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(54) **METHOD AND APPARATUS TO UTILIZE LOCATION DATA TO ENHANCE SAFETY**

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(52) **U.S. Cl.**
CPC ***H04W 4/02*** (2013.01)

(58) **Field of Classification Search**
CPC G01C 21/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,285,041	A		8/1981	Smith
4,571,680	A		2/1986	Wu
4,578,769	A		3/1986	Frederick
5,446,725	A		8/1995	Ishiwatari
5,446,775	A		8/1995	Wright et al.
5,583,776	A		12/1996	Levi et al.
5,593,431	A		1/1997	Sheldon
5,654,619	A		8/1997	Iwashita
5,778,882	A		7/1998	Raymond et al.
5,955,667	A		9/1999	Fyfe
5,960,350	A	*	9/1999	Schorman et al. 455/450
5,976,083	A		11/1999	Richardson et al.
6,013,007	A		1/2000	Root et al.
6,122,595	A		9/2000	Varley et al.
6,135,951	A		10/2000	Richardson et al.
6,145,389	A		11/2000	Ebeling et al.
6,246,321	B1		6/2001	Rechsteiner et al.
6,282,496	B1		8/2001	Chowdhary
6,369,794	B1		4/2002	Sakurai et al.
6,428,490	B1		8/2002	Kramer et al.
6,493,652	B1		12/2002	Ohlenbusch et al.
6,496,695	B1		12/2002	Kouji et al.
6,513,381	B2		2/2003	Fyfe et al.
6,522,266	B1		2/2003	Soehren et al.
6,532,419	B1		3/2003	Begin et al.
6,539,336	B1		3/2003	Vock et al.
6,611,789	B1		8/2003	Darley
6,672,991	B2		1/2004	O'Malley
6,685,480	B2		2/2004	Nishimoto et al.
6,700,499	B2		3/2004	Kubo et al.
6,786,877	B2		9/2004	Foxlin
6,790,178	B1		9/2004	Mault et al.
6,813,582	B2		11/2004	Levi et al.
6,823,036	B1		11/2004	Chen
6,826,477	B2		11/2004	Ladetto et al.
6,836,744	B1		12/2004	Asphahani et al.
6,881,191	B2		4/2005	Oakley et al.

(Continued)

FOREIGN PATENT DOCUMENTS

WO	0188477	A	11/2001

OTHER PUBLICATIONS

"Sensor Fusion," www.u-dynamics.com, 2 pages.

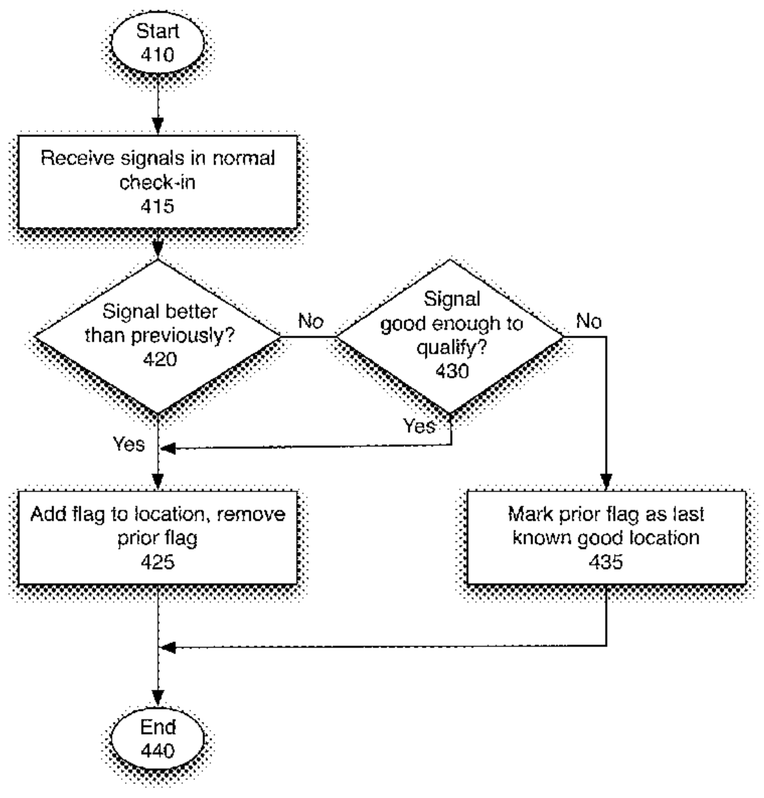
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(57) **ABSTRACT**

A method comprising tracking signal quality received by a mobile device, and flagging a location when a change in signal quality is detected.

13 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

6,885,971	B2	4/2005	Vock et al.	
6,898,550	B1	5/2005	Blackadar et al.	
6,928,382	B2	8/2005	Hong et al.	
6,941,239	B2	9/2005	Unuma et al.	
6,959,259	B2	10/2005	Vock et al.	
6,975,959	B2	12/2005	Dietrich et al.	
7,010,332	B1	3/2006	Irvin et al.	
7,020,487	B2	3/2006	Kimata	
7,054,784	B2	5/2006	Flentov et al.	
7,057,551	B1	6/2006	Vogt	
7,072,789	B2	7/2006	Vock et al.	
7,092,846	B2	8/2006	Vock et al.	
7,148,797	B2	12/2006	Albert	
7,155,507	B2	12/2006	Hirano et al.	
7,158,912	B2	1/2007	Vock et al.	
7,169,084	B2	1/2007	Tsuji	
7,171,331	B2	1/2007	Vock et al.	
7,173,604	B2	2/2007	Marvit et al.	
7,177,684	B1	2/2007	Kroll et al.	
7,200,517	B2	4/2007	Darley et al.	
7,212,943	B2	5/2007	Aoshima et	
7,220,220	B2	5/2007	Stubbs et al.	
7,254,516	B2	8/2007	Case et al.	
7,297,088	B2	11/2007	Tsuji	
7,328,611	B2	2/2008	Klees et al.	
7,334,472	B2	2/2008	Seo et al.	
7,353,112	B2	4/2008	Choi et al.	
7,387,611	B2	6/2008	Inoue et al.	
7,397,357	B2	7/2008	Krumm et al.	
7,428,471	B2	9/2008	Darley et al.	
7,451,056	B2	11/2008	Flentov et al.	
7,457,719	B1	11/2008	Kahn et al.	
7,467,060	B2	12/2008	Kulach et al.	
7,512,515	B2	3/2009	Vock et al.	
7,526,402	B2	4/2009	Tanenhaus et al.	
7,608,050	B2	10/2009	Shugg	
7,617,071	B2	11/2009	Darley et al.	
7,640,134	B2	12/2009	Park et al.	
7,640,804	B2	1/2010	Daumer et al.	
7,647,196	B2	1/2010	Kahn et al.	
7,653,508	B1	1/2010	Kahn et al.	
7,752,011	B2	7/2010	Niva et al.	
7,774,156	B2	8/2010	Niva et al.	
7,811,203	B2	10/2010	Unuma et al.	
7,857,772	B2	12/2010	Bouvier et al.	
7,881,902	B1	2/2011	Kahn et al.	
7,889,085	B2	2/2011	Downey et al.	
7,892,080	B1	2/2011	Dahl	
7,962,312	B2	6/2011	Darley et al.	
7,987,070	B2	7/2011	Kahn et al.	
8,095,146	B2 *	1/2012	Raghavachari	H04W 48/16 455/456.1
8,548,452	B2 *	10/2013	Coskun	G06Q 10/10 455/419
2001/0027375	A1	10/2001	Machida et al.	
2002/0023654	A1	2/2002	Webb	
2002/0027164	A1	3/2002	Mault et al.	
2002/0089425	A1	7/2002	Kubo et al.	
2002/0109600	A1	8/2002	Mault et al.	
2002/0118121	A1	8/2002	Lehrman et al.	
2002/0142887	A1	10/2002	O'Malley	
2002/0151810	A1	10/2002	Wong et al.	
2003/0018430	A1	1/2003	Ladetto et al.	
2003/0048218	A1	3/2003	Milnes et al.	
2003/0083596	A1	5/2003	Kramer et al.	
2003/0093187	A1	5/2003	Walker	
2003/0109258	A1	6/2003	Mantyjarvi et al.	
2003/0139692	A1	7/2003	Barrey et al.	
2003/0149526	A1	8/2003	Zhou et al.	
2004/0138540	A1 *	7/2004	Baker et al.	600/336
2004/0204840	A1	10/2004	Hashima et al.	
2004/0219910	A1	11/2004	Beckers	
2004/0225467	A1	11/2004	Vock et al.	
2004/0236500	A1	11/2004	Choi et al.	
2005/0033200	A1	2/2005	Soehren et al.	
2005/0079873	A1	4/2005	Caspi et al.	
2005/0107944	A1	5/2005	Hovestadt et al.	
2005/0131736	A1	6/2005	Nelson et al.	
2005/0202934	A1	9/2005	Olrik et al.	
2005/0222801	A1	10/2005	Wulff et al.	
2005/0232388	A1	10/2005	Tsuji	
2005/0232404	A1	10/2005	Gaskill	
2005/0234637	A1	10/2005	Obradovich et al.	
2005/0238132	A1	10/2005	Tsuji	
2005/0240375	A1	10/2005	Sugai	
2005/0245275	A1 *	11/2005	Byford	H04W 4/02 455/456.6
2005/0248718	A1	11/2005	Howell et al.	
2006/0020177	A1	1/2006	Seo et al.	
2006/0030270	A1 *	2/2006	Cheng	455/67.11
2006/0063980	A1	3/2006	Hwang et al.	
2006/0064276	A1	3/2006	Ren et al.	
2006/0080551	A1	4/2006	Mantyjarvi et al.	
2006/0100546	A1	5/2006	Silk	
2006/0128371	A1 *	6/2006	Dillon et al.	455/423
2006/0136173	A1	6/2006	Case, Jr. et al.	
2006/0161377	A1	7/2006	Rakkola et al.	
2006/0167387	A1	7/2006	Buchholz et al.	
2006/0206258	A1	9/2006	Brooks	
2006/0223547	A1	10/2006	Chin et al.	
2006/0259268	A1	11/2006	Vock et al.	
2006/0284979	A1	12/2006	Clarkson	
2006/0288781	A1	12/2006	Daumer et al.	
2007/0010259	A1 *	1/2007	Hoffmann	455/456.1
2007/0037605	A1	2/2007	Logan et al.	
2007/0038364	A1	2/2007	Lee et al.	
2007/0061105	A1	3/2007	Darley et al.	
2007/0063850	A1	3/2007	Devaul et al.	
2007/0067094	A1	3/2007	Park et al.	
2007/0073482	A1	3/2007	Churchill et al.	
2007/0082789	A1	4/2007	Nissila et al.	
2007/0125852	A1	6/2007	Rosenberg	
2007/0130582	A1	6/2007	Chang et al.	
2007/0142715	A1	6/2007	Banet et al.	
2007/0208531	A1	9/2007	Darley et al.	
2007/0213126	A1	9/2007	Deutsch et al.	
2007/0250261	A1	10/2007	Soehren	
2007/0260418	A1	11/2007	Ladetto et al.	
2007/0260482	A1	11/2007	Nurmela et al.	
2008/0024364	A1	1/2008	Frederick Taylor	
2008/0059061	A1	3/2008	Lee	
2008/0140338	A1	6/2008	No et al.	
2008/0165737	A1	7/2008	Uppala	
2008/0167801	A1	7/2008	Geelen et al.	
2008/0171918	A1	7/2008	Teller et al.	
2008/0231713	A1	9/2008	Florea et al.	
2008/0254944	A1	10/2008	Muri et al.	
2008/0311929	A1	12/2008	Carro et al.	
2009/0043531	A1	2/2009	Kahn et al.	
2009/0047645	A1	2/2009	Dibenedetto et al.	
2009/0047925	A1 *	2/2009	Rahman	H04W 24/06 455/404.2
2009/0082994	A1	3/2009	Schuler et al.	
2009/0138200	A1	5/2009	Hunter et al.	
2009/0213002	A1	8/2009	Rani et al.	
2009/0216704	A1	8/2009	Zheng et al.	
2009/0234614	A1	9/2009	Kahn et al.	
2009/0291664	A1 *	11/2009	Sandberg et al.	455/404.2
2009/0319221	A1	12/2009	Kahn et al.	
2010/0056872	A1	3/2010	Kahn et al.	
2010/0057398	A1	3/2010	Darley et al.	
2011/0029229	A1 *	2/2011	Hui	G01C 21/20 701/533
2011/0066364	A1	3/2011	Hale	
2011/0195680	A1 *	8/2011	Shaffer	G01C 21/20 455/115.3
2012/0046862	A1 *	2/2012	Griffin	G01C 21/20 701/521

(56) **References Cited**

U.S. PATENT DOCUMENTS

2012/0071174	A1*	3/2012	Bao et al.	455/456.3
2013/0035111	A1*	2/2013	Moeglein et al.	455/456.1

OTHER PUBLICATIONS

Anderson, Ian, et al, "Shakra: Tracking and Sharing Daily Activity Levels with Unaugmented Mobile Phones," Mobile Netw Appl, Aug. 3, 2007, pp. 185-199.

Weckesser, P, et al, "Multiple Sensorprocessing for High-Precision Navigation and Environmental Modeling with a Mobile Robot," IEEE, 1995, pp. 453-458.

Bakhru, Kesh, "A Seamless Tracking Solution for Indoor and Outdoor Position Location," IEEE 16th International Symposium on Personal, Indoor, and Mobile Radio Communications, 2005, pp. 2029-2033.

Fang, Lei, et al, "Design of a Wireless Assisted Pedestrian Dead Reckoning System—The NavMote Experience," IEEE Transactions on Instrumentation and Measurement, vol. 54, No. 6, Dec. 2005, pp. 2342-2358.

Hemmes, Jeffrey, et al, "Lessons Learned Building TeamTrak: An Urban/Outdoor Mobile Testbed," 2007 IEEE Int. Conf. on Wireless Algorithms, Aug. 1-3, 2007, pp. 219-224.

Kalpaxis, Alex, "Wireless Temporal-Spatial Human Mobility Analysis Using Real-Time Three Dimensional Acceleration Data," IEEE Intl. Multi-Conf. on Computing in Global IT (ICCGI'07), 2007, 7 pages.

Park, Chulsung, et al, "ECO: An Ultra-Compact Low-Power Wireless Sensor Node for Real-Time Motion Monitoring," IEEE Int. Symp. on Information Processing in Sensor Networks, 2005, pp. 398-403.

Wang, Shu, et al, "Location Based Services for Mobiles: Technologies and Standards, LG Electronics MobileComm," IEEE ICC 2008, Beijing, pp. 1-66 (part 1 of 3).

Wu, Winston H, et al, "Context-Aware Sensing of Physiological Signals," IEEE Int. Conf. on Engineering for Medicine and Biology, Aug. 23-26, 2007, pp. 5271-5275.

Yoo, Chang-Sun, et al, "Low Cost GPS/INS Sensor Fusion System for UAV Navigation," IEEE, 2003, 9 pages.

* cited by examiner

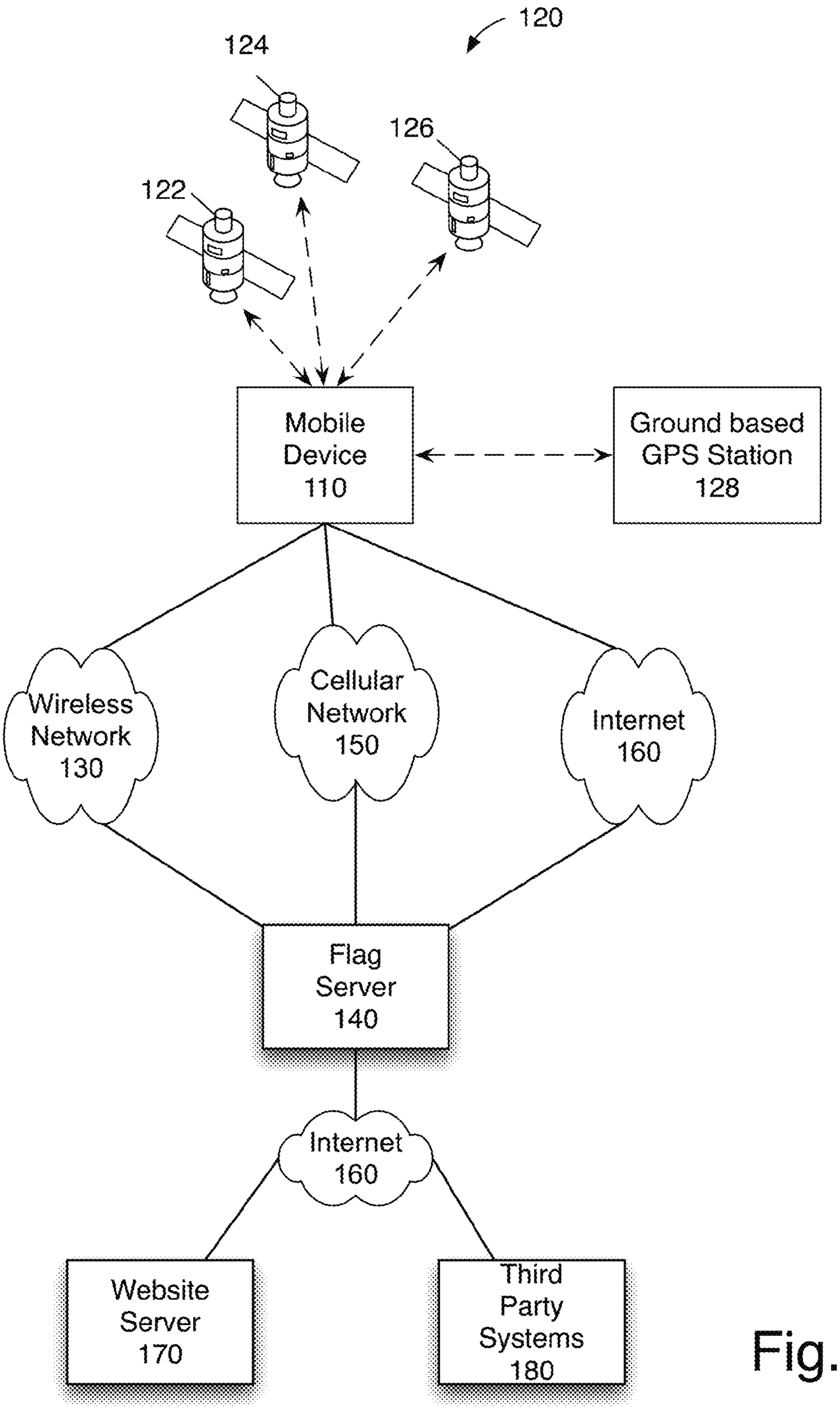

120
124
126
122
Mobile Device 110
Ground based GPS Station 128
Wireless Network 130
Cellular Network 150
Internet 160
Flag Server 140
Internet 160
Website Server 170
Third Party Systems 180

Fig. 1

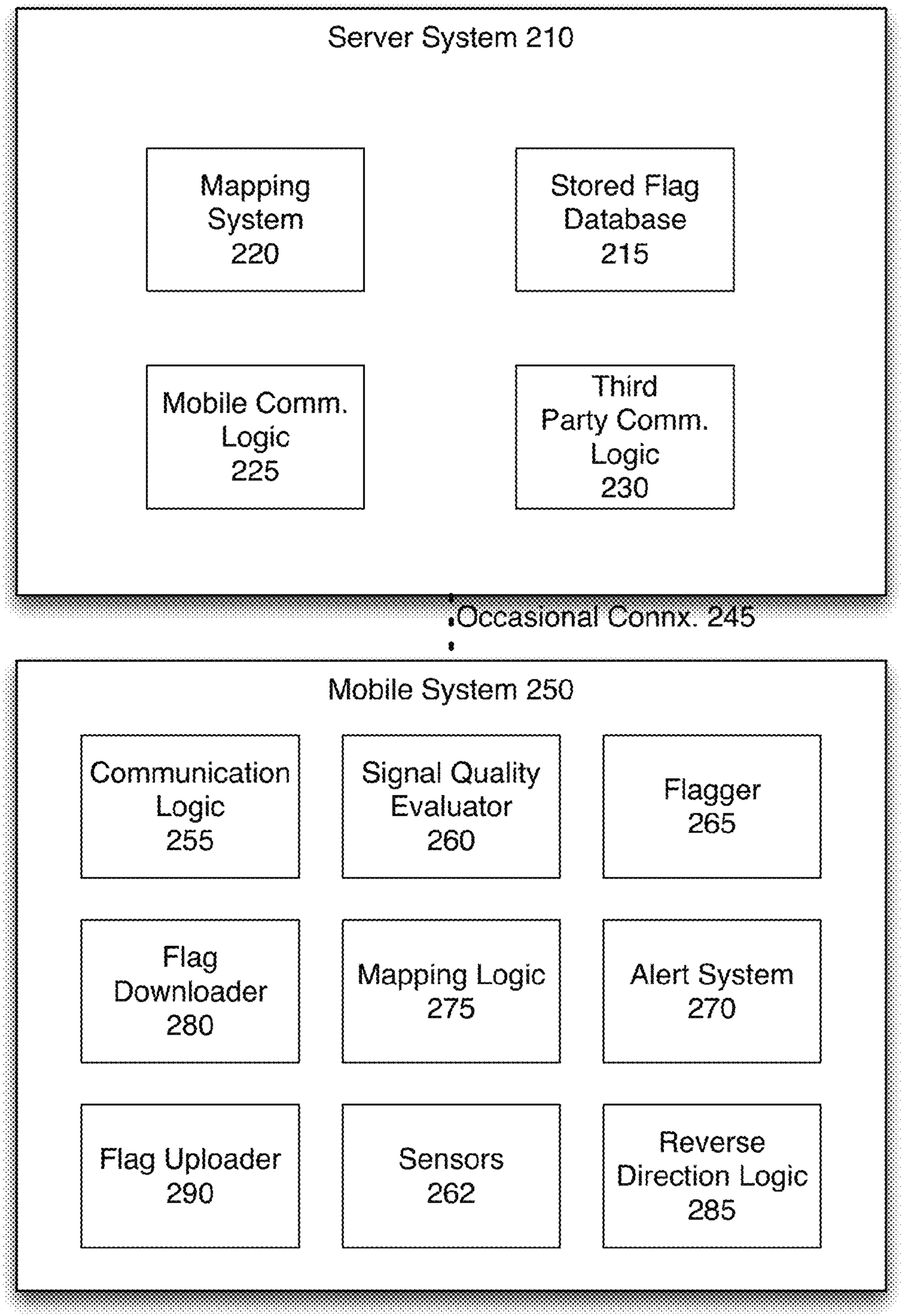

Server System 210
Mapping System 220
Stored Flag Database 215
Mobile Comm. Logic 225
Third Party Comm. Logic 230
Occasional Connx. 245
Mobile System 250
Communication Logic 255
Signal Quality Evaluator 260
Flagger 265
Flag Downloader 280
Mapping Logic 275
Alert System 270
Flag Uploader 290
Sensors 262
Reverse Direction Logic 285

Fig. 2

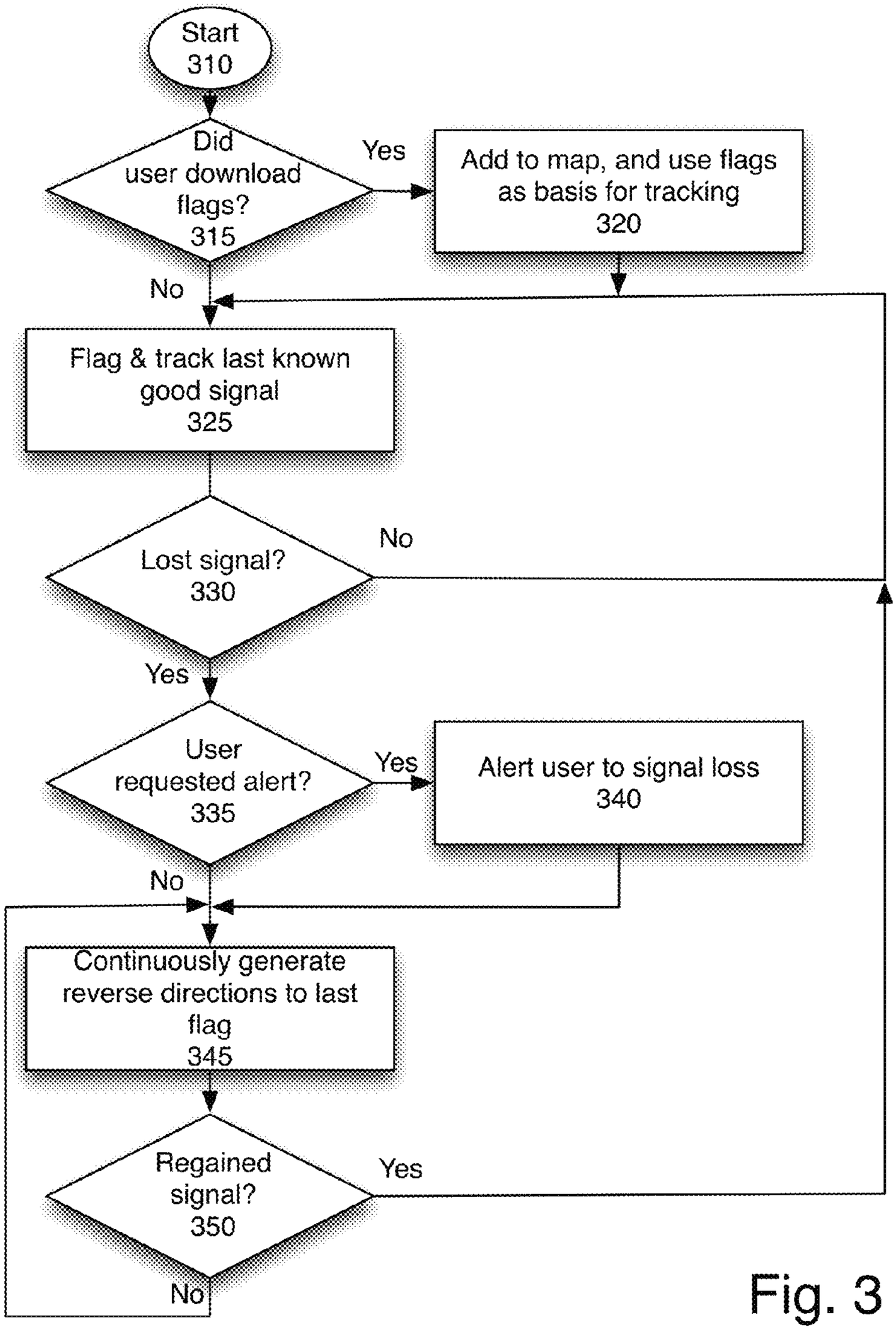

Start
310
Did user download flags?
315
Yes
Add to map, and use flags as basis for tracking
320
No
Flag & track last known good signal
325
Lost signal?
330
No
Yes
User requested alert?
335
Yes
Alert user to signal loss
340
No
Continuously generate reverse directions to last flag
345
Regained signal?
350
Yes
No

Fig. 3

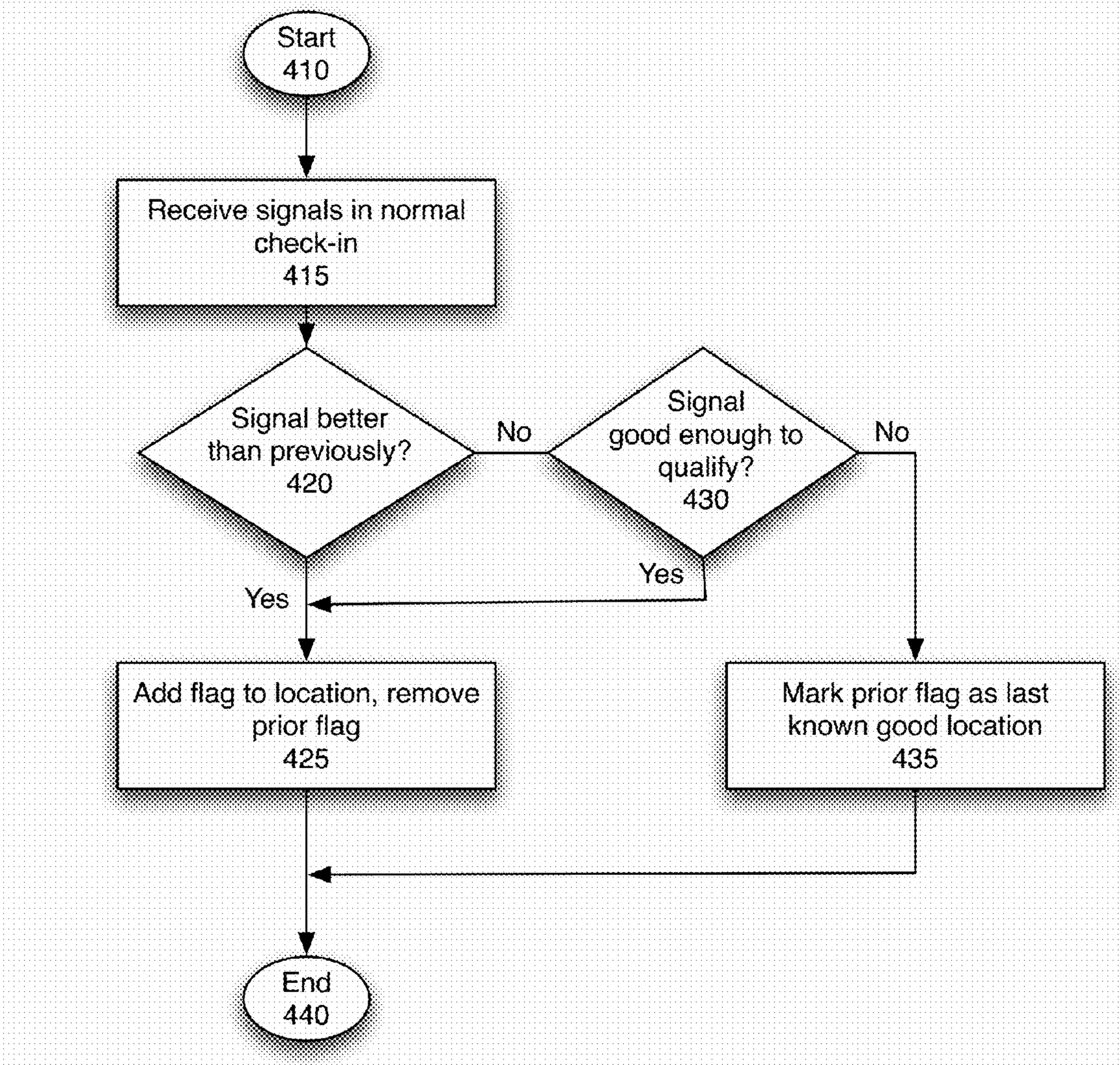

Start
410
Receive signals in normal check-in
415
Signal better than previously?
420
No
Signal good enough to qualify?
430
No
Yes
Yes
Add flag to location, remove prior flag
425
Mark prior flag as last known good location
435
End
440

Fig. 4

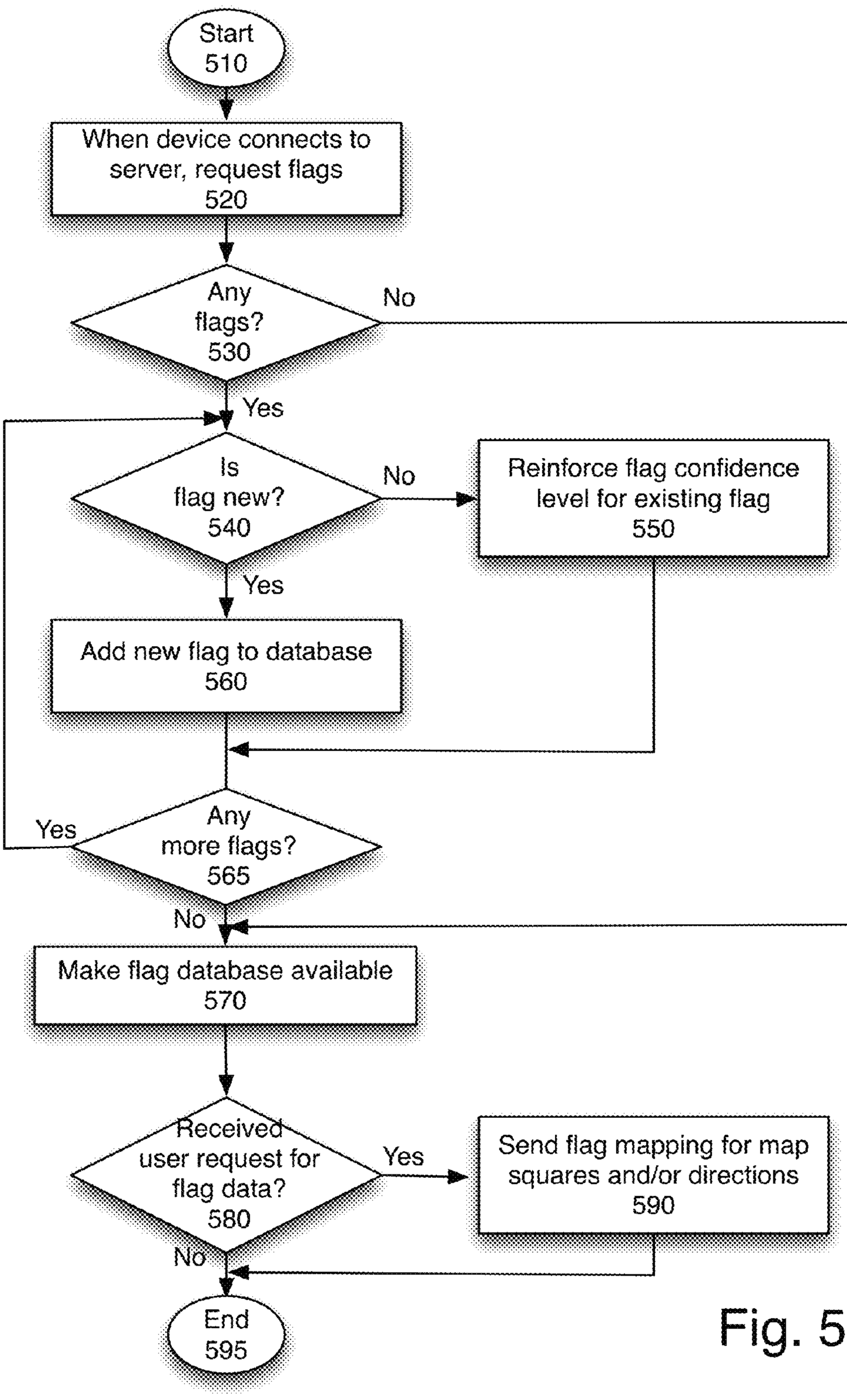

Start
510
When device connects to server, request flags
520
Any flags?
530
No
Yes
Is flag new?
540
No
Reinforce flag confidence level for existing flag
550
Yes
Add new flag to database
560
Any more flags?
565
Yes
No
Make flag database available
570
Received user request for flag data?
580
Yes
Send flag mapping for map squares and/or directions
590
No
End
595

Fig. 5

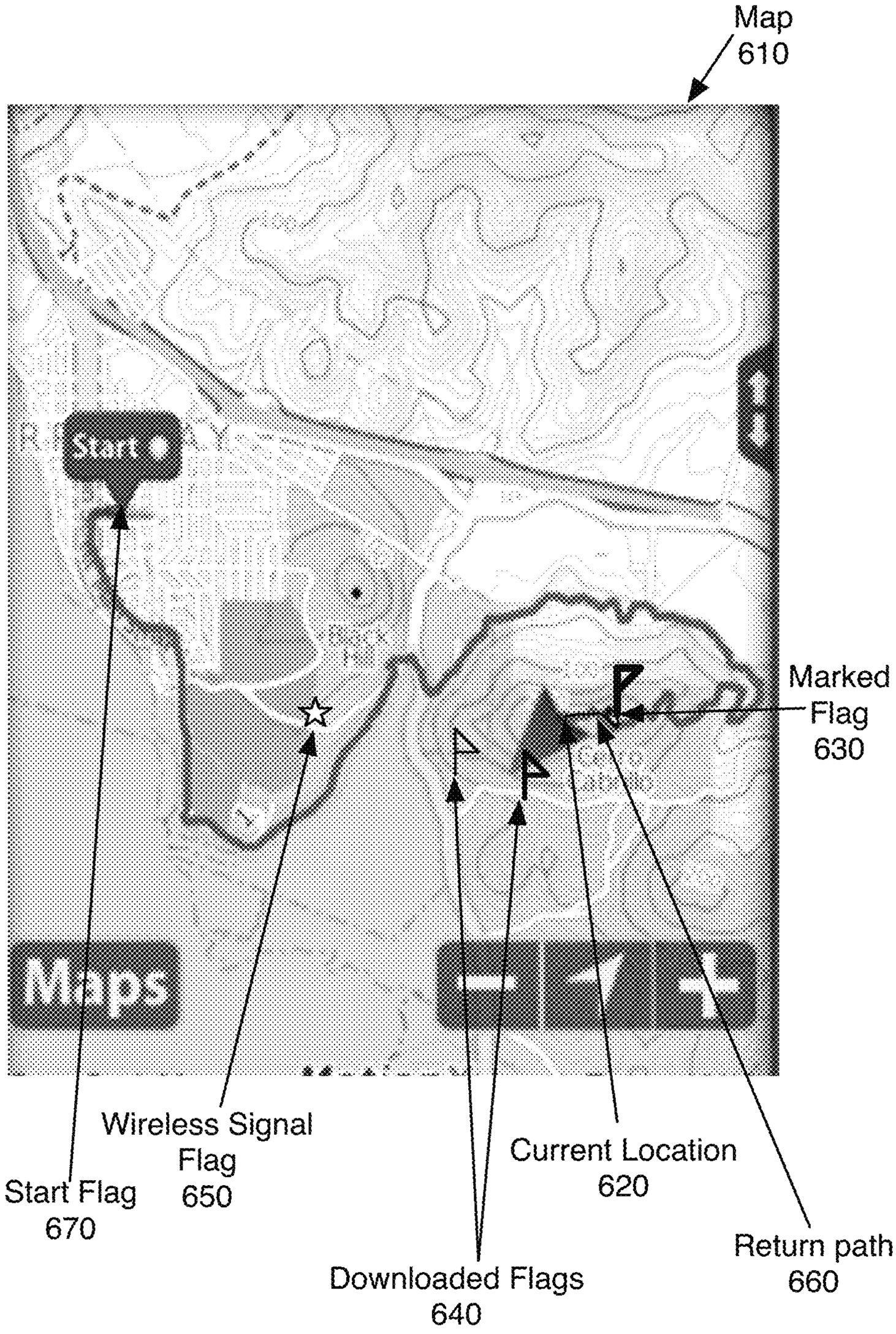

Map
610
Start
Maps
Marked
Flag
630
Start Flag
670
Wireless Signal
Flag
650
Downloaded Flags
640
Current Location
620
Return path
660

Fig. 6

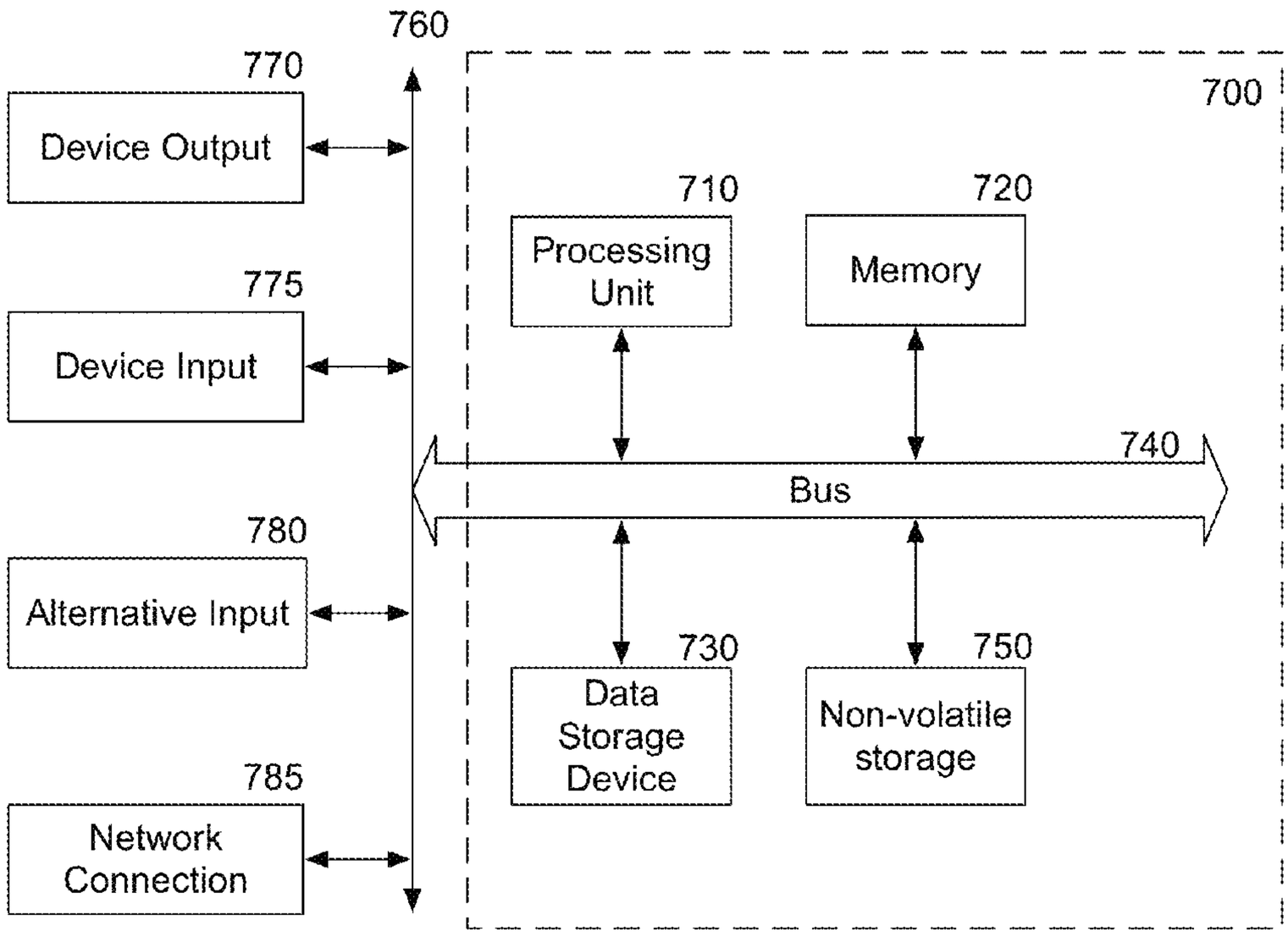

760
770
Device Output
700
710
Processing Unit
720
Memory
775
Device Input
740
Bus
780
Alternative Input
730
Data Storage Device
750
Non-volatile storage
785
Network Connection

Fig. 7

METHOD AND APPARATUS TO UTILIZE LOCATION DATA TO ENHANCE SAFETY

FIELD

A method and apparatus related to global positioning systems, and more specifically to using GPS data to enhance safety.

BACKGROUND

More personal devices, such as smart phones and handheld communications systems, include global positioning system (GPS) chips in addition to communications capability.

However, coverage is still intermittent. Network connections, are not always available. Cellular network coverage may not always be available either. In these cases, the handheld communications system or smart phone becomes useless.

BRIEF DESCRIPTION OF THE FIGURES

The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements and in which:

FIG. **1** is an exemplary system diagram of one embodiment a system.

FIG. **2** is a block diagram of one embodiment of the mobile system and server.

FIG. **3** is a flowchart of one embodiment of using the flagging system.

FIG. **4** is a flowchart of one embodiment of flagging using the system.

FIG. **5** is a flowchart of one embodiment of server interactions.

FIG. **6** is a diagram one embodiment of a user interface.

FIG. **7** is one embodiment of computer system that may be used with the present invention.

DETAILED DESCRIPTION

The present invention is concerned with enabling a system to flag a location, and provide guidance to that location. The location may be automatically or manually flagged because it is the starting point of a path, for example a hike. A location may be automatically flagged when the signal quality of one of a plurality of signals that can be received by a mobile device decreases. By flagging a location corresponding to the last known good quality signal, the user can be guided back to that location, if access to signal becomes a priority. For example, in case of emergency, the ability to call for assistance may be urgent. Using the flagging system, the user can quickly be guided to a location which highly likely has good quality signal. The signals may wireless network signals, cellular network signals, or other signals.

In one embodiment, when the system flags a location, it automatically maintains directions to return to the flagged location. In one embodiment, only the "last known good" flag is maintained for each type of signal. In one embodiment, the system collects flag data from multiple users, in a global database. In one embodiment, the data from the global database may be made available to the users, to provide information about expected signal coverage. The data from this database may be sold or shared with service providers, device providers, in one embodiment.

The following detailed description of embodiments of the invention makes reference to the accompanying drawings in which like references indicate similar elements, showing by way of illustration specific embodiments of practicing the invention. Description of these embodiments is in sufficient detail to enable those skilled in the art to practice the invention. One skilled in the art understands that other embodiments may be utilized and that logical, mechanical, electrical, functional and other changes may be made without departing from the scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims.

FIG. **1** is an exemplary system diagram of one embodiment a system. The mobile device **110** receives data from one or more of a GPS network **120**, a wireless network **130**, a cellular network **150**, and another type of Internet connection **160**. The GPS network **120** may include GPS satellites **122**, **124**, **126** and/or ground based GPS stations **128**. The wireless network **130** may be a wireless signal in accordance with the Wi-Fi standard (IEEE 802.11). The cellular network **150** may be a cellular network service, such as the cellular services provided by AT&T, Verizon, or another company. The Internet connection **160** may be another type of network connection, such as a wired network connection, or a connection through an intermediary device such as a computer system.

The mobile device **110** may track the availability of wireless network signal and/or cellular signal, and flag the last known good location of the signal(s). In one embodiment, the mobile device **110** may also access flags previously recorded, by the user or by others, via flag server **140**. Mobile device **110** may connect to flag server in various ways, e.g. through cellular, wireless, Internet, or through an intermediary such as a computer system to which the mobile device may be occasionally coupled. In one embodiment, the system may also store GPS signal strength data flags. Since GPS signal strength varies based on the current satellite configuration data, this information is associated with a time and date, so that it can be aligned with the known satellite configuration. The satellite configuration data is publicly available.

The flag server **140** receives flags from the mobile device **110**, placed as loss of signal quality is detected. In one embodiment, the flags are received periodically, when placed, or when the mobile device **110** is again connected a high bandwidth network.

In one embodiment, flag server **140** may make the flagging data available to a website **170** or third party systems **180**. This may be used to refine coverage areas, determine coverage holes, or otherwise assess locations of interest.

FIG. **2** is a block diagram of one embodiment of the mobile system and server. The mobile system **250** is coupled through occasional connection **245** to server system **210**.

Server system **210** includes a stored flag database **215**, in which flag data received from various mobile systems is stored. In one embodiment, database **215** may be a distributed database. In one embodiment, database **215** may further include data obtained from other sources. For example, cellular providers make their coverage maps available. In one embodiment, flag database **215** may include data obtained from such coverage maps, or other third party sources. In one embodiment, if GPS signal quality is tracked, the GPS satellite path data is also obtained from a third party source.

Mapping system **220** enables server **210** to display a map of flags from database **215**. In one embodiment, this map may be made available though a website interface, or other interface.

Mobile communication logic **225** receives flag data form mobile systems, and makes flag data available to mobile

systems. Third party communications logic **230** makes the flag data available to other systems, including in one embodiment through a website. The third party communication logic **230** may also, in one embodiment, obtain data from third parties, as noted above. Third party communications logic **230** may be available to users, network signal providers, hardware device manufacturers, government entities, or other third parties. In one embodiment, the data may be made available on a subscription basis. The data may further be exported in various formats.

Mobile system **250** includes communication logic **255** to obtain data from, and send data to, server system **210**. Communications logic **255** may include multiple types of signals, e.g. wireless, cellular, GPS, etc. Mobile system **250** may further include sensors **262** which may be used to add information for signal evaluation and direction logic. Sensors **262** may include one or more of: a gyroscope, an accelerometer, a barometer, a compass, a thermometer.

Signal quality evaluator **260** evaluates signal quality for one or more signals. As noted above, these signals can include one or more of GPS, wireless, cellular, or other signals. When the signal quality evaluator **260** detects a significant drop in signal quality, flagger **265** flags the location. Flagger **265** works with mapping logic **275**, to locate the flag. In one embodiment, an alert system **270** may indicate to the user that signal quality has dropped, or that signal is no longer available. In one embodiment, flagger **265** maintains a flag for the last known good signal location. In one embodiment, separate flags may be maintained for each signal type. In one embodiment, the user may manually add flags, via flagger **265**. When the user manually adds a flag, it may be a flag for routing, or a flag to manually indicate loss of signal quality.

Reverse direction logic **285**, in one embodiment, tracks the user's motion past the last known good signal flag, and maintains directions back to that location. This can be useful in an emergency situation or if the user needs to reach signal for another reason. In one embodiment, the system ensures that even if the mobile system cannot receive signal, reverse direction logic **285** can provide guidance to the user to the last known good signal location.

In one embodiment, mobile system **250** may download flag data from server system **210**, using flag downloader **280**. In one embodiment, flags downloaded in this way are shown with mapping logic **275**. In one embodiment, downloaded flags are differentiated from mobile system placed flags, by color, size, or another differentiator. However, having downloaded flags enables a user to see where signal loss may be expected.

Flag uploader **290** provides the flags placed by the mobile system **250** back to server system **210**. In one embodiment, flag uploader **290** uploads flags whenever the mobile system **250** is coupled to the server system **210** through a high bandwidth connection. In another embodiment, the user may optionally initiate the uploading of flag data. In another embodiment, the mobile system may upload flag data when the mobile system **210** has placed one or more flags which do not correspond to existing flags obtained via flag downloader **280**.

FIG. **3** is a flowchart of one embodiment of using the flagging system. The process starts at block **310**. In one embodiment, this process may be active whenever the mobile device is receiving signals. In one embodiment, the system may be activated by the user. In another embodiment, the system may be activated when certain conditions are met. In one embodiment, the user may manually activate the system. In another embodiment, the system may be activated when the user enters a new area for which the user does not already have a strong flagging data.

At block **315**, the process determines whether the user downloaded any flags. If so, at block **320**, the system adds the downloaded flags to the map. In one embodiment, the downloaded flags are used as the basis for testing, as well.

At block **325**, the process adds a flag whenever one of the tested signals is significantly reduced in quality. The flag, in one embodiment, is added at the last known good signal location. In another embodiment, the flag may be added at the location when the signal is lost, with directionality. In another embodiment, the flagging may mark map areas with signal information, when available, instead of placing individual flags.

At block **330**, the process determines whether the signal has been lost. In one embodiment, a signal is considered lost when the quality of the signal is sufficiently bad to keep a device from making use of the signal. For example, for a GPS signal, if the GPS circuitry cannot get at least three satellite fixes, it cannot calculate location. For a cellular signal, if the signal does not permit a telephone call to be placed or received, it is considered a lost signal. In one embodiment, if calls are dropped, the signal is considered dropped. For a wireless signal, if a significant percentage of packets or pings is not successfully received, it is considered lost. In one embodiment, the device has the capability of determining whether the signal is lost based on the automatic periodic pings built into to the protocol.

If the signal is not lost, the process returns to block **325**, to flag and track the last known good signal.

If the signal is lost, the process continues to block **335**. At block **335**, the process determines whether the user has requested an alert when signal is lost. If so, at block **340**, the user is alerted.

At block **345**, the process continuously generates reverse directions to the last flag, in one embodiment. In one embodiment, this is only done if the signal lost is the cellular signal used to obtain mapping data, or GPS signal. If the signal lost is not a cellular or GPS signal, the system instead formats the last known good flag location such that the GPS system can route back to the flag.

At block **350**, the process determines whether the signal has been regained. If the signal has not been regained, the process continues to block **345** to continue generating reverse directions. If the signal has been regained, the process returns to block **325**, to flag & track the last known good signal. In one embodiment, this involves removing the last flag, and replaces it with a new flag when the signal is regained. Note that while the flag may be removed from the user's display (e.g. no longer shown) it remains in the user's system, and is available for later upload or use.

FIG. **4** is a flowchart of one embodiment of flagging using the system. The process starts at block **410**. In one embodiment, this flowchart corresponds to block **325**, of FIG. **3**.

Returning to FIG. **4**, at block **415**, signals are received in a normal check-in. The normal check in may be the ping sent according to each signal's protocol. In one embodiment, the system may do periodic check-ins. In one embodiment, if the system does independent checking, not protocol dependent, then in one embodiment, the testing depends on one or more of: time elapsed, distance moved, and previously recorded signal strength. At block **415**, signals are received. Note that while this flowchart addresses "signals" each of the signals tested may be on a separate flowchart of testing, with separate timing and conditions.

At block **420**, the process determines whether the signal is better than the previous signal. If the signal is better than previously, the process continues to block **425**. At block **425**, add a flag to the location, and remove the prior location. At this point, the new location marks a "known good" location. The process then ends, at block **440**.

If the signal is not better than the previously marked signal, the process continues to block **430**. At block **430**, the process determines whether the signal is good enough to qualify as a "known good" signal. If so, at block **425**, a flag is added to the location. In one embodiment, if the difference in signal quality is above a threshold, the new flag marks a "known good, but not excellent" level, e.g. is different from the prior marking flag, which is maintained. The process then ends.

If, at block **430**, the process determined that the signal was not good enough, the process continues to block **435**, where the last flag is marked as a "last known good location." As noted above with respect to FIG. **3**, the system uses this flag for guidance, and may make such flags available to the server.

FIG. **5** is a flowchart of one embodiment of server interactions. The process starts at block **510**. In one embodiment, the process is initiated when a mobile device that has the flagging application connects to the server, via a high bandwidth connection. In one embodiment, the process may be initiated when a computer device, which is designed to be coupled to the mobile device, is coupled to the server. In one embodiment, the high bandwidth connection is a wireline connection to a computer device, which in turn is coupled to the server.

At block **520**, when the connection is established, the server requests the new flags recorded by the device. In one embodiment, the flags are free of identifying information (e.g. user data) so that only signal type, location, date/time is included with the flag. In another embodiment, the source device is identified, but no personally identifiable data is included. This may be useful when a particular device consistently produces different results than other devices. For example, if a mobile telephone's antenna is damaged, it may not find good quality cellular network connections in places where others do. By including device-identification data, such false data may be removed from the database.

At block **530**, the server determines whether any flags were received. If no flags were received, the process continues directly to block **570**. If flags were received, the process continues to block **540**.

At block **540**, the process determines whether a selected flag is new. A new flag indicate a location that has not previously been identified as a "last good signal" location. If the flag is new, the new flag is added to the database, at block **560**. If the flag is not new, the flag confidence level for the existing flag is reinforced, at block **550**. In one embodiment, flag confidence level simply indicates the number of times that someone found this flag to be accurate (e.g. last known good signal). In one embodiment, flags within a small distance of each other may be used to reinforce or weaken the value of a particular flag. For example, if a first user places a flag at point A, and the second user places the flag at point A+50 feet, the system would reinforce the first flag, at point A. This is to ensure that the system does not end up with a morass of flags, which would make it impossible to determine a last known good signal location.

At block **565**, the process determines whether there are any more flags to evaluate. If so, the process returns to block **540**, selecting the next flag to determine whether it is a new flag.

If there are no more flags to evaluate, the process, at block **570**, makes the flag database available. Although this is shown as a flowchart, in one embodiment, the flag database is always available, and the updated flag database, including the newly added flags are made available.

At block **580**, the process determines whether the system received a request for flag data. If so, at block **590**, flag mapping data is sent to the user in response to the request. In one embodiment, the user may request flag data by directions/path, zip code, area, county, selected map view, or another selection. In one embodiment, the flag mapping data provides flags for a designated area, indicated by the request, with indications of the confidence interval in that flag. FIG. **6** shows one embodiment of such flag information. The process then ends at block **595**.

FIG. **6** is a diagram one embodiment of a user interface. As can be seen, the map **610** shows the user's current location **620**. A flag **630** shows "last known good signal" as marked by the user's system, for a cellular network signal. In contrast, downloaded flags **640** show other areas of good signal, which the user may reach. The confidence interval in the flag may be visually represented on the map. Here, it is shown by the thickness of the line. However, one of skill in the art would understand that such flags may be differentiated by color, pattern, label, or any other visual queue. Wireless signal flag **650** is also shown, indicating the last known good wireless signal. In one embodiment, the flags for different signal types are distinct, and the flags for marked flags and downloaded flags are also distinct. In one embodiment, start flag **670**, manually added by the user, is also shown and distinct from the other flags.

In one embodiment, the map also shows a return path **660** (here indicated by a black line) to the nearest marked flag **630**. In one embodiment, the return path **660** is designed to provide direction information, even if no signals are available. In one embodiment, if no signals are available, the return path **660** indications may be based on accelerometer measurements of the mobile device. This enables the directing of the user back to a last known good signal, even in a situation where all live signals are lost.

FIG. **7** is one embodiment of computer system that may be used with the present invention. FIG. **7** is a block diagram of a particular machine that may be used with the present invention. It will be apparent to those of ordinary skill in the art, however that other alternative systems of various system architectures may also be used.

The data processing system illustrated in FIG. **7** includes a bus or other internal communication means **740** for communicating information, and a processing unit **710** coupled to the bus **740** for processing information. The processing unit **710** may be a central processing unit (CPU), a digital signal processor (DSP), or another type of processing unit **710**.

The system further includes, in one embodiment, a random access memory (RAM) or other volatile storage device **720** (referred to as memory), coupled to bus **740** for storing information and instructions to be executed by processor **710**. Main memory **720** may also be used for storing temporary variables or other intermediate information during execution of instructions by processing unit **710**.

The system also comprises in one embodiment a read only memory (ROM) **750** and/or static storage device **750** coupled to bus **740** for storing static information and instructions for processor **710**. In one embodiment the system also includes a data storage device **730** such as a magnetic disk or optical disk and its corresponding disk drive, or Flash memory or other storage which is capable of storing data when no power is supplied to the system. Data storage device **730** in one embodiment is coupled to bus **740** for storing information and instructions.

The system may further be coupled to an output device **770**, such as a cathode ray tube (CRT) or a liquid crystal display (LCD) coupled to bus **740** through bus **760** for outputting information. The output device **770** may be a visual output device, an audio output device, and/or tactile output device (e.g. vibrations, etc.)

An input device **775** may be coupled to the bus **760**. The input device **775** may be an alphanumeric input device, such as a keyboard including alphanumeric and other keys, for enabling a user to communicate information and command selections to processing unit **710**. An additional user input device **780** may further be included. One such user input device **780** is cursor control device **780**, such as a mouse, a trackball, stylus, cursor direction keys, or touch screen, may be coupled to bus **740** through bus **760** for communicating direction information and command selections to processing unit **710**, and for controlling movement on display device **770**.

Another device, which may optionally be coupled to computer system **700**, is a network device **785** for accessing other nodes of a distributed system via a network. The communication device **785** may include any of a number of commercially available networking peripheral devices such as those used for coupling to an Ethernet, token ring, Internet, or wide area network, personal area network, wireless network or other method of accessing other devices. The communication device **785** may further be a null-modem connection, or any other mechanism that provides connectivity between the computer system **700** and the outside world.

Note that any or all of the components of this system illustrated in FIG. **7** and associated hardware may be used in various embodiments of the present invention.

It will be appreciated by those of ordinary skill in the art that the particular machine which embodies the present invention may be configured in various ways according to the particular implementation. The control logic or software implementing the present invention can be stored in main memory **720**, mass storage device **730**, or other storage medium locally or remotely accessible to processor **710**.

It will be apparent to those of ordinary skill in the art that the system, method, and process described herein can be implemented as software stored in main memory **720** or read only memory **750** and executed by processor **710**. This control logic or software may also be resident on an article of manufacture comprising a computer readable medium having computer readable program code embodied therein and being readable by the mass storage device **730** and for causing the processor **710** to operate in accordance with the methods and teachings herein.

The present invention may also be embodied in a handheld or portable device containing a subset of the computer hardware components described above. For example, the handheld device may be configured to contain only the bus **715**, the processor **710**, and memory **750** and/or **720**.

The handheld device may be configured to include a set of buttons or input signaling components with which a user may select from a set of available options. These could be considered input device #**1 775** or input device #**2 780**. The handheld device may also be configured to include an output device **770** such as a liquid crystal display (LCD) or display element matrix for displaying information to a user of the handheld device. Conventional methods may be used to implement such a handheld device. The implementation of the present invention for such a device would be apparent to one of ordinary skill in the art given the disclosure of the present invention as provided herein.

The present invention may also be embodied in a special purpose appliance including a subset of the computer hardware components described above. For example, the appliance may include a processing unit **710**, a data storage device **730**, a bus **740**, and memory **720**, and no input/output mechanisms, or only rudimentary communications mechanisms, such as a small touch-screen that permits the user to communicate in a basic manner with the device. In general, the more special-purpose the device is, the fewer of the elements need be present for the device to function. In some devices, communications with the user may be through a touch-based screen, or similar mechanism. In one embodiment, the device may not provide any direct input/output signals, but may be configured and accessed through a website or other network-based connection through network device **785**.

It will be appreciated by those of ordinary skill in the art that any configuration of the particular machine implemented as the computer system may be used according to the particular implementation. The control logic or software implementing the present invention can be stored on any machine-readable medium locally or remotely accessible to processor **710**. A machine-readable medium includes any mechanism for storing information in a form readable by a machine (e.g. a computer). For example, a machine readable medium includes read-only memory (ROM), random access memory (RAM), magnetic disk storage media, optical storage media, flash memory devices, or other storage media which may be used for temporary or permanent data storage. In one embodiment, the control logic may be implemented as transmittable data, such as electrical, optical, acoustical or other forms of propagated signals (e.g. carrier waves, infrared signals, digital signals, etc.).

In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

We claim:

1. A method comprising:

tracking a plurality of signal qualities received by a mobile device;

identifying a drop in the signal quality by comparing a current signal quality to an immediately prior signal quality, where the immediately prior signal quality was above a threshold associated with a good signal quality;

the mobile device placing a flag at a location of a last known good signal in response to the drop in the signal quality, the flag indicating a last known good signal location detected by the mobile device, the last known good signal location being the location where the mobile device received the immediately prior signal quality;

turning on a reverse direction logic and continuously generating reverse directions to the flag indicating the last known good signal location to enable the generation of the reverse directions when signal data for location determination is unavailable, the reverse directions generated based on an available one or more of: global positioning data obtained from a global positioning system (GPS) and network triangulation data obtained from a cellular network connection;

adding the flag to a global database and making the global database of flag data obtained from a plurality of mobile devices available, the global database useful to deter-

mine a coverage of each of the plurality of signals, the flag data not obtainable from the GPS data;

pre-populating an area with predicted flags, based on information in the global database, the prepopulating enabling the user to obtain directions to a predicted flag,

the flag data obtained from a wireless network when the wireless network is available and from the cellular network connection when the wireless network connection is not available;

monitoring the signal quality, and, when the signal quality is above a threshold, removing the flag and turning off the generating of the reverse directions.

2. The method of claim **1**, further comprising:

upon request, providing the directions to the location associated with the last known good quality of the signal.

3. The method of claim **1**, wherein the signal associated with the drop in signal quality is one of: a wireless signal and a cellular network signal.

4. The method of claim **1**, wherein information in the global database associated with a location data of a flag additionally includes one or more of: receiving device, cellular carrier, chip set, time and day, and proximate

location of the device and the user.

5. The method of claim **1**, wherein the continuously generating directions to the flag comprises:

flagging a position of a track; and

maintaining directions to the flagged position when one or more signals used for directions becomes unavailable using one or more of GPS data, motion detector data, and network triangulation data.

6. The method of claim **1**, further comprising:

after a flag is placed, continuously calculating directions from a current location to the flag until the current location is determined to have a signal quality above a threshold.

7. A mobile system comprising:

a signal quality evaluator to periodically evaluate a quality of a signal by comparing a current signal quality to a last in time signal quality and comparing the signal quality to a threshold, where the last in time signal quality was above a threshold associated with a good signal quality;

a flagger to flag a last in time location where the signal quality was evaluated as being above the threshold, in response to the signal quality evaluator indicating that the quality of the signal is below the threshold;

a reverse direction logic to turn on and continuously calculate reverse directions to the flag of

the last in time location where the signal quality was evaluated as being above the threshold, the reverse direction logic to utilize motion sensor data when location signal data is not available, the reverse directions calculated based on an available one or more of: global positioning data obtained from a global positioning system (GPS) and network triangulation data obtained from a cellular network connection;

the flagger to:

add the flag to a global database and make the global database of flag data obtained from a plurality of mobile devices available, the global database useful to determine a coverage of each of the plurality of signals, the flag data not obtainable from the GPS data;

pre-populate an area with predicted flags, based on information in the global database, the prepopulating enabling the user to obtain directions to a predicted flag, the flag data obtained from a wireless network when the wireless network is available and from the cellular network connection when the wireless network connection is not available;

the flagger to remove the flag, and

after further monitoring of the signal quality, the reverse direction logic to turn off the calculation of

the reverse directions, when the signal quality evaluator determines that a current signal quality

is above the threshold.

8. The mobile system of claim **7**, further comprising:

reverse direction logic to utilize a combination of network triangulation data, global positioning data, and step data, to calculate the directions to the flagged location such that the directions are provided even when one or more of the signals becomes unavailable.

9. The mobile system of claim **7**, further comprising:

a flag uploader to send flag data to a database on a server, the database useful to determine a coverage of each of the plurality of signals.

10. The mobile system of claim **9**, wherein information in the database associated with a location data of a flag additionally includes one or more of: receiving device, cellular carrier, chip set, time and day, and proximate location of the device and the user.

11. The mobile system of claim **9**, further comprising:

a flag downloader to enable a user to obtain flag data from the database, to pre-populate an area with the predicted flags based on information in the global database, the

flag downloader utilizing the wireless network for downloading the flag data when the wireless network is available, and otherwise utilizing the cellular network.

12. The mobile system of claim **8**, further comprising:

the reverse direction logic, when the flag has been placed, continuously calculating directions to the flagged position, using one or more of GPS data, motion detector data, and network triangulation data.

13. The mobile system of claim **12**, further comprising:

the flagger to remove the flag, and turn off the reverse direction logic when a current location is determined to have a signal quality above a threshold.

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