

## Specification

### Mobile Terminal, Position Measurement Apparatus, System Using the Same, and Position Measurement Method of Mobile Terminal

5

#### Technical Field

The present invention relates to a mobile terminal, a position measurement apparatus of a mobile terminal, a system using the same, and a position measurement method of a mobile terminal. The present invention particularly relates to a mobile terminal, a position measurement apparatus of a mobile terminal, a system using the same, and a position measurement system of a mobile terminal employing a small zone communication system.

15

#### Background Art

A mobile position detection method of interest to the present invention is disclosed in, for example, Japanese Patent Laying-Open No. 2-44929. According to the present publication, in a mobile communication system that provides communication between a repeater and a mobile through a wave, the wave from a plurality of repeaters is received at each mobile. By using a coverage contour of a reception electric field level from each repeater obtained in advance, the range in which a mobile can be located corresponding to each reception level is obtained to detect the current position of the mobile from the overlap of each range.

25

However, this position detection method using the coverage contour is a macro detection method since it actually detects the position of the mobile and does not take into consideration the blocking and reflection of the waves caused by buildings around the mobile and the geography. Therefore, this method may be suitable for the position detection of a vehicle and the like that travels at high speed. However, there was a problem that this method is not suitable for the position detection of a human being or an object that travels at a low speed.

30

Thus, there is a position determining system utilizing a wireless

communication method of small zones such as a PHS (Personal Handy phone System). In such a position determining system, application is considered of a radiation pattern of a wave to achieve position detection of high accuracy. Such a small zone wireless network is shown in Fig. 11.

5 Referring to Fig. 11, when a fixed or movable center station 91 is to establish conversation communication with a mobile station 7 that is currently on the move, conversation is allowed with a mobile station 7 that is located within a cell 8 of approximately 100 m in radius about a repeater 6 from an exchange station 2 to which center station 91 is connected  
10 through a main line 3 and another exchange station 4 through another main line 5.

In a PHS system, a PHS database is provided. When center station 91 communicates with mobile station 7, the location of mobile station 7 within cell 8 of repeater 6 is recorded in a database of that repeater  
15 provided at center station 91. Also, the entry of mobile station 7 into the area of cell 8 is immediately recorded in the database without effecting communication with repeater 6. It can be identified that mobile station 7 is within a circle of a radius of approximately 100 m about repeater 6 by utilizing this position information of repeater 6 that is known in advance.  
20 Thus, the location of mobile station 7 can be identified. The PHS database is provided within center station 91. Alternatively, a center control station can be additionally provided at main line 3, and prepare a PHS database thereat.

The information identifying a repeater 6 corresponding to a certain  
25 cell 8 in which mobile station 7 is located at a certain time point can be stored and maintained in the PHS database. Technically speaking, center station 91 can receive that information.

Center station 91 has a system that provides display of map  
information on a display device. It is well-known that such a system  
30 providing a display of map information is easily available in the form of a CD-ROM as in the navigation system of a vehicle.

The position information of a repeater 6 corresponding to a cell 8 in which mobile station 7 is located which is obtained from the database of the

PHS is displayed on a screen at center station 91. Repeater 6 is indicated by a marker and the like. A circle of 100 m in radius is provided on the display centered about the marker. Identification is presented that mobile station 7 is located within that circle.

5           Fig. 12 shows a structure of center station 91. Referring to Fig. 12, center station 91 includes a personal computer/work station 12, and a display 61 and a keyboard 11 connected to personal computer/work station 12. Personal computer/work station 12 is connected to a modem 13 for the center. Personal computer/work station 12 is connected to an exchange  
10           station 2 of the telephone central office shown in Fig. 11 via modem 13 for the center.

          In a map 10 appearing on a screen of a display of personal computer/work station 12 at center station 91, a marker 9 indicating a  
15           repeater 6 corresponding to a cell 8 in which mobile station 7 is located, and a circle having a radius of 100 m (in some cases, may not be a circle) about marker 9 are displayed. In this case, it is indicated that mobile station 7 of interest is located within that circle. Mobile station 7 per se cannot be shown on the display.

          Fig. 13 is a block diagram showing a specific structure of center  
20           station 91. Referring to Fig. 13, center station 91 includes a CPU 60 for providing control of the entire apparatus constituting center station 91, a display 61 connected to CPU 60 for displaying the position of mobile station 7 on a map, a ROM 62 and a RAM 63 in which programs and the like defining the operation of center station 91 are stored, and an I/O interface  
25           64 functioning as an interface with an external apparatus.

          A CD-ROM drive 65 for providing a display of map data via I/O  
          interface 64, an automatic calling device 66 for connection to exchange  
          station 2 of the PHS system, and a line disconnection unit 68 for effecting a  
          call by automatic calling device 66 as necessary and disconnecting the line  
30           immediately after receiving data of repeater 6 near which mobile station 7 is located are connected. Line disconnection unit 68 is connected to telephone central office exchange station 2 via modem 13 for the center station, as mentioned above. A hard disk 70 forming a database is

connected to CPU 60.

In addition to directly designating a mobile station 7 from center station 91 via keyboard 11, the line of a subscriber 71 asking for the position information of mobile station 7 is also connected via I/O interface 64. A check is made through a subscriber database 69 connected to I/O interface 64 to identify whether the connected subscriber is a proper predetermined subscriber.

The procedure of sending a signal and receiving position information to search for the position information of mobile station 7 will be described hereinafter with reference to Figs. 11, 12 and 13.

First, keyboard 11 at center station 91 is manipulated to dial automatically the PHS telephone number of mobile station 7 of interest under control of personal computer/work station 12. As shown in Fig. 11, a telephone line is connected to mobile station 7 via a repeater 6 corresponding to cell 8 in which that mobile station 7 is located through exchange station 2 and the like. When line connection is established between center station 91 and mobile station 7, the code number of the relevant repeater 6 is recognized and stored in the database of the PHS. Since this recognition and storage are carried out instantly, the line between center station 91 and mobile station 7 can be disconnected immediately. The position information of repeater 6 is represented by the code of repeater 6 or by the latitude and longitude of repeater 6. The position information is immediately sent from the PHS database to personal computer/work station 12.

At personal computer/work station 12, map information is sent in advance from the incorporated CD-ROM drive 65. The map information is provided in the form of a map 10 on the screen of display 61. By placing the position information represented by the code or the latitude and longitude of repeater 6 on map 10, repeater 6 can be indicated by marker 9 as shown in Fig. 12.

As described above, entry of mobile station 7 into cell 8 of repeater 6 is recognized and stored into the database. The information thereof is provided to center station 91, so that the location of mobile station 7 within

the circle of approximately 100 m in radius about a center 6 can be detected.

Although identification can be made that mobile station 7 is present in a predetermined area about repeater 6 by center station 91 according to the above system, the detailed position within that area range cannot be identified.

To solve this problem, a possible consideration is to have an operator walk around carrying a position measurement apparatus that measures the intensity of the wave. The distance from mobile station 7 can be measured by detecting the intensity of the wave output in the communication between mobile station 7 and repeater 6. However, this method cannot be implemented by the following reasons (1) - (5).

(1) In the PHS, there are a plurality of channels that can be used. The center station cannot identify which channel mobile station 7 uses. In other words, the used channel can be recognized only by mobile station 7 and the corresponding connected repeater 6.

(2) In order to increase the number of conversation channels in the PHS, one channel is time-divisionally multiplexed, so that four mobile stations use one channel. Even if the channel used by mobile station 7 of interest is identified, it is necessary to measure the intensity of the wave only at the moment mobile station 7 of interest is transmitting the wave. The wave cannot be measured unless that certain moment is identified.

(3) Even if the channel is identified by the above (1) or (2), reconnection of the line at the PHS or change in the connecting repeater will cause variation in the conditions of the above (1) and (2). The required information must be collected again from the mobile station in order to measure the wave intensity.

(4) In a general field intensity meter (a measuring device for measuring the intensity of wave), the condition of the above (2) cannot be cleared since only the intensity of the wave of a specified frequency can be detected.

(5) The wave measurement apparatus for the PHS that is commercially available can detect only the control channel of a repeater. The intensity of the wave transmitted from a mobile station cannot be

measured. This is because the control channel of a repeater has a particular channel determined for each manufacturer, and only the channel thereof can be identified.

5 The present invention is directed to solve the above problems. An object of the present invention is to provide a mobile terminal for detecting a detailed position of an object that travels.

Another object of the present invention is to provide a position measurement apparatus that can measure accurately the position of a mobile terminal.

10 A further object of the present invention is to provide a system that effects position detection with the above mobile terminal and position measurement apparatus.

Still another object of the present invention is to provide a method of measuring accurately the location of a mobile terminal.

15

#### Disclosure of Invention

To achieve the above objects according to an aspect of the present invention, the mobile terminal can establish communication with an external apparatus by radio, and includes reception means for receiving a  
20 signal from an external apparatus, and set means responsive to reception of the reception means to set a mode for direct communication with an external apparatus.

Preferably, the reception means receives a signal from an external apparatus via a repeater.

25 Further preferably, the mobile terminal further includes cancel means for canceling a set mode when communication with an external apparatus cannot be established in a predetermined time.

Further preferably, the mobile terminal carries out communication with an external apparatus to notify its own position to the external  
30 apparatus.

Further preferably, the mobile terminal further includes transmission means for transmitting information of environment of the mobile terminal to an external apparatus in a set mode.

Further preferably, the mobile terminal carries out communication employing a small zone communication system.

According to another aspect of the present invention, a position measurement apparatus for detecting the position of a mobile terminal includes transmission means for transmitting a signal to a mobile terminal through a first path, reception means for receiving a signal output from a mobile terminal through a second path in response to transmission, and measurement means for measuring intensity of the signal received by the reception means.

Preferably, the measurement means includes display means for displaying the intensity of a signal in numerals.

Further preferably, the reception means includes a directional antenna.

Further preferably, the reception means includes a non-directional antenna.

Further preferably, the position measurement apparatus identifies the direction where the mobile terminal is located by altering the direction of the directional antenna, and determines whether communication with the mobile terminal is allowed or not by the non-directional antenna.

Further preferably, the position measurement apparatus includes switching means for switching between the directional antenna and the non-directional antenna.

Further preferably, the position measurement apparatus carries out communication employing a small zone communication system.

According to a further aspect of the present invention, the position measurement system is formed of any of the above mobile terminal, and any of the above position measurement apparatus.

According to still another aspect of the present invention, the position measurement method for measuring the position where a mobile terminal is present includes the steps of providing a wave from a mobile terminal by sending a signal to the mobile terminal, measuring the intensity of the output wave, and measuring the position where the mobile terminal is present by the measured wave intensity.

**[Advantage of Embodiment]**

The above embodiments offer the following advantages over conventional art.

5 (1) By virtue of direct communication between a position measurement apparatus 16 and a mobile terminal 17 in a transceiver mode, measurement of wave intensity (electric field intensity) is facilitated. As a result, the position of mobile terminal 17 can be easily measured.

10 (2) The current PHS telephone lines and telephone set hardware can be used. The present invention can be implemented by only modifying the software. Thus, an economic position measurement system can be established.

**Brief Description of the Drawings**

15 Fig. 1 shows an entire structure of a position measurement system according to a first embodiment of the present invention.

Fig. 2 is a block diagram showing a structure of a mobile terminal 17 of Fig. 1.

Fig. 3 is a flow chart showing an operation sequence of mobile terminal 17.

20 Fig. 4 is a flow chart subsequent to Fig. 3.

Fig. 5 is a block diagram showing a structure of a position measurement apparatus 16 of Fig. 1.

Fig. 6 is a flow chart showing an operation sequence of position measurement apparatus 16.

25 Fig. 7 is a flow chart subsequent to Fig. 6.

Fig. 8 is a block diagram showing a structure of mobile terminal 17 according to a second embodiment of the present invention.

30 Fig. 9 is a block diagram showing a structure of a position measurement apparatus according to a third embodiment of the present invention.

Fig. 10 is a block diagram showing a structure of a position measurement apparatus according to a fourth embodiment of the present invention.

Fig. 11 is a diagram for describing a conventional position measurement system.

Fig. 12 shows a structure of a center station 91 of Fig. 11.

Fig. 13 is a block diagram showing a structure of a center station.

5

### Best Mode for Practicing the Invention

Preferable embodiments of the present invention will be described hereinafter with reference to the drawings.

#### [First Embodiment]

10 Fig. 1 shows a structure of a position measurement system according to a first embodiment of the present invention. The present system includes a telephone central office 15, repeaters 6A and 6B connected to telephone central office 15, a position measurement apparatus 16, and a mobile terminal 17.

15 First, the operation of the system will be schematically described. Mobile terminal 17 is attached to an object for position measurement (here, a human being) 18. The person to identify the position of object 18 (referred to as "measurement operator" hereinafter) first identifies the rough location of mobile terminal 17 by the system shown in Figs. 11-13.  
20 The measurement operator approaches the identified approximate position and sends a signal to mobile terminal 17 by communication of a normal PHS through a line (#1) via repeater 6B, telephone central office 15, and repeater 6A. Mobile terminal 17 receiving the signal switches its own mode to the mode that effects direct communication with position  
25 measurement apparatus 16. Here, the line via repeater 6B, telephone central office 15, and repeater 6A is disconnected. The measurement operator carrying position measurement apparatus 16 establishes direct communication with mobile terminal 17 (communication using line #2) to recognize the direction where mobile terminal 17 is present and distance  
30 therefrom according to the intensity of the wave output from mobile terminal 17. Thus, the position of object 18 can be identified.

In the drawing, repeater 6B corresponds to the repeater used by position measurement apparatus 16, and repeater 6A corresponds to the

repeater used by mobile terminal 17.

Fig. 2 is a block diagram showing a structure of mobile terminal 17 of Fig. 1.

Mobile terminal 17 includes a non-directional antenna 101 that is commonly used for transmission and reception, a switch 102 for switching the transmission/reception mode of the antenna, a reception circuit 103 for receiving a wave, a transmission circuit 104 for carrying out transmission, a reception level measurement circuit 105 for measuring the reception level which is the intensity of the received wave, a control microcomputer 106 for providing control of the entire terminal, a data display unit 107 for displaying an input telephone number, the reception level, and the like, an operation key input unit 108 for entering a telephone number or designation of mode switching, a microphone 109 for receiving audio, and a loudspeaker 110 for audio output.

The structure thereof is identical to that of the generally used PHS telephone set. It is to be noted that mobile terminal 17 of the present embodiment operates in both a PHS public mode (the mode of communication in a general PHS, also called common mode) and a transceiver mode. The mode is switched by a signal transmitted from a position measurement apparatus 16 via a repeater and a telephone central office. In a PHS public mode, the user (here, position measurement object 18) enters a telephone number via operation key input unit 108 to call another telephone central office to establish communication. Also, a call from another telephone set can be received.

In a transceiver mode, mobile terminal 17 can directly establish communication with another PHS telephone that is within the range where the wave can be received. When position measurement apparatus 16 is located within the wave available range in the present embodiment, communication therebetween is established. By detecting the intensity of the wave used in this communication by position measurement apparatus 16, the position and direction of mobile terminal 17 can be identified.

Mode switching is implemented by controller microcomputer 106. The mode can also be switched arbitrarily through operation key input unit

108 by the user.

Switch 102 is a circuit for switching antenna 101 for transmission and reception. In general, one antenna 101 is used in a normal PHS telephone.

5 Fig. 3 is a flow chart showing an operation sequence of mobile terminal 17. In this flow chart, the general PHS telephone sequence is not depicted.

10 At step S100, the mode is set to the PHS public mode. At step S101, determination is made whether there is a reception via telephone central office 15 by position measurement apparatus 16. Waiting is conducted until the determination result becomes YES at step S101.

15 Upon YES at step S101, control proceeds to step S102 to disconnect the line via telephone central office 15. At step S103, the mode is switched to the transceiver mode to attempt direct communication with position measurement apparatus 16.

At step S104, determination is made whether communication with position measurement apparatus 16 could not be established within a predetermined time (for example, approximately one minute).

20 When NO at step S104, control proceeds to step S105 to maintain the line for direct communication with position measurement apparatus 16. At this stage, the sound around position measurement object 18 is collected through microphone 109. This sound is transmitted to position measurement apparatus 16.

25 At step S106, determination is made whether there is a measurement end request from position measurement apparatus 16. When NO, the process from step S104 is repeated.

30 When YES at step S104 and YES at step S106, the routine shown in Fig. 4 is executed. Specifically, at step S107, the line of direct communication with position measurement apparatus 16 is disconnected. At step S108, the transceiver mode is terminated. Then, the process from step S100 of Fig. 3 is carried out.

Fig. 5 is a block diagram showing a structure of position measurement apparatus 16 of Fig. 1.

Referring to Fig. 5, position measurement apparatus 16 includes a non-directional antenna 201 commonly used for reception and transmission, a switch 202, a reception circuit 203 for reception, a transmission circuit 204 for carrying out transmission towards mobile terminal 17, a reception level measurement circuit 205 for measuring the intensity (reception level) of a wave transmitted from mobile terminal 17, a control microcomputer 206 for providing control of the entire apparatus, a data display unit 207 that can display a telephone number and the reception level in numerals, an operation key input unit 208 for entering a telephone number, and a speaker 209 for providing the audio caught by microphone 109 of mobile terminal 17.

Position measurement apparatus 16 of the present embodiment has a structure that is schematically identical to that of a general PHS telephone. However, it is to be noted that position measurement apparatus 16 of the present invention operates in both a PHS public mode and a transceiver mode. By sending a signal to mobile terminal 17, the mode of mobile terminal 17 can be forced to be switched to the transceiver mode from the PHS public mode to allow communication between mobile terminal 17 and position measurement apparatus 16 in the transceiver mode.

Figs. 6 and 7 are flow charts showing the operation sequence of position measurement apparatus 16.

According to a position measurement operation at step S200, the mode of position measurement apparatus 16 is set to the PHS conversation mode. At step S201, the telephone number of mobile terminal 17 is input through operation key input unit 208. Here, the telephone number can be directly input through the ten-key, or by the shortened dialing function and the like.

At step S202, a switching request to the transceiver mode is output from position measurement apparatus 16 towards mobile terminal 17 if the line is connected via telephone central office 15. At step S203, the line via telephone central office 15 is disconnected. At step S204, the mode is set to the transceiver mode.

At step S205, determination is made whether communication with mobile terminal 17 could not be established within a predetermined time. When NO, control proceeds to step S206 to maintain the connection between mobile terminal 17 and position measurement apparatus 16 in the transceiver mode. The reception level is measured by reception level measurement circuit 205. The measured reception level is displayed in numerics on data display unit 207. Also, the audio around position measurement object 18 is output from speaker 209. The measurement operator can identify the distance from mobile terminal 17 by the intensity of the reception level. Furthermore, the direction where mobile terminal 17 is present can be identified since the reception level is altered according to its own movement. Furthermore, the environment of position measurement object 18 can be identified by the audio output from speaker 209.

At step S207, determination is made whether there is a position measurement end request through operation key input unit 208. When NO, the process from S205 and et seq. is repeated. When YES at step S207, control proceeds to step S208 to provide a message on data display unit 207 indicating that the position of mobile terminal 17 cannot be measured. Then, control proceeds to step S209 to end the transceiver mode. At step S210, the line is disconnected. At step S211, the mode is set to the PHS conversation mode. Here, the process ends.

When YES at step S207, an end request is output to mobile terminal 17. Then, the process from S209 and et seq. is carried out.

When the position of mobile terminal cannot be measured due to the fact that direct communication with mobile terminal 17 cannot be established, the measurement operator detects the approximate position of mobile terminal 17 by the system shown in Figs. 11-13. Then, the measurement operator moves closer to mobile terminal 17 according to the identified rough position. Then, the process from steps S200 and et seq. is carried out.

The operation of the entire system will be described in detail hereinafter. Position measurement of object 18 to which mobile terminal

17 is attached is carried out according to the following steps.

(1) Mobile terminal 17 is attached to position measurement object 18.

(2) By the system shown in Figs. 11-13, the rough location of mobile terminal 17 is identified.

5       (3) The measurement operator moves towards the position identified by the above (2) carrying position measurement apparatus 16.

      (4) The measurement operator sends a call to mobile terminal 17 from position measurement apparatus 16 in the PHS public mode using the shortened dialing function and the like. Here, line #1 of Fig. 1 is used.  
10      More specifically, communication through repeater 6B, telephone central office 15, and repeater 6A is carried out.

      (5) Upon line connection, a request is output to mobile terminal 17 to switch the mode of mobile terminal 17 to the transceiver mode.

      (6) Upon output of the switching request, the line (#1) connecting  
15      repeater 6B, telephone central office 15, and repeater 6A is disconnected. Position measurement apparatus 16 switches its own mode to the transceiver mode to attempt direct connection with mobile terminal 17 (connection using line #2 of Fig. 1).

      (7) Mobile terminal 17 responds to the request to switch its own  
20      mode to the transceiver mode. A wave (target signal) is output in the transceiver mode.

      (8) Position measurement apparatus 16 indicates the reception level (wave intensity) on data display unit 207 in numerals in the transceiver mode. The display is not restricted to numerical values, and other  
25      representations displays such as a bar graph, in alphabets, and the like can be provided as long as the intensity of the wave reception level can be identified. However, it is desirable to display the intensity of the reception level in multi-stages since the intensity of the reception level cannot be easily identified by just the display of approximately three stages.

30      (9) The measurement operator moves in the direction of a higher level while confirming the displayed reception level. Accordingly, the measurement operator can move closer to mobile terminal 17 and object 18 to eventually find position measurement object 18.

(10) When a state in which communication between position measurement apparatus 16 and mobile terminal 17 cannot be established within a predetermined time (for example, approximately one minute) in the transceiver mode, position measurement apparatus 16 and mobile terminal 17 suspend the communication by the transceiver mode, and switch respective modes to the PHS public mode. Then, mobile terminal 17 waits for a call from center station 91 (Fig. 11) or position measurement apparatus 16. The measurement operator approaches mobile terminal 17 according to the sequence from (2).

(11) When the measurement operator tracks down mobile terminal 17 and position measurement object 18, a communication disconnect request by the transceiver mode is input through operation key input unit 208. In response, position measurement apparatus 16 and mobile terminal 17 are both switched to the PHS public mode.

Thus, a system for accurate position measurement of object 18 can be established.

[Second Embodiment]

Fig. 8 is a block diagram of a mobile terminal according to a second embodiment of the present invention. The mobile terminal is used in a system identical to that of the system of the first embodiment. It is to be noted that the mobile terminal of the second embodiment lacks data display unit 107, operation key input unit 108, microphone 109, and loudspeaker 110 of mobile terminal 17 of Fig. 2. The remaining components are identical to those in Figs. 2 and 8. Therefore, description thereof will not be repeated.

The mobile terminal of the present embodiment has the function of a telephone removed from the mobile terminal of Fig. 2. Therefore, the mobile terminal cannot place a telephone call or receive a telephone call. However, an economic and compact mobile terminal can be provided.

It is effective to attach only microphone 109 to control microcomputer 106. The audio around the mobile terminal can be collected in the transceiver mode through microphone 109 to allow the operator to receive the audible sound at the position measurement apparatus 16 side. The

measurement operator can perceive the environment of the mobile terminal.

[Third Embodiment]

Fig. 9 is a block diagram showing a structure of a position measurement apparatus according to a third embodiment of the present invention. The position measurement apparatus is used in a system identical to that of the first embodiment. The position measurement apparatus has non-directional antenna 201 and switch 202 removed from the position measurement apparatus of Fig. 5. The position measurement apparatus of the third embodiment has a directional antenna 210 attached to reception circuit 203 and a non-directional antenna 211 attached to reception circuit 204.

Since the antennas can be used independently for reception and transmission in the present embodiment, switching by means of a switch is not required. Furthermore, the usage of directional antenna 210 as a reception antenna improves identification of the direction where mobile terminal 17 is present by altering the direction of the reception antenna to catch a stronger reception level.

[Fourth Embodiment]

Fig. 10 is a block diagram showing the structure of position measurement apparatus 16 according to a fourth embodiment of the present invention. This position measurement apparatus is used in a system identical to that of the first embodiment. The position measurement apparatus of the fourth embodiment lacks antenna 201 and switch 202 from the position measurement apparatus of Fig. 5, and has a directional antenna 210 and a non-directional antenna 211 attached to switches 212 and 213. Reception circuit 203 can arbitrary switch the signal between directional antenna 210 and non-directional antenna 211 for reception through switch 212. Switch 212 switches the antenna to be used at an interval of a constant time-period (for example, approximately one second). Reception level measurement circuit 205 can measure the wave intensity received by respective antennas to alternately provide the measured value on data display unit 207.

The measurement operator can identify the approximate distance to

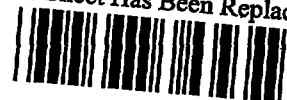
mobile terminal 17 by detecting the intensity of the wave received by non-directional antenna 211. Also, the operator can identify whether communication with mobile terminal 17 is allowed or not. Furthermore, the operator can identify the direction where mobile terminal 17 is present by detecting the wave intensity from directional antenna 210. Thus, position measurement can be effected efficiently.

A microphone 210 can be attached to control microcomputer 206 so that position measurement apparatus 16 can be also used as a telephone in the present embodiment. Such a microphone can be attached to the position measurement apparatus of Fig. 5 or Fig. 9.



## Claims

1. A mobile terminal that can communicate with an external apparatus through radio, comprising:  
5 reception means for receiving a signal from said external apparatus, and  
set means responsive to reception by said reception means for setting a mode for direct communication with said external apparatus.
- 10 2. The mobile terminal according to claim 1, wherein said reception means receives a signal from said external apparatus via a repeater.
3. The mobile terminal according to claim 1, further comprising  
15 cancel means for canceling said set mode when communication with said external apparatus in said set mode cannot be established within a predetermined time.
4. The mobile terminal according to claim 1, wherein said mobile  
20 terminal carries out communication with said external apparatus to notify its own position to said external apparatus.
5. The mobile terminal according to claim 1, further comprising  
25 transmission means for transmitting information of environment of said mobile terminal to said external apparatus in said set mode.
6. The mobile terminal according to claim 1, wherein said mobile  
terminal carries out communication employing a small zone communication system.
- 30 7. A position measurement apparatus for measuring a position of a mobile terminal, comprising:  
transmission means for transmitting a signal to said mobile terminal through a first path,





reception means responsive to said transmission for receiving a signal output from said mobile terminal through a second path, and measurement means for measuring intensity of the signal received by said reception means.

5

8. The position measurement apparatus according to claim 7, wherein said measurement means includes display means for displaying said signal intensity in numerals.

10

9. The position measurement apparatus according to claim 7, wherein said reception means includes a directional antenna.

10. The position measurement apparatus according to claim 9, wherein said reception means includes a non-directional antenna.

15

11. The position measurement apparatus according to claim 10, wherein

a direction where said mobile terminal is present can be identified by altering the direction of said directional antenna, and

20

determination is made whether communication with said mobile terminal is allowed or not by said non-directional antenna.

12. The position measurement apparatus according to claim 10, further comprising switch means for switching between said directional antenna and said non-directional antenna.

25

13. The position measurement apparatus according to claim 7, wherein said position measurement apparatus carries out communication employing a small zone communication system.

30

14. A position measurement system constituted by a mobile terminal that can communicate with an external apparatus through radio and a position measurement apparatus for measuring a position of said





mobile terminal ,

said mobile terminal comprising:

reception means for receiving a signal from said external apparatus,

and

5                    set means responsive to reception by said reception means for  
setting a mode for direct communication with said external apparatus; and  
said position measurement apparatus comprising:

transmission means for transmitting a signal to said mobile terminal  
through a first path,

10                  reception means responsive to said transmission for receiving a  
signal output from said mobile terminal through a second path, and  
measurement means for measuring intensity of the signal received  
by said reception means.

15                  15. A position measurement method for measuring a position where  
a mobile terminal is present, comprising the steps of:

sending a signal to said mobile terminal to output a wave from said  
mobile terminal,

measuring intensity of said output wave, and

20                  measuring position where said mobile terminal is present by said  
measured wave intensity.

This Sheet Has Been Replaced

