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(54) **SYSTEM AND METHOD FOR AUTOMATED UPDATING OF MAP INFORMATION**

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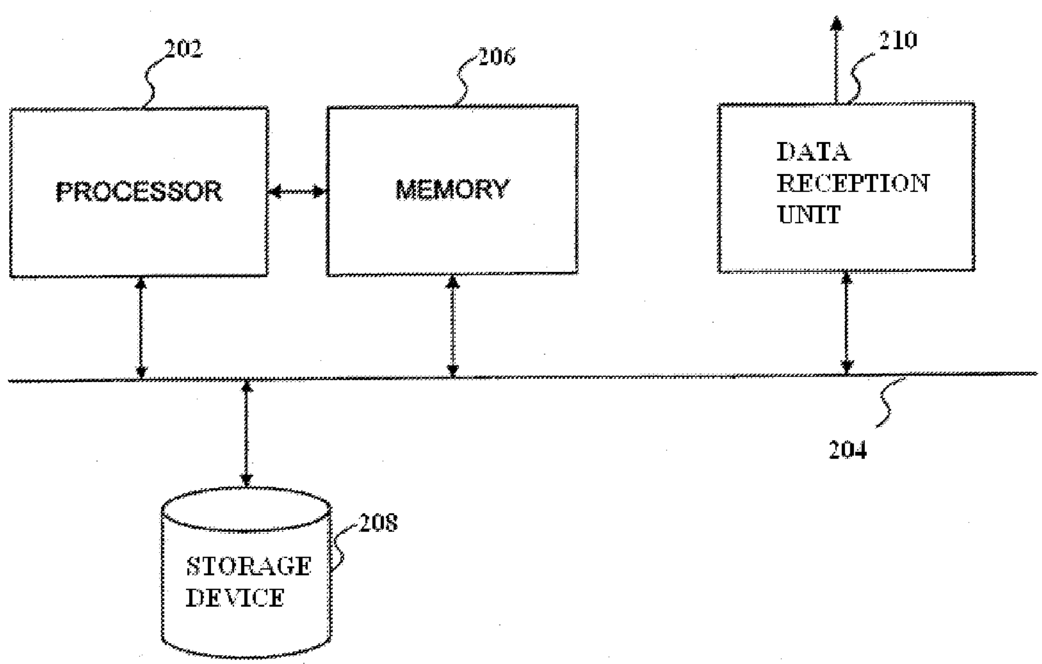
(57) **ABSTRACT**

The characteristics of two intersecting roadways are compared to determine whether an inference can be made as to whether there are traffic controls (e.g., stop signs) on one of the roadways. If a larger road with characteristically higher speed intersects with a small road with lower speed, the small road is determined to have a stop sign. A map database is updated with the information regarding the inferred traffic control, and that information is then usable for purposes such as trip planning.

200



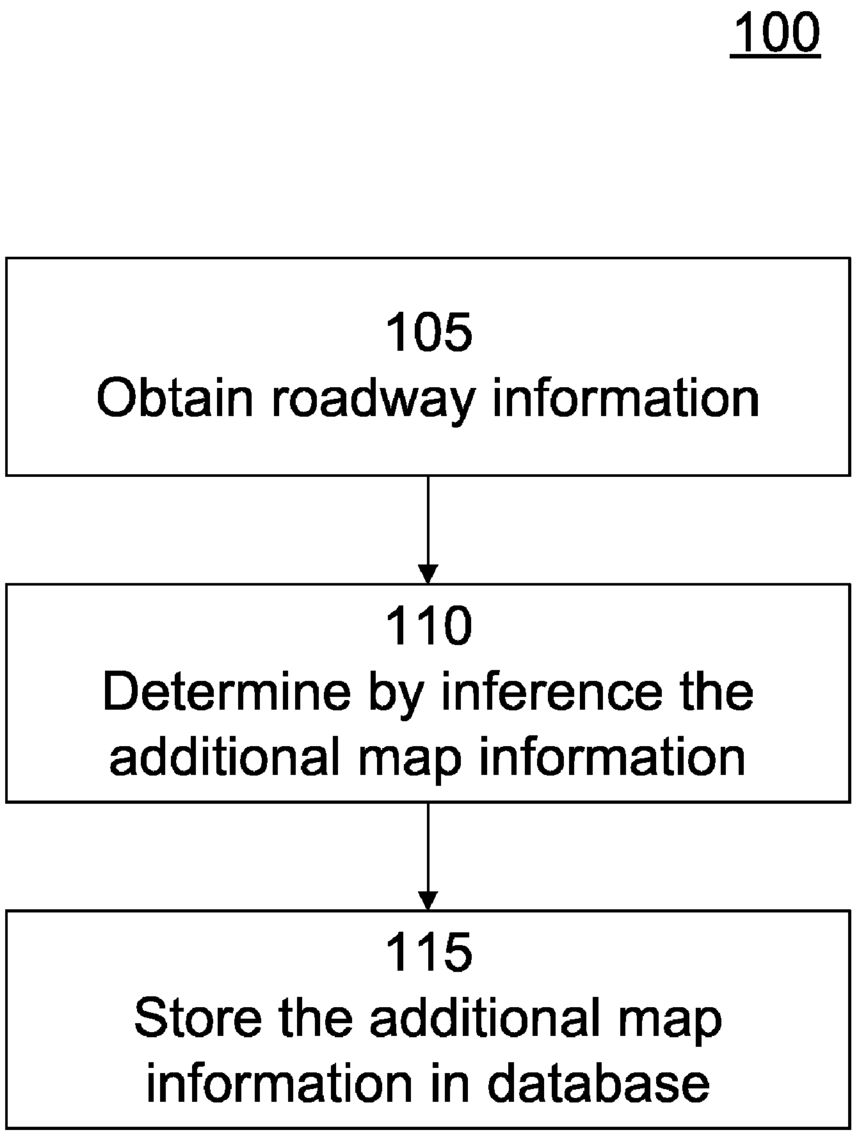

100
105
Obtain roadway information
110
Determine by inference the additional map information
115
Store the additional map information in database

Figure 1

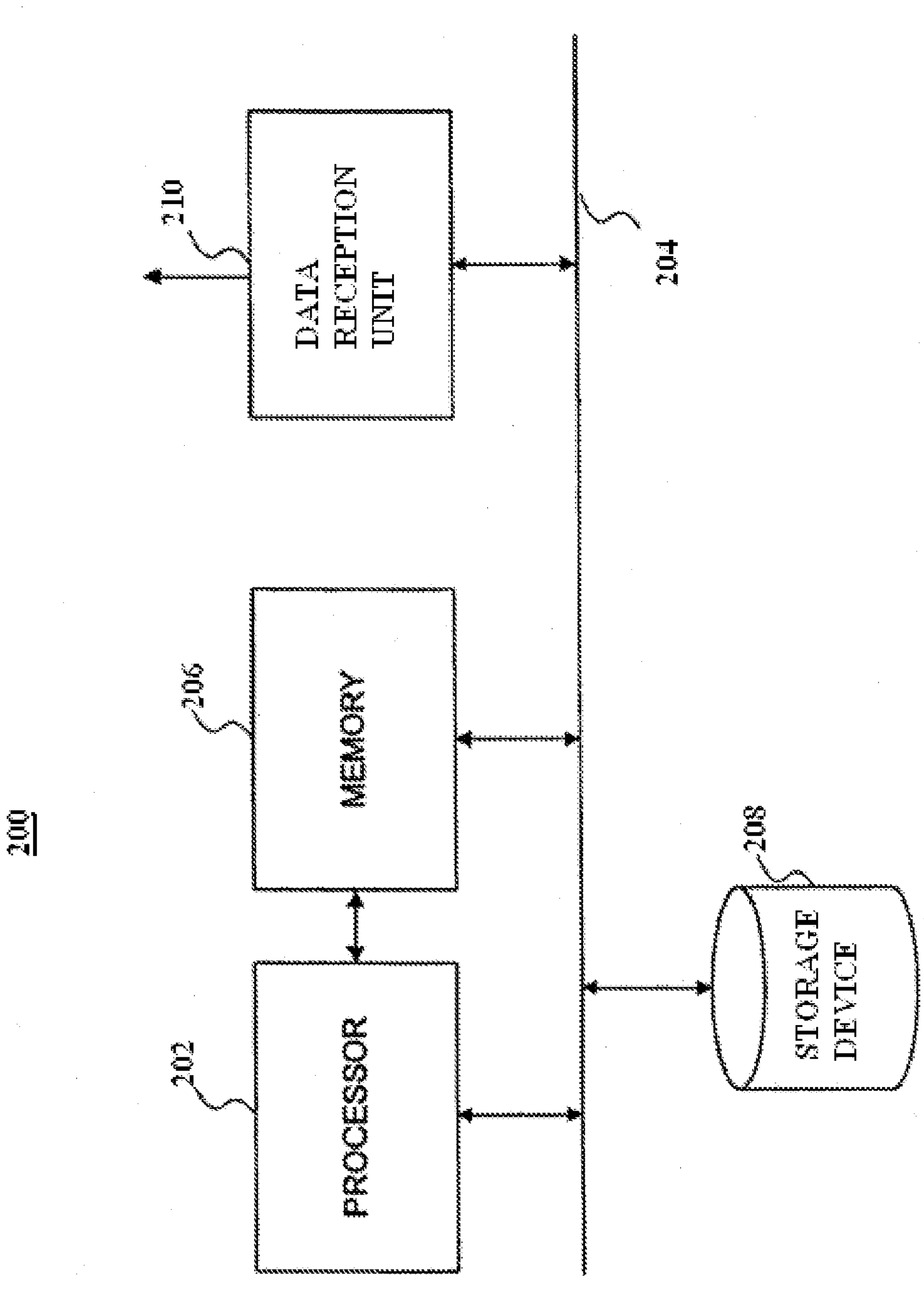

200
202
PROCESSOR
206
MEMORY
210
DATA
RECEPTION
UNIT
204
208
STORAGE
DEVICE

Figure 2

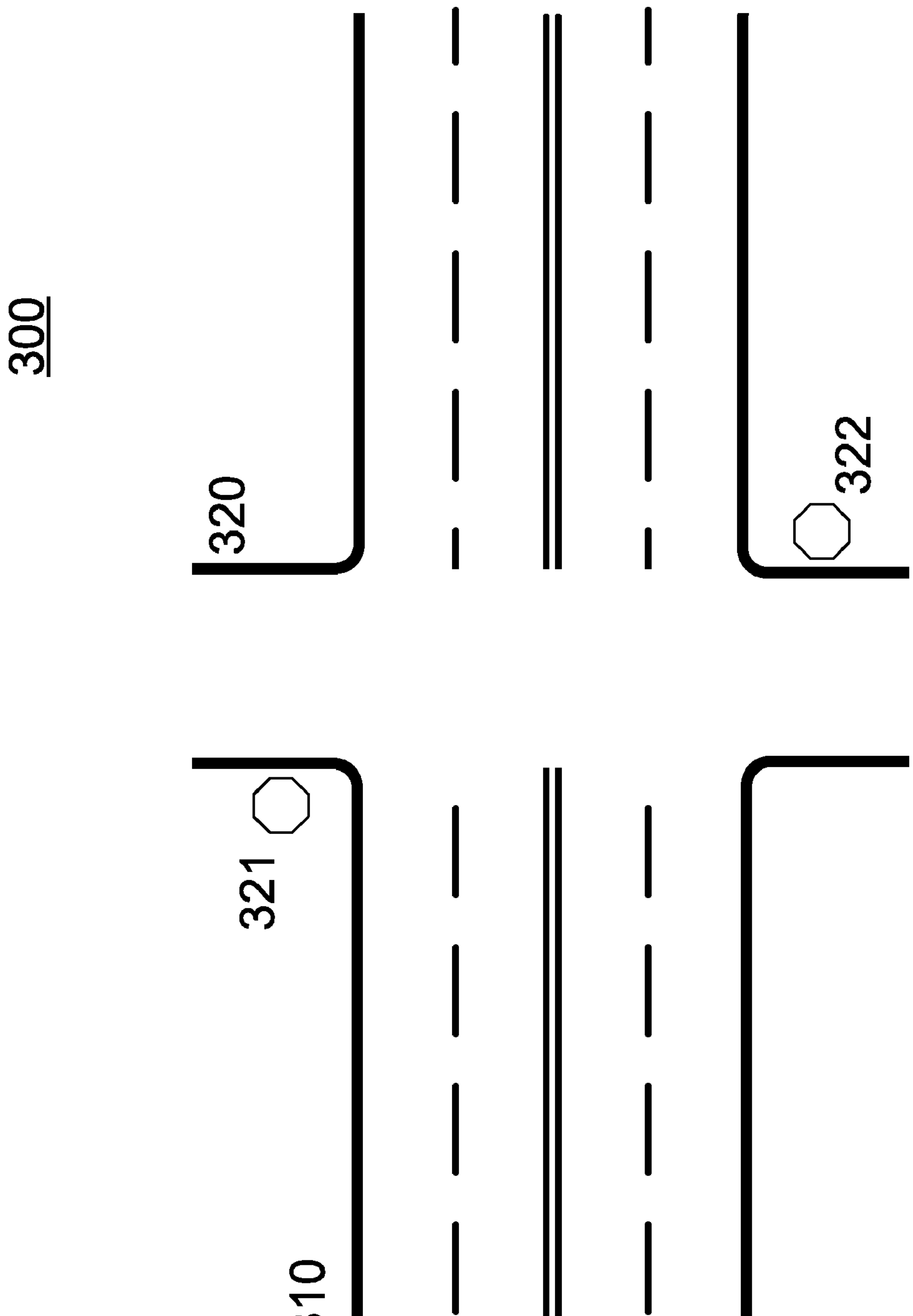


Figure 3

SYSTEM AND METHOD FOR AUTOMATED UPDATING OF MAP INFORMATION

RELATED APPLICATIONS

[0001] This application is a continuation in part of co-pending U.S. patent application Ser. No. 11/851,953, filed Sep. 7, 2007, entitled "System and Method for Automated Updating of Map Information", which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field of Art

[0003] The present invention generally relates to updating and correcting databases of road map information that can be used for vehicle navigation or similar purposes.

[0004] 2. Description of the Related Art

[0005] Digital databases of road map information are essential components of a variety of useful applications, such as vehicle routing. The road map information databases used in vehicle routing systems describe the geographical location and intersections of the roads, or usage restrictions such as one-way restrictions or turn restrictions. The road map information databases also contain other metadata pertinent to vehicle routing, including traffic speeds over the various road segments, the names and address ranges of the roads, the road classification (residential, collector, arterial, highway/freeway) and the like. In conjunction with real-time location data, such as that provided by a satellite-based Global Positioning System (GPS), such databases allow a vehicle routing system to determine the location of a user's vehicle and to take actions useful to the user, such as computing an optimal route from the current location to a desired destination, providing detailed directions for traversing a route, or providing an estimate of the arrival time at the destination. Updates and augmentation of the database further increase the accuracy and capabilities of the applications using the database. For example, the addition to a database of information regarding real-time traffic conditions enables a vehicle routing application to compute a route that not only minimizes overall distance, but also minimizes driving time as well, based on the current traffic speeds associated with the route.

[0006] However, databases frequently lack important categories of information that applications could use to provide more accurate results or entirely new categories of features. Some examples of information that is not generally available are the locations of stop signs and traffic signals, information about whether traffic signals are pre-timed to coordinate with traffic flow, and turn restrictions that may only be active at certain times of day. As an example of the utility of such information, information about turn restrictions that are active at certain times of day could be used to detect that a route that was optimal at 11:00 AM would be entirely prohibited at 6:00 PM, thus avoiding proposing an invalid route to the user.

[0007] Of additional concern is the fact that database information may contain inaccuracies due to human error on the part of those creating the database, or due to failures to update the database to reflect actual changes in the roads subsequent to the creation of the database. For example, a database may erroneously indicate that an intersection has no stop signs even months after stop signs have been installed. Or, a crossing between two roads may be incorrectly identified as an at-grade intersection where, in reality, the crossing involves a bridge, overpass or tunnel.

[0008] Some commentators have discussed the possibility of using in-vehicle GPS units to correct one of the deficiencies found in many databases—the lack of real-time information on traffic speeds—by aggregating the individual vehicle speeds recorded by GPS units over many vehicles to obtain statistical information about likely vehicle speeds on a particular road segment at a given time. However, there remain many other database information deficiencies for which no automated solutions have been discussed, although the need to address these deficiencies becomes ever more pressing as the number of related routing applications grows.

SUMMARY

[0009] As disclosed herein, map database information is augmented using information obtained by recording the movements of a vehicle equipped with a positioning system device, deriving additional map details based upon those movements, and updating the database to reflect the additional details. Alternatively, the information is obtained by inference from related roadway characteristic information, such as may be stored in a database.

[0010] Some embodiments of the invention augment a map database by deriving entirely new categories of information not previously tracked by the database. In one embodiment, the presence of stop signs is detected by observed or otherwise obtained information about relative sizes of intersecting roadways, vehicle speeds, speed limits, or traffic volumes. Thus, embodiments of the invention can be used to derive additional information about characteristics of the roads themselves, independent of current traffic conditions.

[0011] Certain road characteristics (e.g., presence of stop signs) are inferred from other, already known road characteristics. For instance, stop signs may reasonably be inferred for a small two-lane road with a known 30 mph speed limit where it has an at-grade intersection with a four-lane divided highway with a known 55 mph speed limit. Similarly, stop signs may also be inferred for a residential road where it has an at-grade intersection with a non-residential road. Certain turn restrictions may also be inferred from either the geometry or type of road segment. For instance, on-ramps onto the eastbound lanes of a freeway generally cannot be used to maneuver a vehicle onto the westbound lanes. Or, a short road segment which is used as a dedicated right turn lane cannot be used for making left turns.

[0012] The features and advantages described in the specification are not all inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter.

BRIEF DESCRIPTION OF DRAWINGS

[0013] The disclosed embodiments have other advantages and features which will be more readily apparent from the following detailed description and the appended claims, when taken in conjunction with the accompanying drawings, in which:

[0014] FIG. **1** is a flowchart illustrating high-level steps performed according to one embodiment.

[0015] FIG. **2** is a high-level block diagram illustrating a computing device for implementing a preferred embodiment.

[0016] FIG. **3** is a diagram of an intersection for which stop sign information is inferred as described herein.

DETAILED DESCRIPTION

[0017] The figures and the following description relate to preferred embodiments by way of illustration only. It should be noted that from the following discussion, alternative embodiments of the structures and methods disclosed herein will be readily recognized as viable alternatives that may be employed without departing from the principles of the claimed invention.

Method Overview

[0018] Embodiments of the invention perform various map database augmentation and correction techniques to derive additional information not currently within the map database. Such techniques conform to the general pattern set forth in FIG. **1**. At step **105** of FIG. **1**, roadway information is obtained. In one embodiment, such information is obtained by receipt of vehicle readings provided, for example, by conventional satellite-based GPS systems, and include location (e.g. latitude and longitude) and velocity (e.g. speed and heading) information for the vehicle to which they correspond. As an alternative or additional step, if the map database already includes pertinent road characteristic information (e.g., classification of roadways as local as opposed to through highways, speed limits, historical traffic volumes, number of travel lanes) for roadway segments, such information for roadway segments forming the intersection are fetched.

[0019] At step **110**, the information thus obtained is analyzed to determine whether it is reasonable to infer the presence of a traffic control, for example a stop sign. To illustrate, if in step **105** it is determined that an east-west traffic segment has vehicles traveling at 55 mph (whether determined by a database including the speed limit for that segment or as observed using GPS readings from actual vehicles), and it is also determined in the same manner that a segment of an intersecting north-south road has vehicles traveling at 30 mph, it is reasonable to infer the presence of stop signs at the north-south road.

[0020] In many applications, it may not matter that the inference of a stop sign is accurate. There may be a yield sign, a blinking red or yellow light, or a full tri-color traffic light at the intersection. For many applications, however, all that is important is to recognize that traffic on, say, the east-west roadway will likely not be slowed as much at the intersection as traffic on the north-south roadway. Such inferences can be useful in situations that involve estimated travel times for trip planning, for computing routes that minimize delays caused by such traffic controls, and the like. The amount of time spent at one such traffic control may not be significant, but the accumulation of such delays on a route that traverses **100** such intersections can have a significant negative impact on the desirability or optimality of this route. Another case where the inference of a stop sign is useful, even though such an inference may be incorrect, is to bias against routes that cut through residential neighborhoods in order to avoid traffic jams or traffic signals. In particular, inferred stop signs along the residential roads are used to impede traffic flow through the residential neighborhoods.

[0021] Finally, at step **115** the additional inferred information is added to the database. For example, the database is updated to reflect the inference that a pair of stop signs are controlling the north-south road of the intersection. Some commercial road map databases have existing fields that can be directly populated with information such as the location and nature of a traffic control device, such as a stop sign or traffic signal, and such information is simply entered in the required manner. Other databases may not have such a provision already available, and for such databases an ancillary structure is created to allow for entry of such inferred information. For instance, a new field may be created in the database that associates a traffic control device with a particular location and direction of travel. In still other embodiments, a database is "augmented," "updated," or "modified" by creating an entirely new instance of the database or, in some embodiments, creating an entirely new type of database (e.g., as may be best suited for the nature of information now to be included). Thus, terms such as "updating" as used herein are to be interpreted broadly to include any such manner of including such new information in a database, as may be evident to those skilled in the art.

System Architecture

[0022] FIG. **2** is a high-level block diagram illustrating a computing device **200** for modifying map databases according to the general technique set forth in FIG. **1**. In one embodiment, user device **200** is a general purpose computer programmed and configured to provide the operations described herein. Processor **202** is conventionally coupled to memory **206** and bus **204**. Also coupled to the bus **204** are memory **206**, storage device **208**, and data reception unit **210**. The data constituting the map database is contained in storage device **208** and loaded into memory **206**. The general structure of a map database is well-known to those of skill in the art, and conventionally involves storing a series of data objects representing the series of road segments that describes the road, including the spatial extent of the road segment and information associated with the segment, such as speed limit.

[0023] In a typical embodiment, processor **202** is any general or specific purpose processor such as an INTEL **386** compatible central processing unit (CPU). Storage device **208** is any device capable of persistently storing large amounts of data as required by the map database, such as a hard drive or a high-capacity memory card. Memory **206** holds instructions and data used by the processor **202**. The data reception unit **210** receives road characteristic information, such as whether a road is classified as a local residential street or a divided highway, from an external source (not shown, e.g., a municipality's server site via the Internet). Thus, data reception unit **210** can also be considered an input subsystem providing roadway characteristics. The instructions stored in the memory **206** and executed by the processor **202** allow the derivation of additional map information based upon the vehicle readings and the subsequent storing of the additional information within the map database for later use by a navigation or other program. Thus, processor **202** and memory **206** operating together can also be considered an information inference module.

[0024] One of skill in the art would recognize that the above described system is merely for purposes of example, and that many other configurations for implementing the invention are equally possible. For example, the above-disclosed user device **200** of FIG. **2** is implemented in one embodiment as a fixed computer (e.g., a blade-type server accessed via a client computer with a web-based user interface and a shared map database that is globally accessible) and in another embodiment as a user device **200** that is located within a vehicle, so that the map database is local. In one embodiment, a separate computer hosts and provides a global version of the map database, while user device **200** retains a local copy thereof.

Database Updating Operations

[0025] The various map database augmentation and correction techniques performed by embodiments of the invention as set forth in FIG. **1** are now described in more detail below. As previously discussed, one such approach applies the information, such as vehicle speed, provided by a user device to existing information stored in the map database, deriving additional information and updating the database therewith.

[0026] In some environments, such as described in co-pending commonly owned U.S. patent application Ser. No. 11/851,953, published Mar. 12, 2009 as US 2009-0070031 (the contents of which is hereby incorporated by reference as if fully set forth herein), the presence or absence of traffic control devices such as stop signs or traffic signals is detected by observing the speed of a vehicle arriving at an intersection, and the nature/duration of delay of the vehicle at an intersection (e.g., a consistent delay of a few seconds suggests a stop sign, while a green/yellow/red traffic light is suggested by vehicles sometimes being delayed by a significant amount and sometimes not being delayed at all). Data from vehicles may be too sparse in some circumstances to determine whether vehicle stops occur frequently enough at an intersection to warrant an inference of a stop sign. However, there may be sufficient data indicating that traffic in the area regularly travels at high speed on an east-west road and a significantly lower speed on an intersecting north-south road. Alternatively, a map database may be available that includes entries indicating a significantly higher posted speed limit on the east-west road than on the intersecting north-south road. Another usable parameter is volume of traffic. The intersection of one roadway having historically high traffic volumes with another, low-volume roadway suggests there may be a traffic control on the low-volume roadway. Still further, there may be information stored in a database as to a classification for a roadway, such as “residential”, “local”, “through road”, “business route” or “federal highway”, and significant classification differences between two intersecting roadways will in some embodiments support an inference of whether a traffic control is present. While such information may not be sufficient to predict with certainty the presence of any particular traffic control device, for an application not requiring absolute accuracy it may be sufficient to recognize a reasonable likelihood that such a traffic control device is present.

[0027] In a related application, consider a map database that includes stop sign information but does not currently indicate that there are any stop signs at a particular intersection. If a shopping center is built nearby, that may increase traffic flow sufficiently that the municipality decides to put in a pair of stop signs on one of the two roads forming the intersection. Review of traffic volume data over time as described herein may lead to an inference that a stop sign or traffic light has been added, warranting a visual inspection of the intersection to confirm that this is true. If such a stop sign has been added, then correction of the old database information is appropriate, and can either be done manually after the visual inspection or automatically in a provisional manner (subject to verification by later visual inspection).

[0028] Referring now to FIG. **3**, there is illustrated an intersection **300** between a large east-west roadway **310** and a smaller north-south roadway **320**. A commercial map database may represent the larger road **310** differently than the smaller road **320**, for instance indicating that the larger road is a four-lane highway while the smaller road is only two lanes wide (or possibly less). Assuming that the map database also indicates that the intersection **300** is an at-grade intersection, as opposed to being an intersection involving a bridge or other overpass or tunnel, the difference in size of the roadways alone may be sufficient to infer that the municipality or other controlling roadway authority has installed stop signs **321** and **322** to control traffic on the north-south roadway.

[0029] As a slight variation, instead of two intersecting automobile roads, if a roadway intersects a railroad track at grade, that almost certainly indicates a practical need for certain types of vehicles (e.g., school buses, commercial vehicles) to stop before crossing the railroad track. Therefore, for commercial route planning purposes and the like, the addition of a virtual traffic control (the mandatory stop at a railroad track for such vehicles) to a map database allows more accurate navigational services such as travel time planning.

[0030] The nature of each roadway is often usable as a factor in how best to infer the type of traffic control. Where a small country road intersects a large U.S. highway at grade level, it is highly likely that there will be stop signs for the small road but not for the U.S. highway. The presence of a divided highway (i.e., a boulevard or other roadway with a median strip separating travel lanes) further increases the likelihood of such a traffic control on an intersecting smaller roadway. Where a smaller road meets a larger road with an arc-shaped segment rather than at a right angle, there is an increased likelihood that a yield sign rather than a stop sign is controlling traffic from the smaller roadway.

[0031] Using the example illustrated in FIG. **3**, a pseudo-code representation of processing to infer presence of a stop sign in one embodiment is:

[0032] Process Road **310**:

[0033] a. Augment Counter**310** by number of lanes

[0034] b. Augment Counter**310** if roadway is divided

[0035] c. Augment Counter**310** by determined speed in mph/10

[0036] d. Augment Counter**310** if historical traffic volume>20% over average for that type of road

[0037] Process Road **320**:

[0038] a. Augment Counter**320** by number of lanes

[0039] b. Augment Counter**320** if roadway is divided

[0040] c. Augment Counter**320** by determined speed in mph/10

[0041] d. Augment Counter**320** if historical traffic volume>20% over average for that type of road

[0042] If Counter**310**−Counter**320**>3, then infer stop sign on Road **320**

[0043] If Counter**320**−Counter**310**>3, then infer stop sign on Road **310**

[0044] As noted above, the determined speed for each roadway is obtained either by observation of readings from GPS devices in vehicles over time, or by reference to speed limit data (e.g., from an existing database).

[0045] In many instances, each "arm" of an intersection is considered separately, such that road **310** is processed separately for its western arm ("**310**W") and eastern arm ("**310**E") and road **320** is likewise broken up into arms "**320**N" and "**320**S". This allows more detailed processing that is expected, in various environments, to be more accurate in inferring the presence of traffic controls. In one embodiment, processing in this manner is implemented by considering "local" roads to be those classified as residential or having speed limits of 25 mph or less, while "nonlocal" roads are those classified as "collectors" or having classifications higher than "residential". Then, if a map database does not already indicate that an intersection is signalized, processing is implemented in one embodiment as:

[0046] Case: Intersection has both local and nonlocal arms

[0047] a. If there is only one incoming nonlocal arm, then

[0048] i. If there is a local arm which is a continuation of the non-local arm (same road name or no turn from the non-local arm), then infer stop signs are present on all other local arms

[0049] ii. Otherwise, infer stop signs on all arms.

[0050] b. If there is more than one incoming non-local arm, then infer stop signs on all local arms

[0051] i. If there is only one local arm and another non-local arm that is a continuation of the local one, infer stop sign on the non-local continuation arm as well.

[0052] Case: T-intersection involving non-local arms only

[0053] a. If the two "thru road" arms (i.e., the two arms that are collinear) have a speed limit equal or higher than the "side" arm (i.e, the arm that is orthogonal to the thru road arms), infer stop sign on the side arm.

[0054] Case: Four-way intersection involving non-local roads only

[0055] a. If one road has a speed limit 10 mph or lower than the other, infer stop signs on the lower speed limit road only; otherwise infer stop signs on all arms.

[0056] Various other roadway and traffic control characteristics can be inferred in a similar manner. Consider traffic light characteristics, for example. Many traffic lights are synchronized along a roadway and are coordinated with one another such that vehicles traveling at a specified speed will be able to go through many intersections without encountering a red signal. In some implementations, the specified speed varies based on factors such as traffic congestion levels. There may be no database record indicating that certain lights are synchronized or what the synchronization scheme is. Likewise, certain intersections have phases of operation that vary based on congestion or time of day. A green left turn signal may appear before a general green signal, during the general green or after. Controller timing parameters may be programmed by a municipality based on any number of factors. It is not typical for municipalities to provide this detailed information about phasing or timing patters of traffic lights in a form readily usable by map databases. However, if the actual (i.e., real time) state information from each of the lights is available from the municipality, as is now often the case, the phasing and lighting patterns for each light and each intersection in general can be derived from historical analysis of the concurrent states of various lights, and in some instances comparison with other factors such as time of day, congestion levels and the like.

[0057] In one embodiment, phasing of various traffic signals is determined by comparison of real time state information among sets of adjacent traffic signals. This is particularly straightforward in the case of one-way streets.

[0058] In another embodiment, information from vehicles equipped with GPS and communications devices serves as a proxy for such real-time information about phasing. In some environments, sensor information (e.g., from inductive loops embedded in roadways) is available from municipalities that can likewise be used to track movement of individual vehicles over time and thus provide a basis for deriving traffic signal phasing information. For example, vehicles routinely "bunch" at red lights and the size of a particular bunch of vehicles can be used to track those vehicles as a group to determine whether they stop only rarely on a roadway with many signaled intersections (suggesting synchronized traffic lights) or stop fairly frequently and in a somewhat random temporal pattern (suggesting that the segment of roadway does not enjoy synchronized traffic lights).

[0059] In still another embodiment, some municipalities provide traffic phase mappings or related information (e.g., so-called "ring diagrams") that likewise can be used to infer map database information. For example, a municipality may mark an intersection as subject to a generalized phase, such as "Phase 7—Pedestrian Fully Protected". In this instance, inferences can be made that at least during certain time periods, stopping times will be increased for vehicles because they will be subject not only to red lights to allow orthogonally-directed traffic to pass, but also red lights to allow pedestrians to pass. Similarly, published information noting signaling configuration for "inbound commute" suggests potential use of center lane or breakdown lane restrictions that provide an extra lane in the inbound direction or synchronized lights favoring inbound traffic. All such information is available in various embodiments to be used as factors for derivation of map database information.

[0060] Those skilled in the art will readily recognize other algorithms that may be employed in other embodiments or environments to obtain reasonable map database inferences, for instance where traffic controls such as stop signs are likely to be located.

[0061] Thus, embodiments of the invention allow the capture of numerous additional types of information not previously reflected within the map database, leading to greater functionality and greater accuracy for the increasing number of map applications that rely on such information.

[0062] As used herein any reference to "one embodiment" or "an embodiment" means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

[0063] As used herein, the terms "comprises," "comprising," "includes," "including," "has," "having" or any other variation thereof, are intended to cover a non-exclusive inclusion. For example, a process, method, article, or apparatus that comprises a list of elements is not necessarily limited to only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. Further, unless expressly stated to the contrary, "or" refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

[0064] In addition, the words "a" or "an" are employed to describe elements and components of the invention. This is done merely for convenience and to give a general sense of the invention. This description should be read to include one or at least one and the singular also includes the plural unless it is obvious that it is meant otherwise.

[0065] Certain aspects of the present invention include process steps and instructions described herein in the form of a method. It should be noted that the process steps and instructions of the present invention could be embodied in software, firmware or hardware.

[0066] The computer program for deriving additional information is preferably persistently stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, application specific integrated circuits (ASICs), or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus.

[0067] Upon reading this disclosure, those of skill in the art will appreciate still additional alternative structural and functional designs for a system and a process for automated updating of a map database through the disclosed principles herein. Thus, while particular embodiments and applications have been illustrated and described, it is to be understood that the present invention is not limited to the precise construction and components disclosed herein and that various modifications, changes and variations which will be apparent to those skilled in the art may be made in the arrangement, operation and details of the method and apparatus of the present invention disclosed herein without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A system for updating a map database, comprising:

a data reception module configured to obtain a first roadway size characteristic associated with a first road and a second roadway size characteristic associated with a second road, the first road and the second road meeting at an intersection; and

an inference processor operably connected to the data reception module and configured to derive from the first roadway size characteristic and the second roadway size characteristic additional information not already stored within the map database and automatically update the map database to reflect the additional information, wherein the additional information denotes presence of a traffic control device.

2. A system, comprising:

a map database comprising information associated with roads;

an input subsystem configured to provide roadway characteristics;

an information inference module configured to derive from the roadway characteristics additional information not already stored within the map database and automatically update the map database to reflect the additional information.

3. The system of claim **2**, wherein the information inference module is further configured to determine presence or absence of a traffic control based upon vehicle speeds on each of two roadways forming an intersection, in order to derive the additional information.

4. The system of claim **2**, wherein the vehicle speeds are derived from GPS readings sent by vehicles.

5. The system of claim **2**, wherein the vehicle speeds are derived from speed limits on each of the two roadways.

6. The system of claim **2**, wherein the vehicle speeds are derived from operation of fixed roadway sensors.

7. The system of claim **2**, wherein the information inference module is further configured to determine a type of a traffic control based upon vehicle speeds, in order to derive the additional information.

8. The system of claim **7**, wherein the type includes at least one of the group consisting of: a stop sign, a traffic light, a synchronized traffic light, a yield sign, a turn restriction control, a lane restriction control, a railroad crossing control and a pedestrian crossing control.

9. The system of claim **3**, wherein the traffic control includes at least one of the group consisting of: a stop sign, a traffic light, a synchronized traffic light, a yield sign, a turn restriction control, a lane restriction control, a railroad crossing control and a pedestrian crossing control.

10. The system of claim **2**, wherein the roadway characteristics include at least one of the group consisting of: roadway classification, roadway historical traffic volume, traffic signal phasing, traffic signal state information, roadway sensor information.

11. The system of claim **1**, wherein the additional information further denotes characteristics of the traffic control device.

12. A method for automatically updating a map database, comprising:

receiving map information from the map database, the map database comprising information associated with roads;

receiving roadway characteristic information;

deriving additional information not already stored within the map database responsive to the roadway characteristic information; and

updating the map database to reflect the derived additional information.

13. The method of claim **12**, wherein deriving additional information comprises determining presence or absence of a traffic control based upon vehicle speeds on each of two roadways forming an intersection.

14. The method of claim **12**, wherein the vehicle speeds are derived from GPS readings sent by vehicles.

15. The method of claim **12**, wherein the vehicle speeds are derived from speed limits on each of the two roadways.

16. The method of claim **12**, wherein the vehicle speeds are derived from operation of fixed roadway sensors.

17. The method of claim **12**, wherein deriving additional information includes determining a type of a traffic control based upon vehicle speeds.

18. The method of claim **17**, wherein the type includes at least one of the group consisting of: a stop sign, a traffic light, a synchronized traffic light, a yield sign, a turn restriction control, a lane restriction control, a railroad crossing control and a pedestrian crossing control.

19. The method of claim **12**, wherein the traffic control includes at least one of the group consisting of: a stop sign, a traffic light, a synchronized traffic light, a yield sign, a turn restriction control, a lane restriction control, a railroad crossing control and a pedestrian crossing control.

20. The method of claim **12**, wherein the roadway characteristics include at least one of the group consisting of: roadway classification, roadway historical traffic volume, traffic signal phasing, traffic signal state information, roadway sensor information.

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