unit ("HHU") 18 is plugged into the activation socket 56. At step 1304 a power on self test (POST) is performed to determine that the HHU and its components are functioning within normal operating parameters. If at step 1306 the POST fails, the process proceeds to step 1308. If the at step 1306 the POST fails, the process proceeds to step 1307 where the operator is informed by a display to obtain a new HHU. At step 1308, the point of sale terminal 54 receives an authorization code of a user and/or proper payment. For example, golf course personnel may have a special code to avoid the payment of a fee to activate a unit. On the other hand, golfers or non-golf course personnel may be required to pay a certain amount of money prior to authorization, such as by sliding a credit card through a credit card reading device at the point of sale terminal 54. The activation process is interrupted, at step 1310, if the hand-held unit 18 does not have enough battery power to last through a complete golf round which takes about 5 hours and the operator is requested to obtain a new HHU 18. The point of sale terminal 54 reads, at step 1312, the unique ID of the hand-held distance unit 18 to use for paging and other communication and tracking purposes. The process proceeds to step 1314 where the point of sale terminal 54 requests that the user select the golfer, greenskeeper, surveyor, test or asset tracking mode of operation.

[0068] To ensure that only appropriate users access certain modes of operations, various levels of authorization may optionally be used in the system. For example, a non-golf course personnel may not have access to the greenskeeper or surveyor modes. However, golf course personnel may have access to all modes. Therefore, at optional step 1316 (shown in dashed line), user authorization is checked. If the user has not given the proper authorization, at optional step 1318 (shown in dashed line) the operator is informed and the
selected module is not downloaded. If the user has authorization for the mode or module selected, at step 1324 the appropriate module is downloaded. If the authorization option is not used, the process proceeds from step 1314 to step 1324. If the golfer mode 60 was selected, the process proceeds to step 1330a where the software golfer mode module 78A or 78B and the points-of-interest ("POI") locations 82 stored for the holes and pins are downloaded to the hand-held distance unit 18 from the base station 14. If the user selected the greenskeeper mode 62, the greenskeeper mode module 84 is downloaded at step 1330b along with the latitude, longitude and altitude positions of the greens and personality parameters of the golf course. If the user selected the surveyor mode 64, the surveyor mode module 86 is downloaded at step 1330c along with a list of the available points-of-interest types stored in the system. The various points-of-interest types may include sand bunkers, trees, creeks, greens, lakes, etc. Additionally, any points-of-interest location which have been previously identified in the system are also downloaded along with the other data. If the user selected the test mode 66, the test mode module 87 is downloaded at step 1330d. If the user selected the asset tracking mode 68, the asset tracking mode module 88 is downloaded at step 1330e. After the appropriate module has been downloaded, the hand-held distance unit 18 is now ready for the functionality provided by the downloaded module.

[0069] The personality parameters include items such as the golfer’s handicap, driving distance as well as operational parameters such as the operational cycle of the GPS receiver 1160, the radio transceiver 1150, low noise amplifier 1165, the display screen 96 and the operational cycle and appearance of any informational or error messages. Error messages can be programmed to flash and remain on the display for a predetermined period of time. Also, because the hand-held unit 18 is continually aware of its position on the golf course, the operational cycle of the GPS receiver 1160 and low noise amplifier 1165 can be advantageously configured so that the GPS receiver 1160 and low noise amplifier 1165 are automatically placed in a sleep (low energy use) mode when the hand-held distance unit 18 is within a predetermined distance of the green, such as 25 yards. The sleep mode can be programmed to last for a predetermined period of time, such as 3 minutes, or until the user presses any key or combination of keys.

[0070] Referring to FIG. 14a, the processes of the golfer mode 60 are illustrated. At step 1402, a golfer selects the hole number that the golfer is playing by using the previous hole button 110 or the next hole button 112. After selecting the hole number, at step 1406 the golfer positions the hand-held distance unit 18 over the golf ball. The golfer then presses the yardage key 114 of the hand-held distance unit 18 to indicate that the golfer desires yardage measurements for his current position. At step 1408, the hand-held distance unit 18 receives a signal from the golfer to provide the yardage measurement to the pin position and points-of-interest. At step 1410, the hand-held distance unit determines the distance to the pin and determines the distance to golfer relevant points-of-interest. The distances are determined by identifying the current position of the hand-held distance unit 18 using the GPS signals 28 received and calculating the distances to the points-of-interest as stored in the database 1110 of the hand-held unit 18. At step 1416, the hand-held distance units 18 display the distances to the pin, golfer relevant points-of-interest, and displays an option for a pro tip (see FIG. 5). After the distances are displayed to the various points-of-interest, the golfer has the option to select a pro tip by pushing the SEL key 116 of the hand-held distance unit 18. If a pro tip is not selected, the hand-held distance unit 18 continues to display the point-of-interest data for the last position selected by the golfer. If, however, at step 1420, the golfer selects the pro tip option, the process proceeds to step 1422 where a pro tip screen (see FIG. 6) is displayed on the hand-held distance unit 18 and the pro tip applicable for the current situation or golfer’s skill is displayed.

[0071] Referring to FIG. 14b, the process is discussed for determining the distance to the pin and the distances to golfer-relevant points-of-interest in the golfer mode 60. At step 1424, the hand-held distance unit 18 processes GPS signals 28 to determine the hand-held distance unit’s location. The location of the hand-held distance unit 18 is determined as discussed below in connection with FIG. 14c. At step 1430, the process determines whether the latitude, longitude and altitude for the determined location of the hand-held distance unit 18 is within a specified range of the known latitude, longitude and altitude for the hole indicated. If the golfer initiated measurement for the hole is not within the identified range for the hole selected by the user on the display screen 96, the process proceeds to step 1431 where the hand-held distance unit 18 indicates to the user that the hole selected is incorrect and requests the user to enter a new hole. The process proceeds to step 1434 where the hand-held distance unit 18 waits for another request from the user for yardage information. The process then proceeds to step 1424 as discussed above. If, however, at step 1430, the latitude, longitude and altitude determined in response to the user’s request for a yardage measurement is within a predetermined range of the known latitude, longitude and altitude of the indicated hole, the process proceeds to step 1432.

[0072] At step 1432, the hand-held distance unit 18 calculates the distances to the points-of-interest in the database 1110 for the specified hole. The process proceeds to step 1436 where the golfer module further determines whether the points-of-interest are behind the golfer or within a maximum and minimum range values specified or relevant for golfer’s specific parameters. For example, as discussed in connection with FIG. 3, a golfer may indicate the maximum distance that the golfer can hit a golf ball and distances beyond that maximum value except for the pin position are not displayed for points-of-interest beyond that distance. Additionally, a golfer may indicate during initial set-up a minimal distance value for which points-of-interest inside of that minimum distance value are not displayed to the golfer. The process then proceeds to step 1438 where the points-of-interest behind the golfer or outside of the golfer specific parameters or range are eliminated from display.

[0073] Referring to FIG. 14c, the process for determining the hand-held distance unit 18 location is illustrated. When an indication is given to read a GPS signal 28, the system of the present invention preferably does not assume that the reading is an accurate reading because the reading may be an anomaly caused by the entry or exit of a satellite vehicle from the transmission path of an antenna. To help account for these anomalies and readings, the present invention, at step 1450 calculates a sample GPS reading from the signals received. This sample reading is compared to the average of
the past five (5) GPS readings made by the hand-held distance unit 18 at step 1452. At step 1460, the process determines whether the sample reading was within a certain specified range of the average. This range may vary as known to those skilled in the art. If the sample was within the range of the average of the past five (5) readings, the average of the past five (5) readings plus the new sample is used as the current position of the hand-held unit. If, however, at Step 1460, the sample was not within the specified range of the average, eight (8) new position measurements are taken at Step 1466. At Step 1468, the eight (8) new position measurements are averaged as the location of the hand-held distance unit 18. By using the process described in FIG. 14c, accurate GPS position measurements can be assured. The number of positions used in averaging may be varied.

[0074] Referring to FIG. 15, the process for updating pin positions in the greenskeeper mode 62 is illustrated. At step 1502, the greenskeeper selects the hole for which the updated pin position is to be determined. The greenskeeper positions the hand-held distance unit 18 over the hole at step 1504 in preparation for requesting a new pin location. At step 1508, when the greenskeeper presses the yardage button 116, the hand-held distance unit 18 receives the indication that the location of the new hole position is to be determined. At step 1510, the GPS signals 28 are processed to determine the location of the hand-held distance unit 18. The location of the hand-held distance unit 18 can be determined as discussed in connection with FIG. 14c. At step 1512, the hand-held distance unit 18 determines whether the measured latitude, longitude and altitude are within a specified range of the known hole location selected by the user. If the latitude, longitude and altitude are not within a specified range of the known location, the process proceeds to step 1514 where an indication is provided to the user that the hole selected is incorrect and the user is requested to enter a new hole number. The process is then directed back to step 1508 and then to step 1510 if at step 1512, the currently measured latitude, longitude and altitude are within a specified range of the hole, the process proceeds to step 1518. At step 1518 the hand-held distance unit 18 wirelessly transmits the updated pin position, unit ID, and other distance calculation parameters, such as the latitude, longitude and altitude measurements, the satellites from which GPS signals 28 are received and the number of satellites from which the GPS signals 28 are received, to the base station 14. At step 1522, the base station 14 stores the updated pin positions in database 82 and wirelessly broadcasts at step 1524, the updated pin position from the base station 14 to all and held-distance units 18 which are operating in golfer mode 60. By wirelessly transmitting the new updated pin positions from the hand-held unit 18 operating in the greenskeeper mode 62 to the base station 14 and by broadcasting the new updated pin positions to all hand-held distance units 18 operating in golfer mode 60, golfers are ensured to have the most recent pin position updates which is valuable information to a golfer.

[0075] Referring to FIG. 16, the processes implemented for the surveyor mode 64 are illustrated. At step 1602, a user selects the hole number for which the user desires to define points-of-interest. At step 1604, the hand-held distance unit 18 displays a list of points-of-interest (POIs) types available for the specific golf course. A points-of-interest types may include creeks, trees, hazards, sand bunkers, greens, lakes, cart paths etc. From this list, the user may select the appropriate point-of-interest being defined. At step 1608, the hand-held distance unit 18 determines which point-of-interest type was selected by a user. At step 1610 the user then positions the hand-held distance unit 18 over the point-of-interest selected by the user, such as a sand bunker. At step 1614 the surveyor presses the yardage button 114 to indicate to the hand-held distance unit 18 that a position measurement is desired. At step 1620, the process determines the location of the hand-held distance unit 18. The location is determined as discussed in connection with FIG. 14c. The process proceeds to step 1622 where the hand-held distance unit 18 wirelessly transmits the selected points-of-interest type and the determined location to the base station 14 for storage as indicated as step 1624.

[0076] The descriptions given herein are provided as examples and are not intended to limit the principles or scope of the present invention. Those skilled in the art would readily appreciate from a review of the descriptions herein that many modifications, changes or extensions may be made from the specific embodiment described herein without departing from the scope of the invention defined by the following claims. For example, because each hand-held distance unit has a unique identification, it is possible to use the system of the present invention to locate missing or lost units. Further, areas of the golf course can be demarcated to be off limits or no go zones, such as a parking lot or maintenance area. When the hand held unit is taken into such areas, the golfer can be alerted that use of the hand-held unit in such areas is not permitted and an alert can be displayed at the base station informing the golf course staff that a unit has been taken off premises or into a prohibited areas.

What is claimed:

1. A system for use in determining distances between a mobile distance determination unit and points-of-interest on a golf course, comprising:

storage means containing a plurality of operating mode modules downloadable when selected by a user into the mobile distance determination unit for operation therein, each of said modules containing instructions, information, and data including predefined points of interest, for operating the mobile distance determination unit in given mode of operation;

a base station comprising means for receiving and processing GPS signals, means for receiving and transmitting RF signals, means for communicating data, instructions and messages to an operator, means for receiving inputs from said operator for processing by said base station; and means for downloading at least one of said operating mode modules to the mobile distance determination unit in response to a user request;

a mobile distance determination unit comprising means for receiving and processing an operating mode module downloaded therein, means for receiving and processing GPS signals, means for receiving and transmitting RF signals, means for communicating data, instructions and messages to a user, and means for receiving inputs from said user for processing by said mobile distance determination unit, said mobile distance determination unit being operable in at least one of a plurality of
modes in accordance with the information and data contained in the downloaded operating mode module;
said mobile distance determining unit when downloaded with a first one of said operating mode modules being operative in a first mode of operation to determine a first location of the mobile distance determination unit, to calculate the distances between the first location and predefined points-of-interest locations stored in the mobile distance determination unit, and to display the distances calculated between the first location and the predefined points-of-interest;
said mobile distance determining unit when downloaded with a second one of said operating mode modules being operative in a second mode of operation to determine a second location of the mobile distance determination unit and to associate the second location with a point-of-interest on a golf course, thereby defining a point-of-interest/second location association, said mobile distance determination unit being operative to transmit said point-of-interest/second location association to the base station for communication to mobile distance determination units when operating in said second mode;
said mobile distance determining unit when downloaded with a third one of said operating mode modules being operative in a third mode of operation to determine GPS signal coverage and RF signal coverage of the golf course; and
said mobile distance determining unit when downloaded with a fourth one of said operating mode modules being operative in a fourth mode of operation to determine the location of a movable asset when placed on such asset and communicating the changing location of such asset to the base station as said asset moves.

2. The system of claim 1 wherein the first, second, third, and fourth mode of operation is determined in response to a user selecting the desired mode of operation for the mobile distance determination unit.

3. The system of claim 1 wherein the means to download the operating mode module is a RF wireless transmission.

4. The system of claim 1 wherein the means to download the operating mode module is an interface socket provided on the base station to which said mobile distance determination unit is connected.

5. The system of claim 1 wherein, when the mobile distance determination unit is operating in the first, second, or fourth mode of operation, the operating mode module data is updated with new data transmitted from the base station.

6. The system of claim 1 wherein the operating mode module further comprises duty cycling functionality.

7. The system of claim 6 wherein the duty cycling functionality is programmable for use in one of the following modes: distance of the mobile determining unit from the hole, power usage of the mobile distance determination unit, operator defined variables, and pattern of play and such duty cycling mode is activated upon downloading into the mobile distance determination unit.

8. The system of claim 1 wherein each mobile distance determining unit has a unique identification that is addressable by the base station.

9. The system of claim 8 where the base station maintains and tracks the location of each mobile distance determination unit by its identification.

10. The system of claim 1 wherein the mobile distance determining unit performs a power on self test of its components on activation.

11. The system of claim 1 wherein the power capacity in the mobile distance determining unit is determined prior to use on the golf course.

12. The system of claim 1 wherein the download of the operating mode modules further comprises the RF frequencies of operation to be used by the mobile distance determining unit.

13. The system of claim 1 wherein said second operating mode module is operative to provide a list of point-of-interest types to a user for selection, said second operating mode module being operative to associate said second location with a point-of-interest type selected from said list by said user, and being operative to communicate said association to said base station.

14. The system of claim 13 wherein said point-of-interest association is wirelessly communicated to said base station.

15. The system of claim 1 wherein for each operating mode module at least one of said points-of-interest evaluated for each golf hole on the golf course is selected from a group comprising: a golf hole located on a green of a golf hole on the golf course, a hazard on said hole, a tree on said hole, the front of the green on said hole, and the back of the green on said hole.

16. The system of claim 1 wherein said mobile distance determination unit is a hand held unit.

17. In a system having one or more mobile distance determination units in operation on a golf course and communicable with a base station, a method for updating mobile distance determination units on a golf course, comprising the steps of:

- operating a first mobile distance determination unit to determine a new location for a point-of-interest defined for a golf course;
- wirelessly transmitting update data to identify said new location from said first mobile distance determination unit to a base station;
- processing at said base station said updated data for broadcasting to said operating mobile distance determination units;
- wirelessly broadcasting said updated data from said base station to said operating mobile distance determination units; and
- updating at said operating mobile distance determination units point-of-interest location data contained therein with said updated data, said update data being used to determine distances between said operating mobile distance determination units and said new locations.

18. The method of claim 17 wherein said first and operating mobile distance determination units are operative to operate in a first or second mode of operation comprising:
said first and said operating mobile distance determination units determining a first location of the mobile distance determination unit, calculating the distances between the first location and predefined points-of-interest locations stored in the mobile distance determination unit,
and displaying the distances calculated between the first location and the predefined points-of-interest when operating in said first mode;
said first and said operating mobile distance determination units determining a second location of the mobile distance determination unit and associating the second location with a point-of-interest on a golf course, thereby defining a point-of-interest/second location association, said mobile distance determination unit being operative to transmit said point-of-interest/second location association to a base station for communication to mobile distance determination units when operating in said second mode.

19. The method of claim 18 wherein said distances are determined using global positioning system (GPS) satellites.

20. A method of alerting a user that a distance measurement request contains inaccurate data in mobile distance determination system, comprising the steps of:
(a) receiving an indication from a mobile distance determination unit that a distance measurement is to be made for a user identified point-of-interest;
(b) determining the location of the mobile distance determination unit based on GPS signals;
(c) determining whether the location determined in step (b) is within a predetermined range of known location coordinates for said point-of-interest identified by said user;
(d) indicating that the point-of-interest identified by the user is not correct if said location determined in step (b) is not within said range.

21. A method of alerting a user that a mobile distance determination unit is improperly located, comprising the steps of:
(a) determining the current location of the mobile distance determination unit based on GPS signals;
(b) determining whether the location determined in step (b) is within a pre-determined range of known unacceptable location coordinates; and
(c) indicating that the mobile distance determination unit is not properly located if said location determined in step (b) is within said range.

22. A method of ensuring that distance measurements determined in a mobile distance determination unit for a golf course are accurate, comprising the steps of:
calculating a sample location measurement for a mobile distance determination unit for determining distances on a golf course in response to a user request;
determining whether said sample location measurement is within a predetermined range of a first selected number of previously determined location measurements for said mobile distance determination unit;
computing a current location measurement using said sample location measurement and said previously determined location measurements if said sample location measurement is within said predetermined range;
successively computing a second number of location measurements; and
using said second number of location measurements to compute a current location for said mobile unit if said sample location measurement is not within a predetermined range of said previously determined location measurements.

23. The method of claim 22 wherein said step of using comprises computing a weighted average of the sample location measurement and said second number of location measurements.

24. The method of claim 23 wherein the weighted average is established by using GPS parameters to establish a weight for each particular sample location measurement.

25. The method of claim 23 wherein the step of successively computing further comprises computing a variable number of sample locations where said number is based on a user defined threshold being reached.

26. A method of presenting point-of-interest data of a course to a user of a mobile distance determination unit, comprising the steps of:
determining the location of a mobile distance determination unit on a golf course using GPS signals;
calculating the distances from the mobile distance determination unit to points-of-interest downloaded in the mobile distance determination unit for the golf course; and
displaying for a particular shot to be made by the golfer only those points-of-interest defined for the golf hole that the golfer is playing that are within golfer specific parameters defined specifically for said golfer.

27. The method of claim 26 further comprising displaying for a particular shot to be made by the golfer a unique pro tip defined for the golf hole that the golfer is playing that is within golfer specific parameters defined specifically for said golfer.

28. The method of claim 26 wherein said golfer specific parameters are based on the golfer’s skill.

29. The method of claim 28 wherein said golfer specific parameters are defined during an activation procedure for said mobile distance determination unit.

30. A mobile distance determination unit for use in determining distances on golf courses, comprising:
means for communicating information to and from a user, said means comprising visual displays, audible displays and vibratory displays;
means for receiving inputs from the user;
a processor being operative to determine a first location of a mobile distance determination unit, to calculate the distances between the first location and predefined points-of-interest locations stored in the mobile distance determination unit, and to communicate the distances calculated between the first location and the predefined points-of-interest to the user; and
a paging unit located in said mobile distance determination unit for receiving a pager message signal to a golfer for
which said mobile distance determination unit is activated.

31. The apparatus of claim 30 wherein said pager message signal informs said golfer to report to a specified location on the golf course.

32. The apparatus of claim 30 wherein said pager message signal informs said golfer of the playing conditions of the golf course, said conditions comprising weather alerts, local rules, golf cart usage, and unique text messages.

33. The apparatus of claim 30 wherein said pager message signal informs said golfer that the current location of mobile distance determination unit is in a prohibited area.

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