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Certification

Welocalize Translations

TRANSLATORS' DECLARATION:

We, David Takata and Michael Larson, hereby declare:

That we possess advanced knowledge of the Japanese and English languages. The attached Japanese into English translation has been translated by us and to the best of our knowledge and belief, it is a true, correct and complete translation of: L11031_01-2_JP2003-130680A. We hereby certify under penalty of perjury that the foregoing is true and correct.

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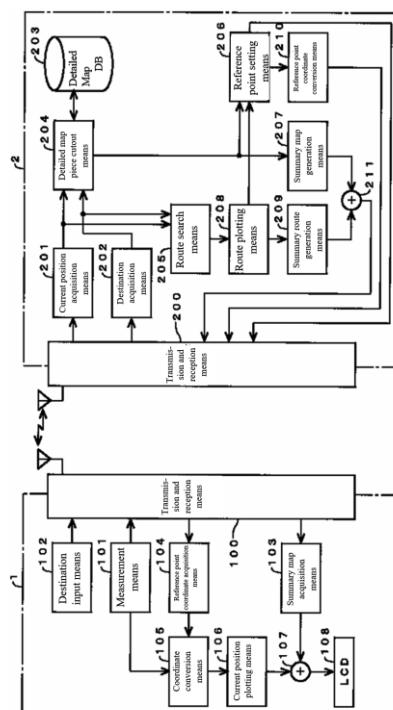
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(54) [Title of Invention] MAP DISPLAY TERMINAL, MAP DISPLAY DEVICE, AND WIRELESS TERMINAL AND MAP SERVER THEREOF

(57) [Abstract]

[Problem] To provide a map display terminal, a map display device, and a wireless terminal 1 and a map server thereof that can achieve high visibility even on a small screen of a mobile telephone or the like.

[Resolution Means] A map server 2 includes: means 204 for cutting out a detailed map piece of a vicinity of a current position of a wireless terminal from a detailed map database 203; means 206 for setting a plurality of reference points; means 207 for generating a summary map on the basis of the detailed map piece; and means 210 for converting absolute coordinates (first coordinate system) of each reference point into relative coordinates (second coordinate system), wherein the summary map as well as the absolute coordinates and relative coordinates of each reference point are returned to the wireless terminal 1. The wireless terminal 1 includes means 105 for converting the absolute coordinates of the present position into relative coordinates on the basis of a correspondence relationship between the absolute coordinates and the relative coordinates of each reference point, wherein the current position is displayed superimposed on the summary map on the basis of the relative coordinates of the current position.



[Scope of Patent Claims]

[Claim 1] A map display terminal that positions a current position and displays such superimposed on a map screen, the map display terminal comprising:

means for positioning the current position in a first coordinate system;
 means for storing a detailed map managed in the first coordinate system;
 means for cutting out a detailed map piece in a vicinity of the current position from the detailed map;
 means for generating a summary map managed in a second coordinate system different from the first coordinate system on the basis of the detailed map piece;
 means for setting a plurality of reference points at a predetermined position;
 means for converting coordinates in the first coordinate system of each of the reference points into coordinates in the second coordinate system;
 means for converting coordinates in the first coordinate system of the current position into coordinates in the second coordinate system on the basis of a correspondence relationship between coordinates in the first coordinate system and coordinates in the second coordinate system of each of the reference points; and
 means for displaying the current position superimposed on the summary map on the basis of the coordinates in the second coordinate system of the current position.

[Claim 2] The map display terminal according to claim 1 comprising:

means for inputting a destination;
 means for cutting out a detailed map piece of a predetermined range from the detailed map on the basis of the current position and the destination;
 means for searching for a route from the current position to the destination; and
 means for generating a summary route for notating the route on the summary map, wherein the means for displaying displays the current position and the summary route superimposed on the summary map.

[Claim 3] The map display terminal according to claim 2, wherein the means for setting the reference points sets at least one reference point on the searched route.

[Claim 4] The map display terminal according to claim 2, wherein the means for setting the reference points sets at least one reference point on or in the vicinity of a corner on the searched route.

[Claim 5] A map server of a map display device

in which a wireless terminal positions its own current position, transmits such to a map server, and displays the current position of the wireless terminal superimposed on a map image returned from the map server, wherein

the map server comprises:

means for storing a detailed map managed in a first coordinate system;
 means for cutting out, from the detailed map, a detailed map piece in a vicinity of the current position of the wireless terminal notified from the wireless terminal;
 means for setting a plurality of reference points at a predetermined position;
 means for generating a summary map managed in a second coordinate system different from the first coordinate system on the basis of the detailed map piece;
 means for converting coordinates in the first coordinate system of each of the reference points into coordinates in the second coordinate system; and
 means for returning image information of the summary map as well as coordinates in the first coordinate system and coordinates in the second coordinate system of each of the reference points to the wireless terminal.

[Claim 6] The map server of the map display device according to claim 5, the map server comprising:

means for cutting out a detailed map piece of a predetermined range from the detailed map on the basis of a destination and a current position notified from a wireless terminal;
 means for searching for a route from the current position to the destination;
 means for generating a summary route for notating the route on a summary map; and
 means for generating a summary route map on the basis of the summary map and the summary route; wherein

the means for returning returns the summary route map as well as coordinates in the first coordinate system and coordinates in a second coordinate system for each of the reference points.

[Claim 7] The map server of the map display device according to claim 5, wherein the means for setting reference points sets at least one reference point on the searched route.

[Claim 8] The map server of the map display device according to claim 5, wherein the means for setting reference points sets at least one reference point on or in the vicinity of a corner on the searched route.

[Claim 9] A wireless terminal of a map display device in which a wireless terminal positions its own current position, transmits such to a map server, and displays the current position of the wireless terminal superimposed on the map image returned from the map server, the wireless terminal comprising:
 means for positioning the current position in a first coordinate system;
 means for notifying the map server of the current position;
 means for acquiring, from the map server, image information of the summary map adopting the second coordinate system different from the first coordinate system;
 means for acquiring coordinates in the first coordinate system and coordinates in the second coordinate system for a plurality of reference points on the summary map;
 means for converting coordinates in the first coordinate system of the current position into coordinates in the second coordinate system on the basis of a correspondence relationship between coordinates in the first coordinate system and coordinates in the second coordinate system of each of the acquired reference points; and
 means for displaying the current position superimposed on the summary map on the basis of coordinates in the second coordinate system of the current position.

[Claim 10] The wireless terminal of the map display device according to claim 9, the wireless terminal further comprising:
 means for inputting a destination; and
 means for notifying the map server of the destination.

[Claim 11] The wireless terminal of the map display device according to claim 9, wherein the means for positioning the current position communicates with a plurality of base stations, measures a distance to each base station, and positions the current position on the basis of these measurement results.

[Claim 12] The wireless terminal of the map display device according to claim 9, wherein the means for positioning the current position positions the current position on the basis of a reception time of a GPS signal transmitted from a plurality of GPS satellites.

[Claim 13] A map display device in which a wireless terminal positions its own current position, transmits such to a map server, and displays the current position of the wireless terminal superimposed on a map image returned from the

map server, wherein:
 the wireless terminal comprises:
 means for positioning the current position in a first coordinate system; and
 means for notifying the map server of the current location;
 the map server comprises:
 means for storing a detailed map managed in the first coordinate system;
 means for cutting out, from the detailed map, a detailed map piece in a vicinity of the current position of the wireless terminal notified from the wireless terminal;
 means for setting a plurality of reference points in a predetermined position;
 means for generating a summary map managed in a second coordinate system different from the first coordinate system on the basis of the detailed map piece;
 means for converting coordinates in the first coordinate system of each of the reference points into coordinates in the second coordinate system; and
 means for returning image information of the summary map as well as coordinates in the first coordinate system and coordinates in the second coordinate system of each of the reference points to the wireless terminal; and
 the wireless terminal further comprises:
 means for acquiring image information of the summary map;
 means for acquiring coordinates in the first coordinate system and coordinates in the second coordinate system for the plurality of reference points;
 means for converting coordinates in the first coordinate system of the current position into coordinates in the second coordinate system on the basis of a correspondence relationship between coordinates in the first coordinate system and coordinates in the second coordinate system for each of the acquired reference points; and
 means for displaying the current position overlapped on the summary map on the basis of coordinates in the second coordinate system of the current position.

[Claim 14] The map display device according to claim 13, the wireless terminal further comprising:
 means for inputting a destination; and
 means for notifying the map server of the destination; and
 the map server further comprising:
 means for cutting out a detailed map piece of a predetermined range from the detailed map on the

basis of the current position and destination notified from the wireless terminal;
 means for searching for a route from the current position to the destination;
 means for generating a summary route for notating the route on a summary map; and
 means for generating a summary route map on the basis of the summary map and the summary route; wherein

the means for returning returns the summary route map as well as coordinates in the first coordinate system and coordinates in the second coordinate system for each of the reference points.

[Detailed Description of Invention]

[0001]

[Technical Field of Invention] The present invention relates to a map display terminal, a map display device, and a wireless terminal and a map server thereof that position a current position and display such on a map image, and more particularly relates to a map display terminal, a map display device, and a wireless terminal and a map server thereof that can ensure high visibility even on a small display screen such as a mobile telephone or a PHS telephone by summarizing and displaying a map.

[0002]

[Conventional Art] With the development of the Global Positioning System (GPS), automotive navigation systems have become widespread. In this type of system, one's own current position is positioned, map information stored in a storage medium such as CD-ROM or DVD-ROM is read, and the positioned current position is displayed on a display together with a surroundings map. Furthermore, when a desired destination is input, an optimal route from the current position to the destination is found and display and sound of guidance are output.

[0003] Moreover, map information services using a wireless terminal such as a mobile telephone or PHS telephone are also being provided in recent years. In this type of service, when a wireless terminal positions its own current position and notifies a map server of such, map information of a vicinity of the current position is provided from the map server to the wireless terminal. The wireless terminal displays the current position positioned by itself on a display overlapped on the received surrounding map.

[0004]

[Problem to be Solved by Invention] The display of a mobile wireless terminal such as a mobile

telephone or a PHS telephone is inevitably smaller than a display of an on-vehicle navigation system. Thus, there is a technical problem in that when a detailed map similar to that of a large screen is displayed on this, visibility worsens.

[0005] Such a technical problem can be solved by, for example, separately preparing a map (summary map) having intersections and landmark surroundings that are important for guidance deformed and displayed emphasized and enlarged for a mobile wireless terminal. However, because coordinate systems do not match between the deformed map and the original detailed map, it has been difficult to accurately map the current position positioned on the basis of the detailed map onto the deformed summary map.

[0006] Moreover, because information of two maps must be prepared, not only does the map server become larger, but applications for route search and the like must also be developed separately.

[0007] An object of the present invention is to solve the problems of the conventional art described above and to provide a map display terminal, a map display device, and a wireless terminal and a map server thereof that achieve high visibility even on a small screen.

[0008]

[Means for Solving Problem] The present invention is characterized in that the following means are conferred to achieve the object described above.

[0009] (1) A map display terminal that positions a current position and displays such superimposed on a map screen, provided with: means for positioning the current position in a first coordinate system (absolute coordinate system); means for storing a detailed map managed in the first coordinate system; means for cutting out a detailed map piece in a vicinity of the current position from the detailed map; means for generating a summary map managed in a second coordinate system (relative coordinate system) different from the first coordinate system on the basis of the detailed map piece; means for setting a plurality of reference points in a predetermined position; means for converting coordinates in the first coordinate system of each of the reference points into coordinates in the second coordinate system; means for converting coordinates (absolute coordinates) in the first coordinate system of the current position into relative coordinates on the basis of a correspondence relationship between the absolute coordinates and coordinates (relative

coordinates) in the second coordinate system of each of the reference points; and means for displaying the current position overlapped on the summary map on the basis of the relative coordinates of the current position.

[0010] (2) A map server of a map display device in which a wireless terminal positions its own current position, transmits such to the map server, and displays its own current position superimposed on a map image returned from the map server, provided with: means for storing a detailed map managed in a first coordinate system (absolute coordinate system); means for cutting out, from the detailed map, a detailed map piece in a vicinity of the current position of the wireless terminal notified from the wireless terminal; means for setting a plurality of reference points on the detailed map piece; means for summarizing the detailed map piece and generating a summary map managed in a second coordinate system (relative coordinate system); means for converting coordinates (absolute coordinates) in the first coordinate system of each reference point into coordinates (relative coordinates) in the second coordinate system (relative coordinate system); and means for returning image information of the summary map as well as the absolute coordinates and relative coordinates of each reference point to the wireless terminal.

[0011] (3) A wireless terminal of a map display device in which a wireless terminal positions its own current position, transmits such to a map server, and displays its own current position superimposed on a map image returned from the map server, provided with: means for positioning the current position on a first coordinate system (absolute coordinate system); means for notifying the map server of the current position; means for acquiring image information of a summary map adopting a second coordinate system (relative coordinate system); means for acquiring coordinates (absolute coordinates) in the first coordinate system and coordinates (relative coordinate) in the second coordinate system for a plurality of reference points on the summary map; means for converting the absolute coordinates of the current position into relative coordinates on the basis of a correspondence relationship between the absolute coordinates and the relative coordinates of each reference point; means for finding the current position on the summary map on the basis of the relative coordinates of the current position; and means for displaying the summary map and the current position superimposed.

[0012] According to characteristic (1) above, the wireless terminal cuts out a detailed map piece on the basis of its own current position and generates a summary map thereof. This summary map uses the second coordinate system as a reference, but because the absolute coordinates of the current position can be converted into relative coordinates by finding the correspondence relationship between the coordinates (absolute coordinates) in the first coordinate system and the coordinates (relative coordinates) in the second coordinate system for a plurality of reference points on the map, its own current position can be displayed superimposed on the summary map.

[0013] According to characteristics (2) and (3) above, the map server cuts out a detailed map piece on the basis of current position information of the wireless terminal received from the wireless terminal and generates a summary map thereof. This summary map uses the second coordinate system as a reference, but the map server finds the correspondence relationship between the coordinates (absolute coordinates) in the first coordinate system and the coordinates (relative coordinates) in the second coordinate system for a plurality of reference points on the map, and notifies the wireless terminal of this and image information of the summary map. Since the absolute coordinates of the current position can be converted into relative coordinates on the basis of the correspondence relationship in the wireless terminal, its own current position can be displayed superimposed on the summary map.

[0014]

[Embodiments of Invention] Preferable embodiments of the present invention will be described in detail below with reference to the drawings. FIG. 1 is a diagram illustrating a configuration of a map display device that is one embodiment of the present invention and is configured of a mobile wireless terminal 1 such as a mobile telephone or a PHS telephone and a map server 2 that includes a detailed map database (DB). The wireless terminal 1 and the map server 2 mutually perform wireless communication via a wireless base station, not illustrated.

[0015] FIG. 2 is a block diagram illustrating a configuration of main components of the wireless terminal 1 and the map server 2.

[0016] In the wireless terminal 1, positioning means 101 perform absolute positioning of its own current position on a first coordinate system (hereinafter expressed as absolute coordinate system) on the basis of latitude and longitude.

Coordinates on the absolute coordinate system (hereinafter expressed as absolute coordinates) of the current position can be positioned on the basis of a well-known three-point measurement technique of detecting reception time of GPS radio waves transmitted from a plurality of GPS satellites or measuring communication time with three neighboring base stations.

[0017] A predetermined destination is input by operation of a user from destination input means 102. Absolute coordinates $P(x, y)$ of the positioned current position and absolute coordinates $Q(x, y)$ of the input destination are transmitted to the map server 2 via transmission and reception means 100.

[0018] In the map server 2, current position acquisition means 201 and destination acquisition means 202 acquire the absolute coordinates $P(x, y)$ of the current position and the absolute coordinates $Q(x, y)$ of the destination transmitted from the wireless terminal 1 via transmission and reception means 200. A detailed map created on the basis of the absolute coordinate system is saved in advance in a detailed map database (DB) 203. Detailed map piece cutout means 204 cut out a detailed map piece of a predetermined range from the detailed map stored in the detailed map DB 203 on the basis of the absolute coordinates $P(x, y)$ of the current position and the absolute coordinates $Q(x, y)$ of the destination. FIG. 3 is a diagram illustrating one example of the cut-out detailed map piece, and each road and block is notated in detail and accurately.

[0019] Reference point setting means 206 set a plurality of reference points on the cut-out detailed map piece. Summary map generation means 207 generate a summary map on the basis of the detailed map piece. Note that a method for generating the summary map on the basis of the detailed map is disclosed in detail in a patent application (JP H11-202762) by the applicants of the present invention, and so descriptions thereof are omitted here.

[0020] FIG. 4 is a diagram illustrating one example of the summary map, and among the roads described according to the actual road width and orientation on the detailed map piece of FIG. 3, narrow roads are omitted, and all roads within a predetermined range of road widths are described having the same width. Moreover, the directions of the roads are unified in horizontal or vertical directions, and all the blocks are simplified into rectangles. On this summary map, the coordinates of each part are relatively managed on the basis of the second coordinate system (hereinafter expressed as relative coordinate system) in which

the upper right end coordinate is (0, 0) and the lower left end coordinate is (80, 80).

[0021] Route search means 205 search for an optimal route from the current position to the destination on the basis of the absolute coordinates $P(x, y)$ of the current position, the absolute coordinates $Q(x, y)$ of the destination, and the detailed map. Route plotting means 208 plot the optimal route on the absolute coordinate system. Summary route generation means 209 summarize the plotted optimal route and generate a summary route on the relative coordinate system.

[0022] Overlapping means 211 overlap the summary map and the summary route to generate a summary route map (FIG. 14). Reference point coordinate conversion means 210 convert the absolute coordinates of each reference point into relative coordinates corresponding to the summary map. This coordinate conversion method is also disclosed in detail in a patent application (JP H11-202762) by the applicants of the present invention, and so description thereof is omitted here.

[0023] The transmission and reception means 200 returns the summary map (or summary route map) and, as shown in FIG. 15, the correspondence relationship between the absolute coordinates and the relative coordinates at each reference point to the wireless terminal 1.

[0024] Returning to the wireless terminal 1, summary map acquisition means 103 acquire a summary map (or a summary route map) returned from the map server 2 in response to transmission (step S4) of the absolute coordinates of the current position. A reference point coordinate acquisition unit 104 acquires the absolute coordinates and the relative coordinates of each reference point returned together with the summary map from the map server 2. Coordinate conversion means 105 convert the absolute coordinates $P(x, y)$ of the current position found by the positioning means 101 into relative coordinates $p(\alpha, \beta)$ on the basis of the correspondence relationship (FIG. 15) between the acquired absolute coordinates and relative coordinates of each reference point.

[0025] Current position plotting means 106 plot the positioned current position on the summary map. Overlapping means 107 overlap and output a mark of the plotted current position on the acquired summary map. An output image is displayed on an LCD display 108.

[0026] Next, operation of the map display device above will be described in detail along the flowcharts of FIGS. 5, 6, and 7.

[0027] In the wireless terminal 1, in step S1 of FIG. Toyota Petition '628 Exhibit 1009

5, a menu screen is displayed on the LCD display 108 as illustrated in FIG. 8(a). In the present embodiment, a plurality of operation modes are prepared, including a first mode that displays a surrounding map and a second mode that searches for and displays a route to the destination, but only the first and second modes will be described here.

[0028] When “display of surrounding map” is selected in step S2, in step S3, the absolute coordinates $P(x, y)$ of the current position are positioned in the positioning means 101. In step S4, the positioning results are transmitted to the map server 2 via the transmission and reception means 100. In step S5, the device stands by waiting for a response from the map server 2.

[0029] Meanwhile, in the map server 2, when the positioning results, that is, the absolute coordinates $P(x, y)$ of the current position of the wireless terminal 1, are received in step S21, in step S22, the detailed map piece (FIG. 3) within a predetermined range (for example, 300 square meters) centered on the current position is cut out from the detailed map DB 203 by the detailed map piece cutout means 204.

[0030] In step S23, the plurality of reference points is set at predetermined positions on the detailed map piece by the reference point setting means 206. FIG. 9 is a diagram illustrating one example of a setting method of the reference points, and in the present embodiment, a total of five reference points R1 to R5 is set at four corners and a centroid position of the detailed map piece, and absolute coordinates thereof are stored. In step S24, the summary map generation means 207 generates a summary map (FIG. 4) of the cut-out detailed map piece.

[0031] In step S25, as illustrated in FIG. 10, the coordinates on the summary map of the five reference points R1 to R5, that is, the relative coordinates, are found by the reference point coordinate conversion means 210. In step S26, the image information of the summary map and the relationship between the absolute coordinates and the relative coordinates of each of the reference points R1 to R5 (FIG. 15) are returned to the wireless terminal 1.

[0032] In the wireless terminal 1, in step S5, when the summary map and the absolute coordinates and relative coordinates of each reference point are acquired, in step S6, the received summary map is displayed on the LCD display 108.

[0033] In step S7, its own current position is again positioned by the positioning means 101. In step S8, the absolute coordinates $P(x, y)$ of the current

position are converted into the relative coordinates $p(\alpha, \beta)$ on the basis of the correspondence relationship (FIG. 15) between the absolute coordinates and the relative coordinates found for each reference point, and mapped on the summary map.

[0034] FIG. 7 is a flowchart illustrating a procedure of the mapping process of the step S8, and mainly illustrates operation of the coordinate conversion means 105. FIG. 11 is a diagram schematically expressing the content of the mapping process.

[0035] In FIG. 7, in step S81, the distances between the absolute coordinates $P(x, y)$ of the current position and all of the reference points R1 to R5 are found on the absolute coordinate system. In step S82, the three reference points having the shortest distance are selected. Here, the description continues assuming that the reference points R1 (x_1, y_1), R2 (x_2, y_2), and R3 (x_3, y_3) are selected. In step S83, (double) an area S of the triangle having the three selected reference points R1, R2, R3 as vertices is found based on the following formula (1).

$$S = |(x_1 - x_3)(y_2 - y_3) - (x_2 - x_3)(y_1 - y_3)| \dots (1)$$

[0036] In step S84, as illustrated in FIGS. 11(a), (b), area coordinates S1, S2, and S3 of three triangles having the absolute coordinates $P(x, y)$ of the current position as a vertex are found on the basis of the following formulas (2), (3), and (4), respectively.

$$S1 = |(x_2 - x)(y_3 - y) - (x_3 - x)(y_2 - y)| / S \dots (2)$$

$$S2 = |(x_1 - x)(y_3 - y) - (x_3 - x)(y_1 - y)| / S \dots (3)$$

$$S3 = |(x_1 - x)(y_2 - y) - (x_2 - x)(y_1 - y)| / S \dots (4)$$

[0037] In step S85, the position on the summary drawing of the current position, that is, the relative coordinates $p(\alpha, \beta)$ of the current position, is found on the basis of the following formulas (5) and (6).

$$\alpha = S1 \cdot \alpha_1 + S2 \cdot \alpha_2 + S3 \cdot \alpha_3 \dots (5)$$

$$\beta = S1 \cdot \beta_1 + S2 \cdot \beta_2 + S3 \cdot \beta_3 \dots (6)$$

[0038] Returning to FIG. 5, at step S9, it is determined whether the relative coordinates $p(\alpha, \beta)$ of the current position have deviated from the summary map. If not, in step S10, as illustrated in FIG. 8(b), a mark representing the current position is generated by the current position plotting means 106 and overlapped on the summary map. Then, the process returns to step S7 and the process up to step S10 is repeated. Therefore, the current position on the summary map displayed on the LCD display 108 changes in synchronization with movement of the current position as illustrated in FIG. 8(c).

[0039] Note that in the step S9, when it is determined that the current position has deviated from the summary map, the process returns to step

S4, the positioning results are transmitted, and a summary map of a new range is acquired.

[0040] Meanwhile, when “route search to destination” is selected in the step S2, in step S11 of FIG. 6, the destination (here, Shinjuku Station) is input from the destination input means 102 as illustrated in FIG. 8(d). In step S3, the absolute coordinates $P(x, y)$ of the current position are positioned by the positioning means 101. In step S13, each coordinate of the current position and the destination is transmitted to the map server 2 via the transmission and reception means 100. In step S5, the device stands by waiting for a response from the map server 2.

[0041] In the map server 2, when the absolute coordinates of the current position of the wireless terminal 1 and the destination are received in step S31, in step S32, the detailed map piece (FIG. 3) of a predetermined range including the current position and the destination is cut out from the detailed map DB 203 by the detailed map piece cutout means 204. In step S33, the optimal route from the current position to the destination is found by the route search means 205. In step S34, a plurality of reference points is set on the detailed map piece.

[0042] FIG. 12 is a diagram illustrating one example of a setting method of the reference points, and in the present embodiment, reference points R1 to R11 are set at the four corners of the detailed map piece and on a plurality of positions on the searched route, and absolute coordinates thereof are stored. Note that it is desirable to set the reference points particularly at corners, intersections, or branching points on the route.

[0043] In step S35, the summary map generation means 207 generates a summary map (FIG. 4) of the detailed map piece. In step S36, the route is plotted by the route plotting means 208, and further, the summary map is summarized and a summary route L generated by the summary route generation means 209. At step S37, as illustrated in FIG. 13, the summary map and the summary route L are overlapped.

[0044] In step S38, as illustrated in FIG. 14, the relative coordinates of the nine reference points R1 to R11 are found by the reference point coordinate conversion means 210. In step S39, the summary map and the correspondence relationship between the absolute coordinates and the relative coordinates of each reference point R1 to R11 are returned to the wireless terminal 1.

[0045] In the wireless terminal 1, in step S5, when the summary map and the absolute coordinates and

relative coordinates of each reference point R1 to R11 are received, in step S6, the received summary information is displayed on the LCD display 108.

[0046] In step S7, its own current position is positioned by the positioning means 101. In step S8, the current position is mapped on the relative coordinate system on the basis of the correspondence relationship between the relative coordinates and the relative coordinates in each reference point. In step S9, it is determined whether the positioned current position has deviated from the summary map, and if not, in step S10, as illustrated in FIG. 8(e), a mark representing the current position is displayed on the summary map. Then, the process returns to the step S7 and the process up to step S10 is repeated. Therefore, the current position on the summary map displayed on the LCD display 108 changes in synchronization with movement of the current position as illustrated in FIG. 8(f).

[0047] Note that in the embodiment described above, the map display device of the present invention is described as being configured by the wireless terminal 1 and the map server 2, but the present invention is not limited only thereto, and a portion of the functions of the wireless terminal 1 and the map server 2 may be distributed to another server, and the wireless terminal 1 may communicate with a plurality of servers.

[0048] Furthermore, in the embodiment described above, the present invention was described using a server (map server)/client (wireless terminal) system as an example, but it is also possible to incorporate all functions into the wireless terminal.

[0049] FIG. 16 is a block diagram illustrating a configuration of a map display terminal 3 that is another embodiment of the present invention, and because the same reference signs as described above represent the same or equivalent portions, descriptions thereof are omitted.

[0050] In the present embodiment, all functions are installed in the map display terminal 3 such as a mobile telephone, a mobile PC, or a personal digital assistant (PDA). The detailed map DB 203 is configured by, for example, a portable semiconductor memory or disk memory, and is detachably equipped to the map display terminal 3.

[0051] Other configurations are the same as the embodiment described above, and the detailed map piece cutout means 204 cuts out a detailed map piece of a predetermined range from the detailed map DB 203 on the basis of the current position and the destination. The summary route generated by the summary route generation means 209 and the

summary map generated by the summary map generation means are overlapped by the overlapping means 211 and the overlapping means 107 further overlaps and displays a mark of the current position.

[0052]

[Effect of Invention] According to the present invention, the following effects are achieved.

(1) Because a summary map is generated on the basis of a detailed map stored in the map server and this is distributed to each wireless terminal and displayed, a highly visible map and guidance can be displayed on a small display of the wireless terminal without separately preparing a map server specialized for the summary map or an application for the summary map.

(2) Because coordinates (absolute coordinates) on the basis of an absolute coordinate system adopted in a detailed map and coordinates (relative coordinates) on the basis of a relative coordinate system adopted in a summary map are provided to a wireless terminal for a plurality of reference points on a map, the wireless terminal can easily map its own current position obtained as absolute coordinates onto a summary map managed by the relative coordinate system.

(3) So long as the reference points are set on an optimal route obtained by a route search, the current position on the summary map when moving along the optimal route can be accurately displayed.

(4) So long as the reference points are set on a corner on an optimal route obtained by a route search, the current position on the summary map when moving along the optimal route can be further accurately displayed.

[Brief Description of Drawings]

[FIG. 1] A diagram illustrating a configuration of a map display device that applies the present invention.

[FIG. 2] A block diagram illustrating a configuration of the wireless terminal and the map server.

[FIG. 3] A diagram illustrating one example of a detailed map.

[FIG. 4] A diagram illustrating one example of a summary map.

[FIG. 5] A flow chart (1) illustrating operation of the present embodiment.

[FIG. 6] A flow chart (2) illustrating operation of the present embodiment.

[FIG. 7] A flowchart of a mapping process.

[FIG. 8] A diagram illustrating a display example of a display in a wireless terminal.

[FIG. 9] A diagram illustrating one example of a setting method of reference points.

[FIG. 10] A diagram illustrating a position of reference points on the summary map.

[FIG. 11] A diagram schematically expressing the content of the mapping process.

[FIG. 12] A diagram illustrating one example of a setting method of reference points.

[FIG. 13] A diagram illustrating a state in which the summary map and a summary route are overlapped.

[FIG. 14] A diagram illustrating one example of a summary route map.

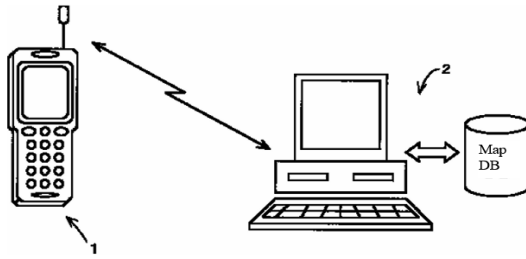
[FIG. 15] A diagram illustrating a relationship between absolute coordinates and relative coordinates of a reference point.

[FIG. 16] A block diagram of a map display terminal that applies the present invention.

[Description of Reference Numerals]

1...Portable wireless terminal, 2...Map server, 100...Transmission and reception means, 101...Positioning means, 102...Destination input means, 103...Summary map acquisition means, 104...Reference point coordinate acquisition unit, 105...Coordinate conversion means, 106...Current position plotting means, 107...Overlapping means, 108...LCD display, 200...Transmission and reception means, 201...Current position acquisition means, 202...Destination acquisition means, 203...Detailed map DB, 204...Detailed map piece cutout means, 205...Route search means, 206...Reference point setting means, 207...Summary map generation means, 208...Route plotting means, 209...Summary route generation means, 210...Reference point coordinate conversion means

[FIG. 1]

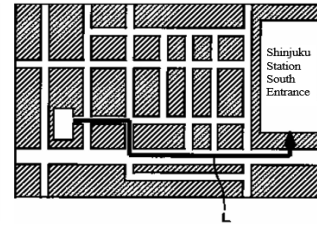


[FIG. 3]

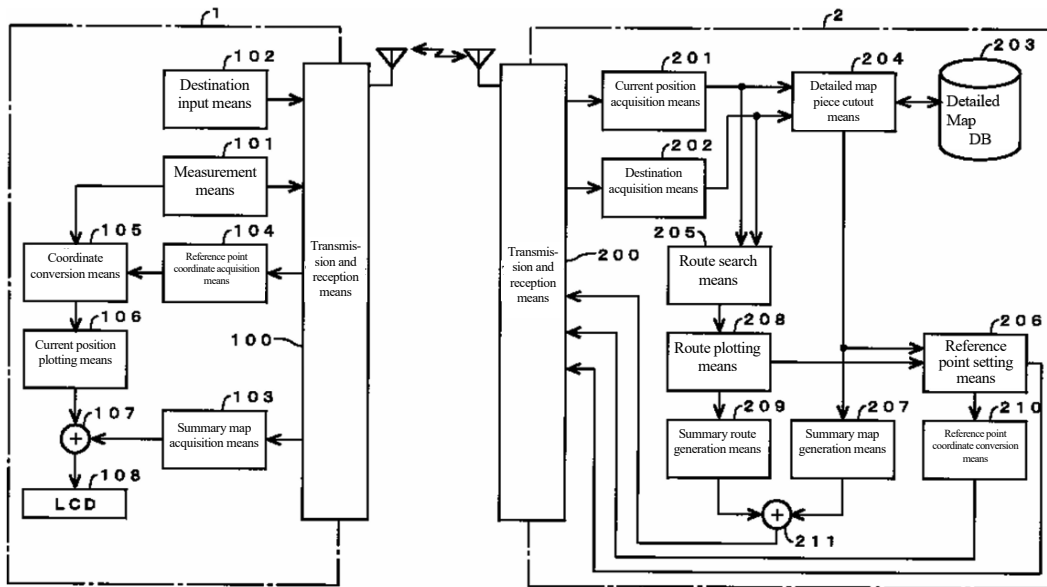
Detailed map (absolute coordinate system)



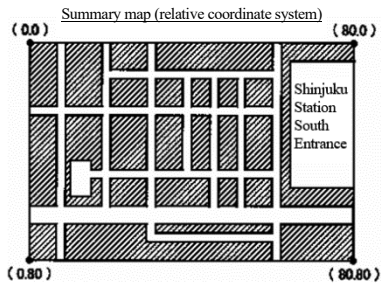
[FIG. 13]



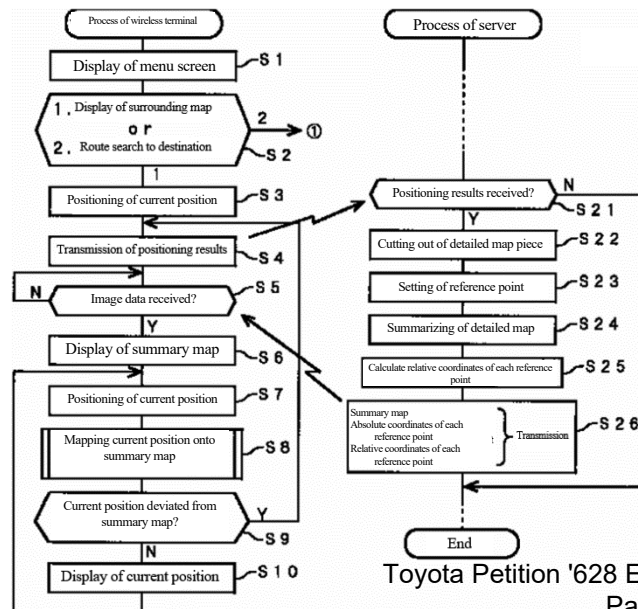
[FIG. 2]



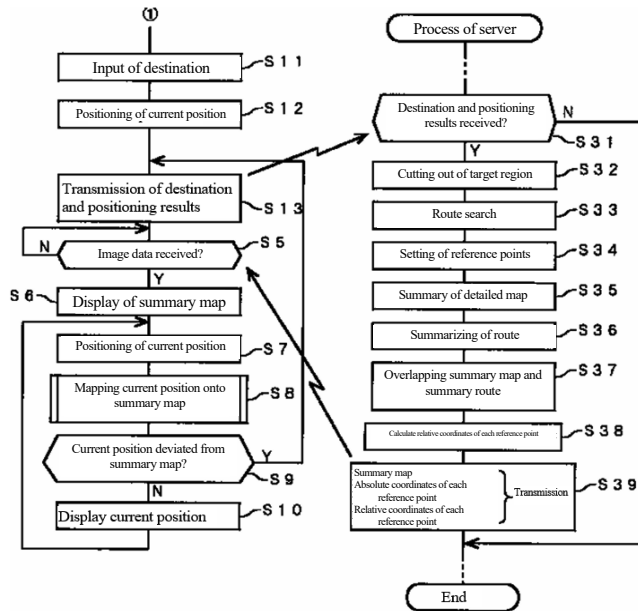
[FIG. 4]



[FIG. 5]

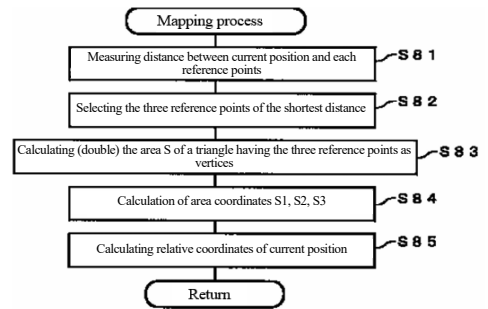


[FIG. 6]

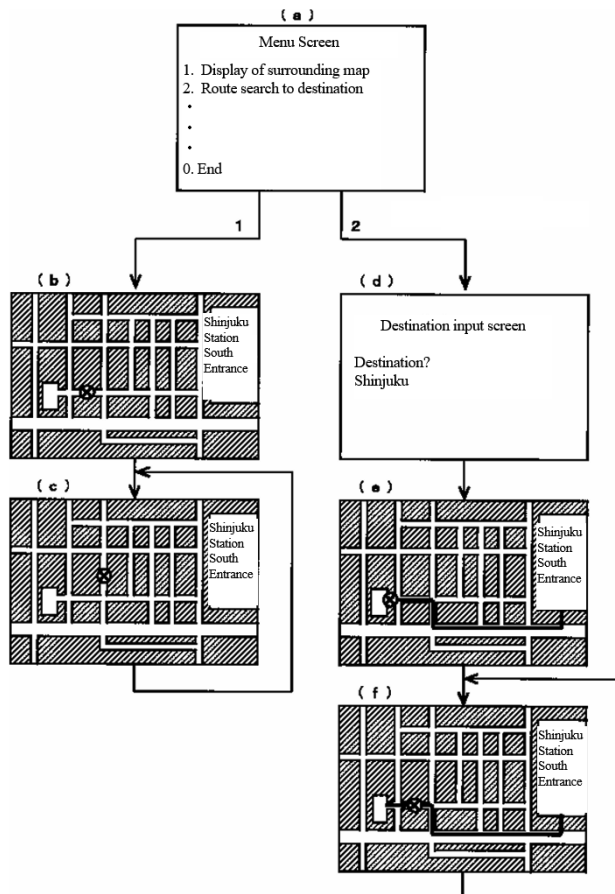


[FIG. 8]

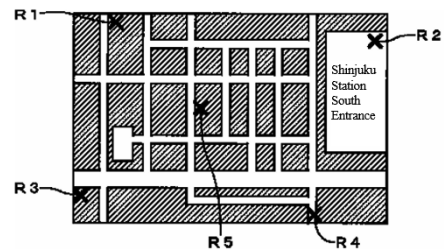
[FIG. 7]



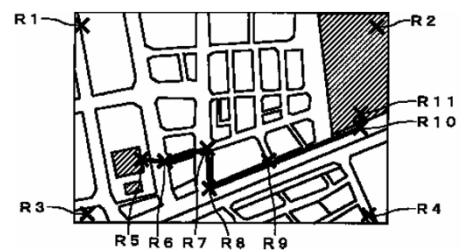
[FIG. 9]



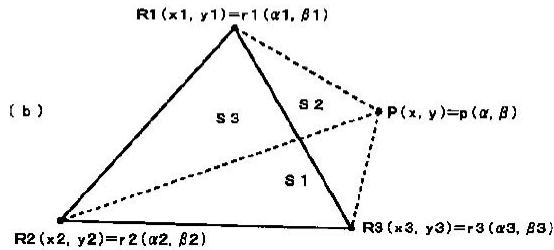
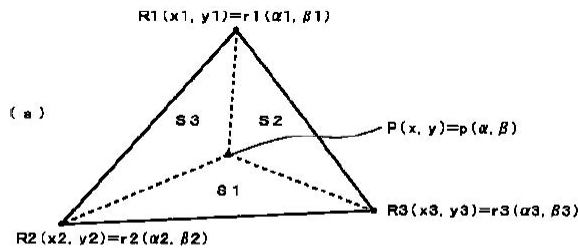
[FIG. 10]



[FIG. 12]



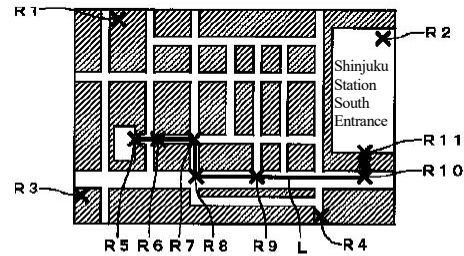
[FIG. 11]



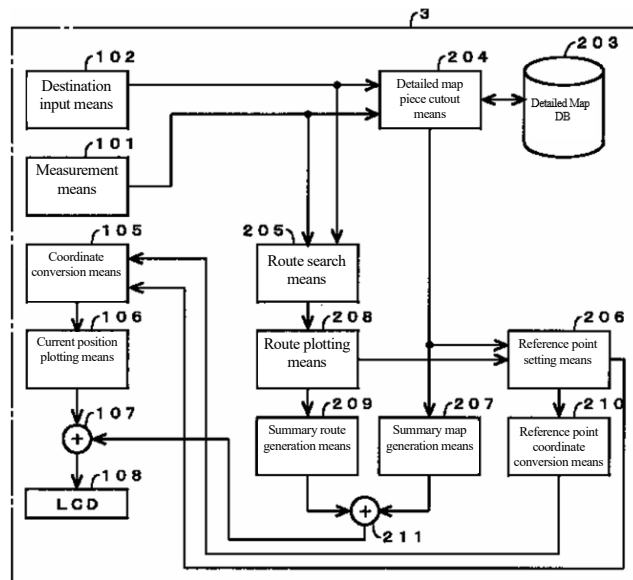
[FIG. 15]

Reference point	Absolute coordinates	Relative coordinates
R 1	139.693, 35.690	10, 5
R 2	139.700, 35.690	78, 10
R 3	139.693, 35.688	3, 70
R 4	139.700, 35.688	60, 80
R 5	139.697, 35.689	35, 38

[FIG. 14]



[FIG. 16]



Continue from front page:

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