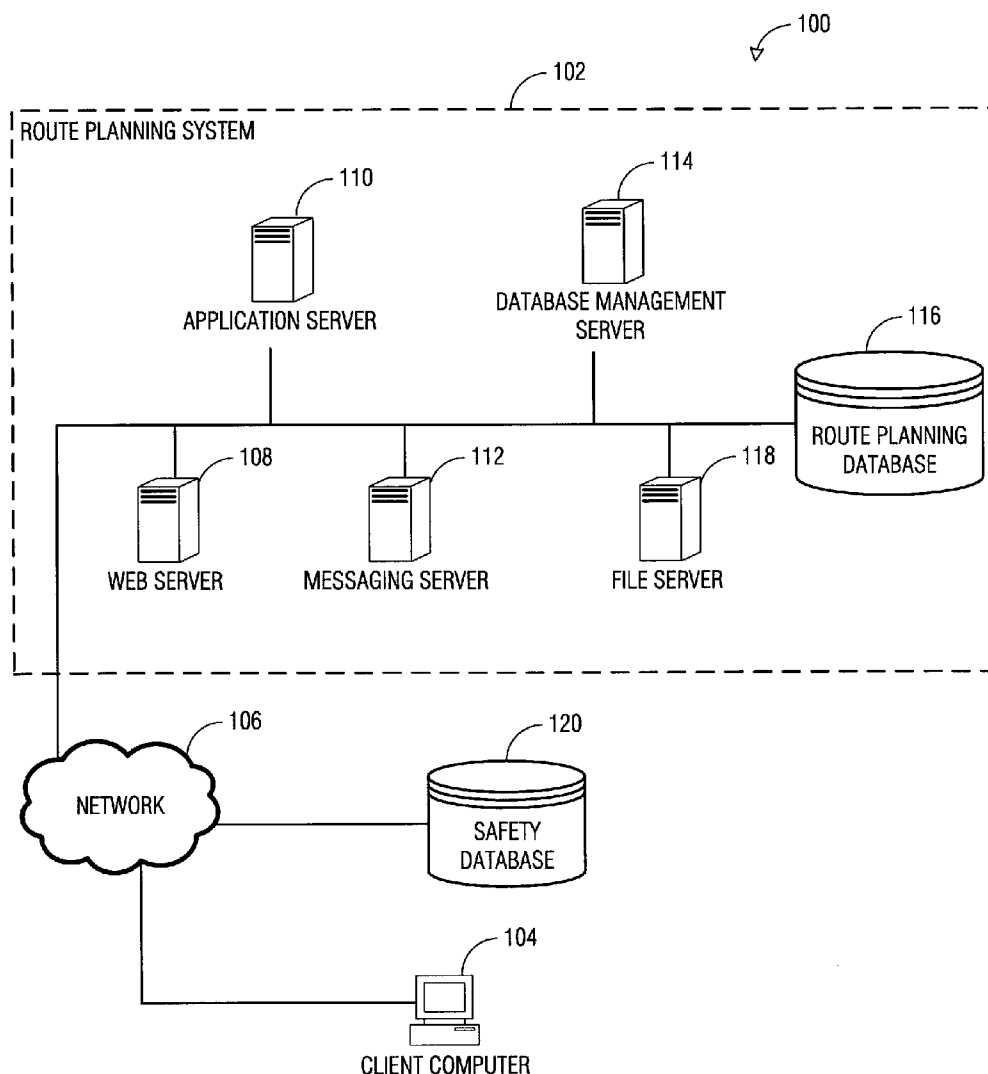




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(19) **United States**(12) **Patent Application Publication**
Speier et al.(10) **Pub. No.: US 2013/0080055 A1**(43) **Pub. Date: Mar. 28, 2013**(54) **SYSTEM AND METHOD FOR TRAVEL
ROUTE PLANNING USING SAFETY
METRICS****Publication Classification**(51) **Int. Cl.**
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Steven W. Lundberg, Edina, MN (US)(21) Appl. No.: **13/682,409**(22) Filed: **Nov. 20, 2012****Related U.S. Application Data**(63) Continuation of application No. 11/838,101, filed on
Aug. 13, 2007, now Pat. No. 8,315,792.(57) **ABSTRACT**

Systems and methods are described to receive a safety preference; calculate a temporary route; analyze a portion of the temporary route to determine whether the portion is sufficiently safe based on the safety preference; modify the portion of the temporary route when the portion is not sufficiently safe; and present the temporary route. Other systems and methods are described.



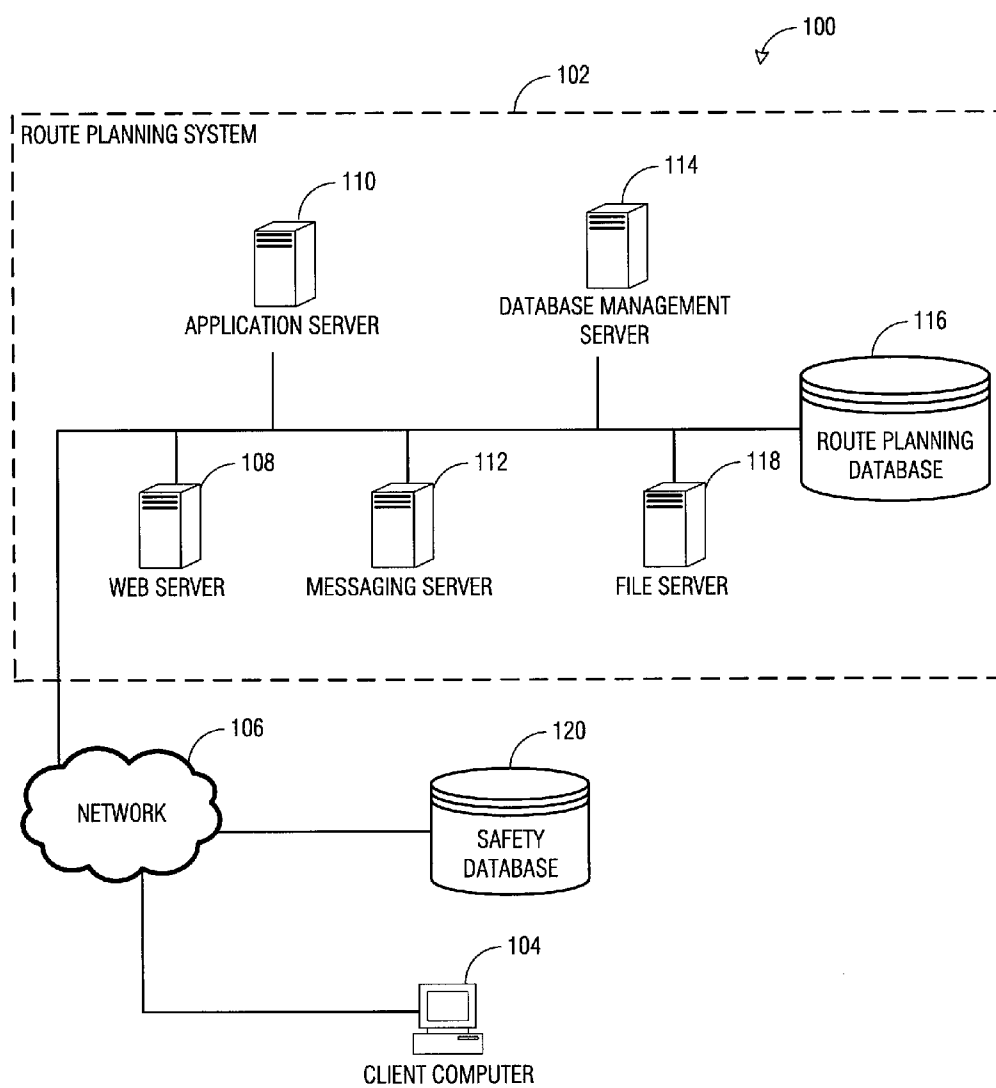
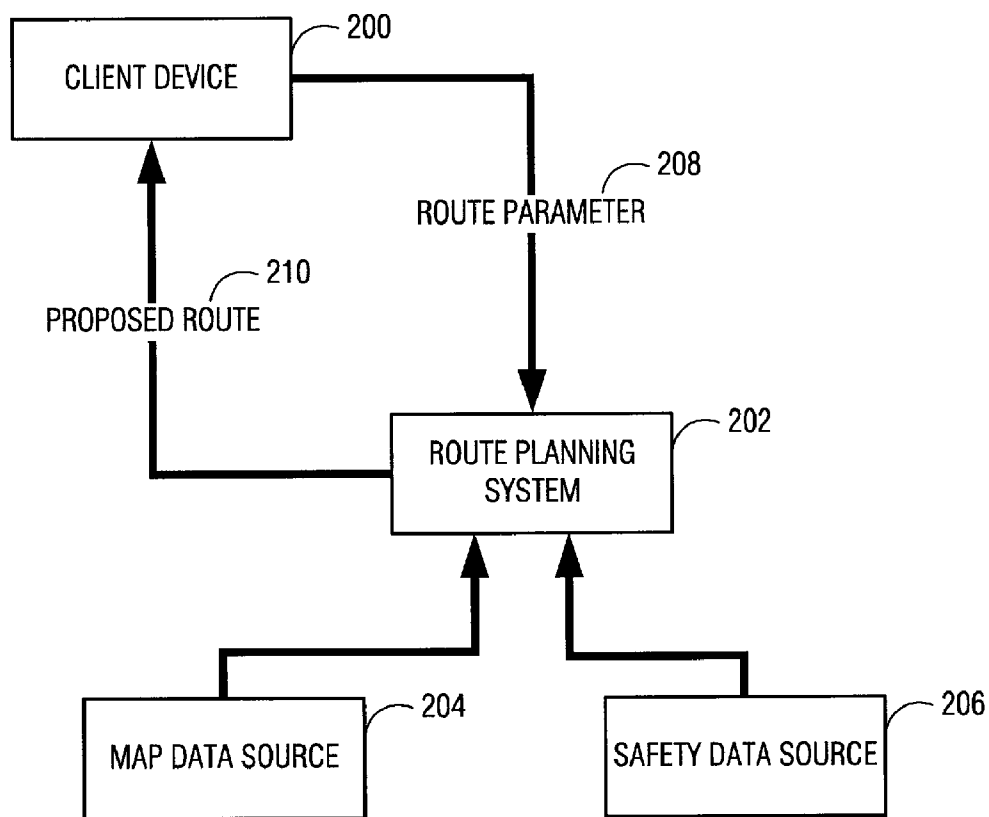
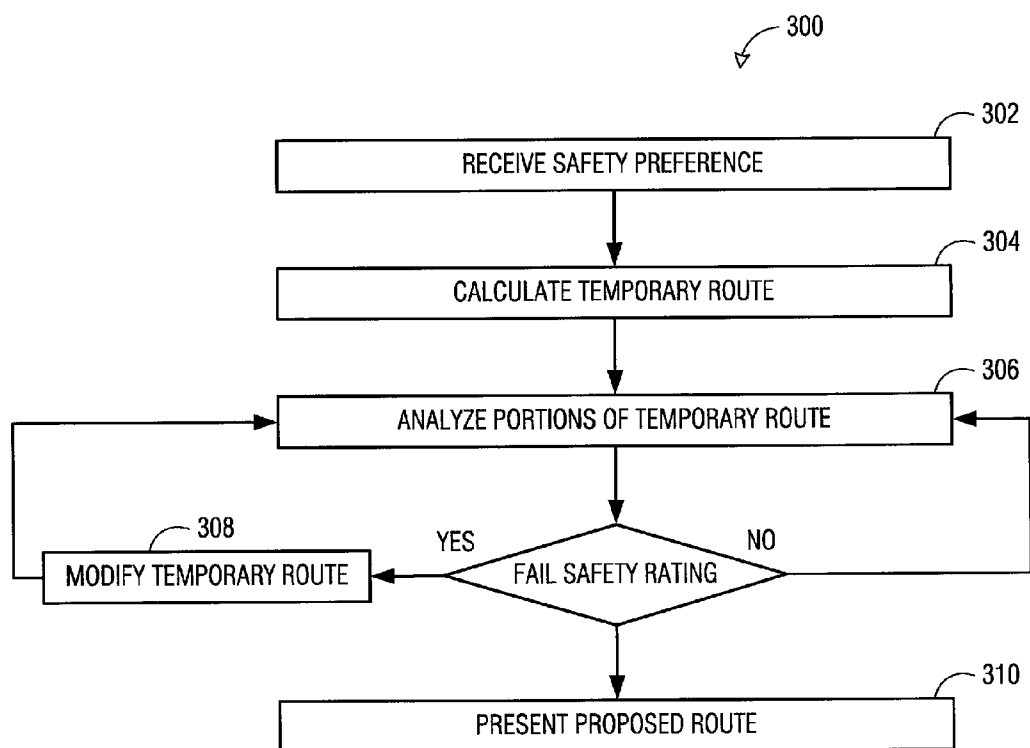
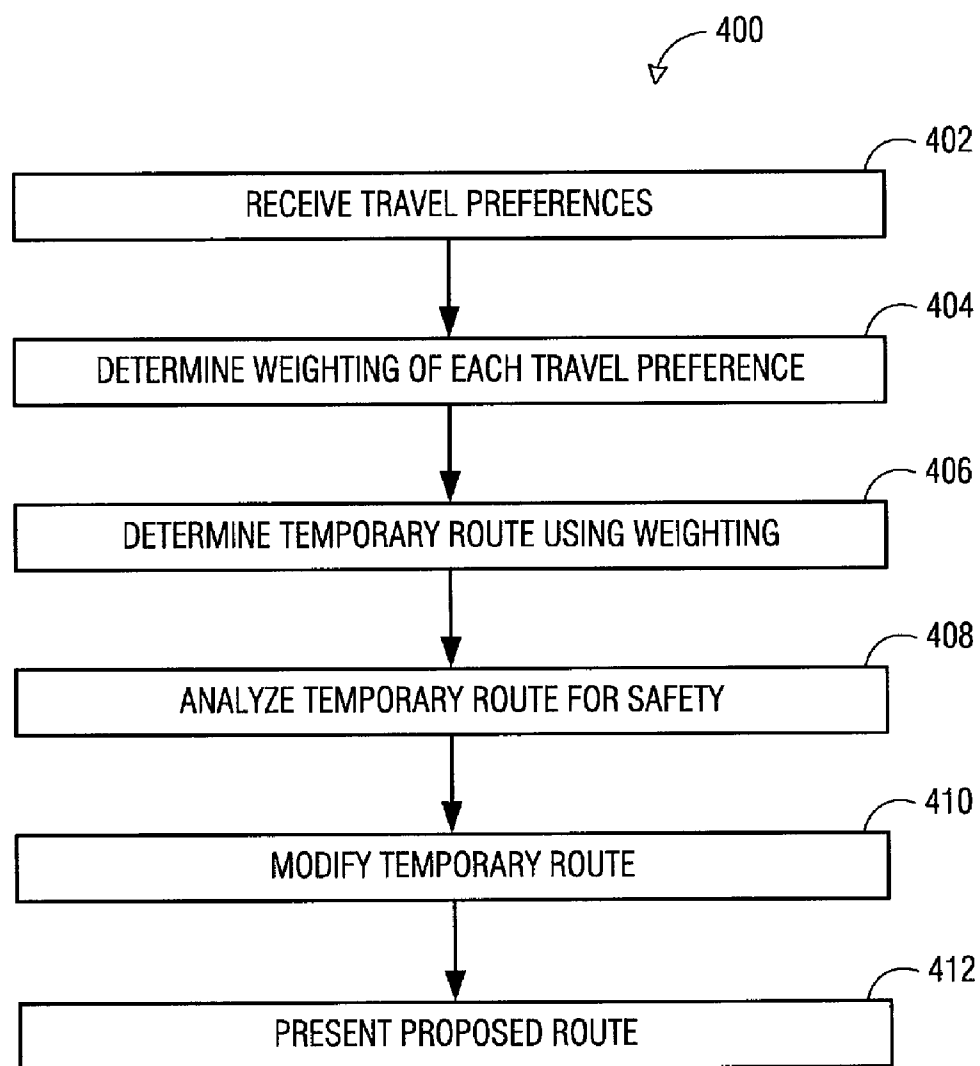
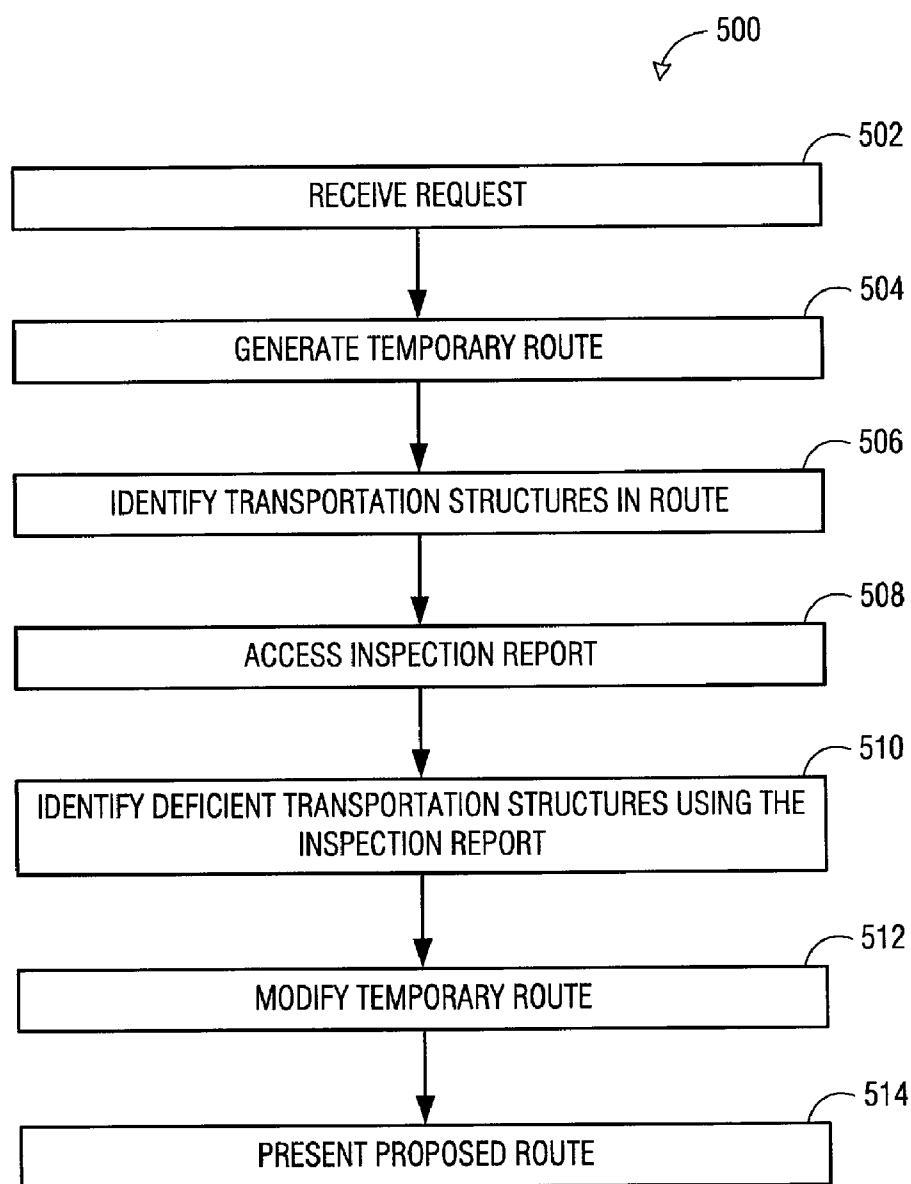


FIG. 1

**FIG. 2**

**FIG. 3**

*FIG. 4*

*FIG. 5*

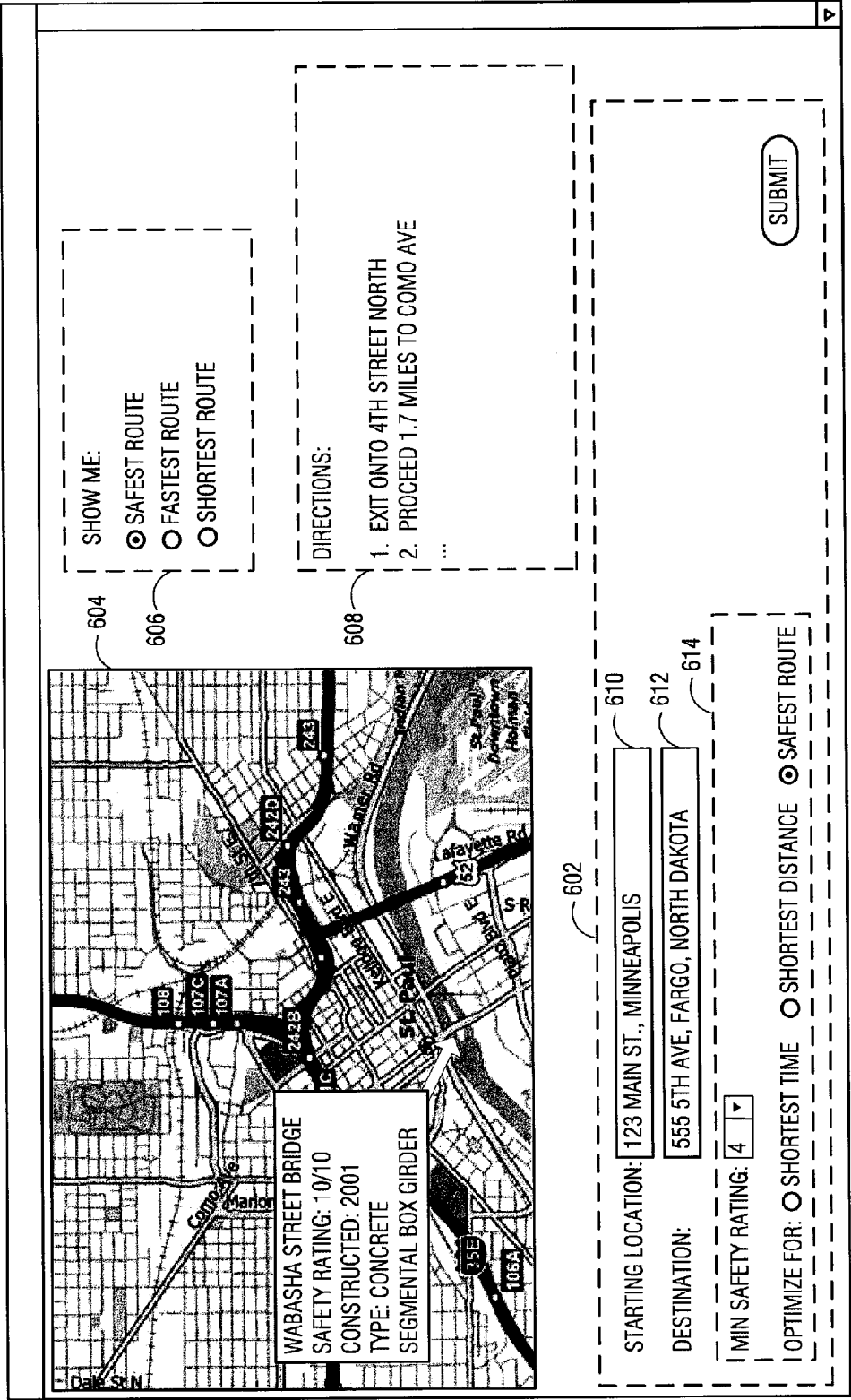


FIG. 6

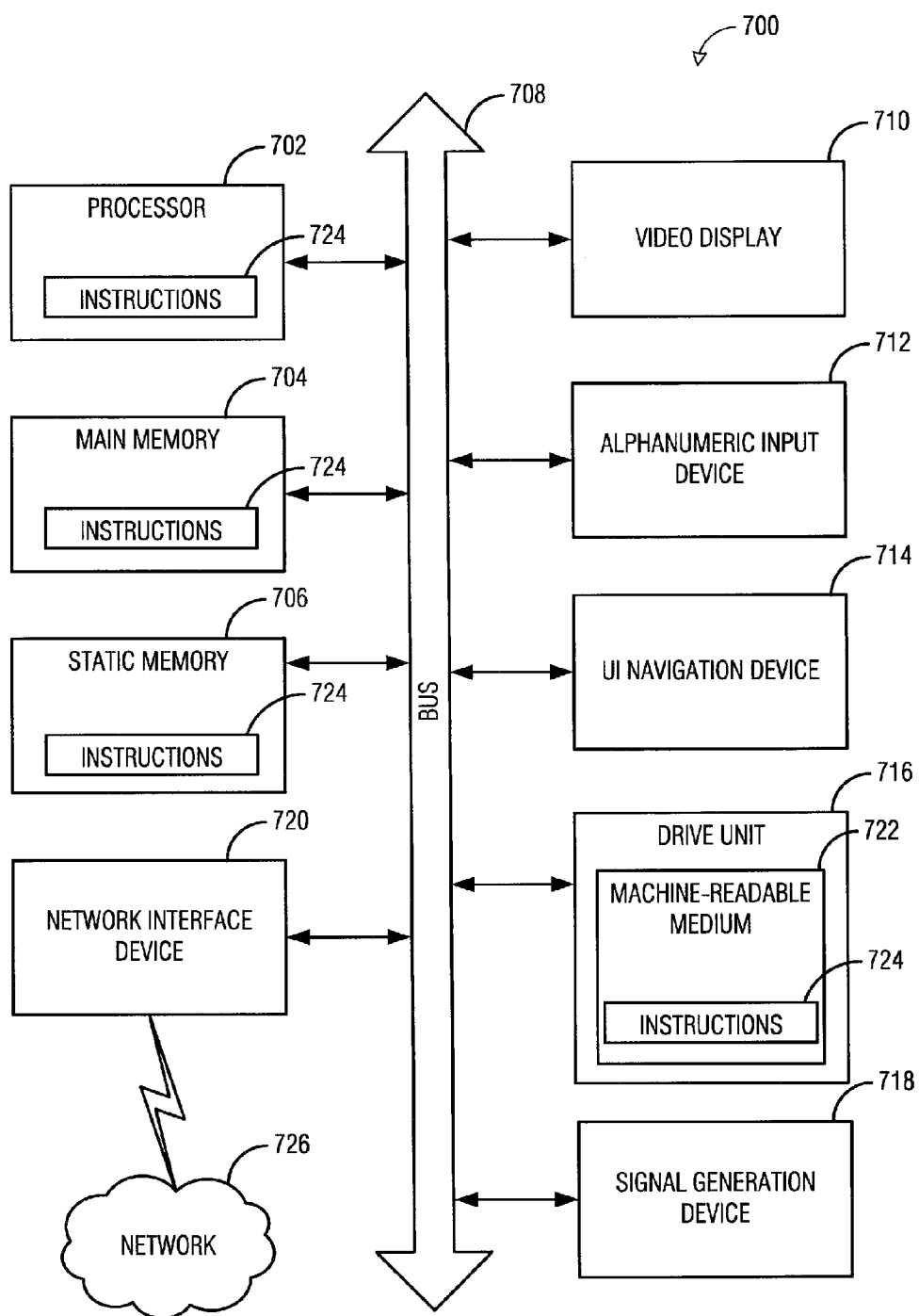


FIG. 7

SYSTEM AND METHOD FOR TRAVEL ROUTE PLANNING USING SAFETY METRICS

CLAIM OF PRIORITY

[0001] This application is a continuation of and claims priority under 35 U.S.C. §120 to U.S. patent application Ser. No. 11/838,101, entitled "SYSTEM AND METHOD FOR TRAVEL ROUTE PLANNING USING SAFETY METRICS," filed on Aug. 13, 2007, which is hereby incorporated by reference herein in its entirety.

FIELD

[0002] The present disclosure relates generally to computer systems. In an example embodiment, the disclosure relates to a system and method for travel route planning using safety metrics.

BACKGROUND

[0003] Computerized navigation systems may be used by travelers to provide route planning, location information, directions to or maps of places of interest, and other details of a journey. Some navigation systems provide detailed directions from a starting location to a destination location. The detailed directions may be determined with a focus on travel time or travel distance.

BRIEF DESCRIPTION OF DRAWINGS

[0004] The present disclosure is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

[0005] FIG. 1 is a diagram of a networked system, in accordance with an example embodiment;

[0006] FIG. 2 is a block diagram illustrating data flow, in accordance with an example embodiment;

[0007] FIG. 3 is a flow diagram illustrating a method of generating a travel route, in accordance with an example embodiment;

[0008] FIG. 4 is a flow diagram illustrating a method of generating a travel route using two or more factors, in accordance with an example embodiment;

[0009] FIG. 5 is a flow diagram illustrating a method of generating a travel route using historical inspection data, in accordance with an example embodiment;

[0010] FIG. 6 is a user-interface, in accordance with an example embodiment; and

[0011] FIG. 7 is a block diagram of a machine in the example form of computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed, in accordance with an example embodiment.

DETAILED DESCRIPTION

[0012] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of an example embodiment of the present disclosure. It will be evident, however, to one skilled in the art that the present disclosure may be practiced without these specific details.

[0013] FIG. 1 is a schematic view of a computer network system 100 according to various embodiments. The computer

network system 100 includes a route planning system 102 and a client computer 104, communicatively coupled via a network 106. In addition, a safety database 120 is communicatively coupled to the network and accessible by the client computer 104 and the route planning system 102.

[0014] The client computer 104 may include a general-purpose computing device, such as a laptop, desktop, or handheld computer; a specialized computing device, such as an on-board navigation device or a kiosk; or other devices, such as a mobile telephone or a personal digital assistant (PDA).

[0015] In an embodiment, the route planning system 102 includes a web server 108, an application server 110, a messaging server 112, a database management server 114, which is used to manage at least a route planning database 116, and a file server 118. The route planning system 102 may be implemented as a distributed system, for example one or more elements of the route planning system 102 may be located across a wide-area network from other elements of the route planning system 102. As another example, a server (e.g., web server 108, file server 118, database management server 114) may represent a group of two or more servers, cooperating with each other, in providing a pooled, distributed, or redundant computing model.

[0016] The network 106 may include local-area networks (LAN), wide-area networks (WAN), wireless networks (e.g., 802.11 or cellular network), the Public Switched Telephone Network (PSTN) network, ad hoc networks, personal area networks (e.g., Bluetooth) or other combinations or permutations of network protocols and network types. The network 106 may include a single local area network (LAN) or wide-area network (WAN), or combinations of LANs or WANs, such as the Internet. The various devices coupled to the network 106 may be coupled to the network 106 via one or more wired or wireless connections. The wireless connections may be short-range (e.g., inductive telemetry or Bluetooth) or longer-range (e.g., IEEE 802.11, IEEE 802.x wireless communication, 3G, 4G, or cellular wireless) protocols.

[0017] The web server 108 may communicate with the file server 118 to publish or serve files stored on the file server 118. The web server 108 may also communicate or interface with the application server 110 to enable web-based presentation of information. For example, the application server 110 may consist of scripts, applications, or library files that provide primary or auxiliary functionality to the web server 108 (e.g., multimedia, file transfer, or dynamic interface functions). In addition, the application server 110 may also provide some or all of the interface for the web server 108 to communicate with one or more of the other servers in the route planning system 102, e.g., the messaging server 112 or the database management server 114.

[0018] The route planning database 116 may include data to calculate routes, provide directions, provide location information, and the like. For example, the route planning database 116 may include geographical or topological map data, road data, waterway data, railway data, lodging information (e.g., campgrounds, motor parks, or hotels), tourist destinations, retail store information (e.g., gas stations, grocery stores, laundromats, or shopping centers), and scenic destinations. The route planning database 116 may also include safety metrics or other safety data related to a transportation structure. In this description, a transportation structure may include structures such as roads, bridges, tunnels, overpasses, mountain passes, and the like. Safety metrics or other safety data may include inspection ratings, user feedback ratings,

accident metrics, traffic congestion, weather hazards (e.g., risk of mudslides, rock falls, or wash outs), or condition of a transportation structure. The route planning database **116** may be implemented as a relational database, a centralized database, a distributed database, an object oriented database, or a flat database in various embodiments. In some embodiments, the route planning database **116** may include data that is periodically or regularly updated, mirrored, synchronized, replicated, or otherwise provided by an external data source (e.g., the safety database **120**).

[**0019**] The safety database **120** may include data related to inspections of a transportation structure. The safety database **120** may be managed by a municipal, county, state, or federal entity or office, such as the National Transportation Safety Board (NTSB), United States Department of Transportation (USDOT), Federal Highway Administration (FHWA), or various state departments of transportation (e.g., the Minnesota Department of Transportation (MnDOT)). The safety database **120** may include one or more historical inspection reports, such as annual inspections. The safety database **120** may also include accident reports, investigative reports, or other information related to transportation structures included in the safety database **120**. For example, if a tugboat runs into a pier supporting a bridge, the safety database **120** may include an accident report describing the incident, a investigative report describing a possible cause of the accident. The investigative report may also include an indication of whether and to what extent the collision may have caused any structural damage affecting the safety rating of the bridge. Such information may be organized and stored in the safety database **120**.

[**0020**] In an embodiment, a user (not shown) at a client computer **104** may interface with the route planning system **102**, such as by using the web server **108**, to initiate a route planning activity. The route planning activity may include activities, such as preparing a travel itinerary, providing travel preferences, obtaining a map related to a route, and obtaining directions to a destination. The user may be presented one or more questions with relevant options for answers using user-interface elements, such as drop down lists, check boxes, radio buttons, text input fields, or the like. The user-interface may be implemented using a variety of programming languages or programming methods, such as HTML, VBScript, JavaScript, XML, XSLT, AJAX, Java, and Swing.

[**0021**] FIG. 2 is a block diagram illustrating data flow, in accordance with an example embodiment. The elements illustrated in FIG. 2 include a client device **200**, a route planning system **202**, a map data source **204**, and a safety data source **206**. The client device **200** may include or be included in a client interface device, such as the client computer **104**. The route planning system **202** may include some or all of the components illustrated in route planning system **102** in FIG. 1. The map data source **204** may include information such as survey maps, computer-generated maps, satellite images, nautical maps, roadway maps, or the like. The map data source **204** may be included in the route planning database **116**. In addition, the map data source **204** may be provided by an external source, such as a governmental, commercial, or educational institutions. The safety data source **206** may include or be included in the safety database **120**.

[**0022**] During operation, one or more route parameters **208** may be communicated from the client device **200** to the route planning system **202**. The route parameters **208** may include data such as a starting address, a destination address, a mini-

mum acceptable or target safety rating of transportation structures, a weighting of various factors related to the route to be planned, locations of interest to be included in the route to be planned, or other parameters related to route planning or itinerary planning. The various factors related to the route to be planned may include a preference to minimize the amount of time spent traveling, a preference to minimize the distance traveled, a preference to maximize the reliability or safety of a proposed route, a relative importance of one factor over another (e.g., emphasizing the reliability of safety of a route at the expense of timeliness).

[**0023**] The minimum acceptable safety rating, which may also be classified as a reliability rating, may be provided as a single rating reflecting a minimum acceptable rating for all transportation structures in general or as a group of different safety ratings that correspond with different types of transportation structures. For example, a minimum safety rating of four out of ten may be indicated for tunnels, whereas a minimum safety rating of seven out of ten may be indicated for bridges. As another example, transportation structures may be further grouped into subsets using a data corresponding with the structure, such as the age of the structure, the type of construction, the design of the structure, environmental factors that may affect the structural integrity of the transportation structure, and the like.

[**0024**] The route planning system **202** may access data from the map data source **204** and the safety data source **206** to produce a proposed route based on the route parameters **208** provided by the client device **200**. In particular, the route planning system **202** may use data from the map data source **204** to construct one or more routes from a starting location to an ending location and then use data from the safety data source **206** to modify the constructed routes. The modifications may include removing portions of a constructed route that fail to meet a safety preference recited in the route parameters **208**. For example, a safety preference may indicate a minimum safety rating of a bridge or overpass and the route planning system **202** may take this into account when constructing a proposed route to avoid or minimize the use of bridges or overpasses that fail to meet the safety preference. As another example, the safety preference may indicate a preference to avoid or favor certain types of bridge designs or constructions when determining a proposed route. Bridge designs may be characterized by their general type (e.g., suspension, cantilever, truss, arch, beam and girder, etc.) or by their specific type (e.g., cable-stayed suspension, cantilever through truss, Wichert truss, fixed hingeless arch, king post truss, etc.). Bridge data may be obtained from a governmental agency (e.g., the FHWA's National Bridge Inventory system, state-level departments of transportation, etc.), private entities, educational institutions, etc. Combinations or permutations of safety preferences may be used to customize a proposed route.

[**0025**] In an embodiment, the route planning system **202** generates a route using weighted factors. The weighted factors may be provided by a user via the client device **200** or the weighted factors may be derived from related information. For example, the type of travel (e.g., business or pleasure), the participants in the travel (e.g., a single person or a family of five), the destination location, the beginning location, the mode of travel, or other characteristics of the travelers, the transportation used, or the locations visited or traveled through may be used to derive a weighting of the various factors.

[0026] After generating a route using the route parameters 208 provided, the route planning system 202 communicates at least one proposed route 210 to the client device 200. The client device 200, or a user using the client device 200, may accept or reject the proposed route 210 and provide an alternative set of route parameters 208 to the route planning system 202. In an embodiment, the client device 200, or a user using the client device 200, does not need to provide express acceptance of the proposed route 210, simply using the proposed route 210 without attempting to generate another route is implied acceptance. In some embodiments, an express acceptance is used by the route planning system 202 as an indication of an acceptable route with the route parameters 208 provided or other factors. For example, the route planning system 202 may then use the accepted route when generating routes for other similar requests with similar parameters.

[0027] FIG. 3 is a flow diagram illustrating a method 300 of generating a travel route, in accordance with an example embodiment. At 302, a safety preference is received. The safety preference may be provided using a numerical indication (e.g., 4 out of 5, 8 stars), an alphanumeric indication (e.g., “good”, “better”, “best”, “5 star”), or other indicia.

[0028] At 304, one or more temporary routes are calculated from a starting location to a destination location. As an example, the temporary routes may be calculated using a hierarchy or an ordering, such as calculating routes minimizing distance first, then selecting routes from the calculated routes with an emphasis on minimizing travel time. As another example, the temporary routes may be calculated by separately or independently calculating routes that minimize travel time and travel distance, and then selecting routes that substantially overlap.

[0029] At 306, one or more portions of the temporary routes are analyzed to determine if they meet or exceed the safety preference provided at 302. If a portion of a temporary route fails to meet the safety preference, then at 308, the temporary route is modified to exclude the portion identified as being insufficiently safe. If a modification renders a temporary route unusable, or there is no modification that could be made to accommodate the safety preference, then the temporary route may be discarded.

[0030] After the temporary routes have been modified to avoid any identified unsafe portions, then at 310, the temporary routes are presented as one or more proposed routes.

[0031] FIG. 4 is a flow diagram illustrating a method 400 of generating a travel route using two or more factors, in accordance with an example embodiment. At 402, two or more travel preferences are received. The travel preferences may include preferences such as a preference to minimize travel time, travel distance, or dangerous travel conditions. The travel preferences may also include a minimum safety rating of transportation structures encountered on a proposed route. Other travel preferences may be provided as well, such as a travel time period (e.g., departure and arrival dates or times), preferred travel time (e.g., driving after hours to avoid traffic congestion), or travel style (e.g., scenic country road routes preferred over interstate highway routes).

[0032] At 404, a weighting of each travel preference is determined. In an embodiment, the travel preferences are weighted by a user who provided the travel preferences. In another embodiment, the travel preferences are weighted using information related to the travel route, for example, the number of travelers, the reason or type of travel, the destination,

the dates of travel, etc. For example, if the dates of travel define a relatively short period and the distance to be traveled is calculated to be relatively long, then minimizing travel time may be weighted more than maximizing safe routes.

[0033] At 406, one or more temporary routes are determined using the weighted factors as guidance. At 408, one or more portions of each temporary route is analyzed to determine whether the portion has a deficient safety rating. At 410, portions of temporary routes with deficient safety ratings are modified (e.g., re-routed) if possible and presented (block 412) as one or more proposed routes.

[0034] FIG. 5 is a flow diagram illustrating a method 500 of generating a travel route using historical inspection data, in accordance with an example embodiment. At 502, a request to generate a travel route is received. The request may include one or more parameters, such as a starting location, an ending location, a start travel date, an end travel date, a minimum acceptable safety rating or reliability rating of transportation structures, and the like.

[0035] At 504, one or more temporary routes are generated using the parameters in the request. At 506, one or more transportation structures are identified in the temporary routes. In an embodiment, the method 500 attempts to identify every transportation structure in each temporary route. In another embodiment, the method 500 uses a filter to identify a selection of transportation structures in the temporary routes. As an example, the filter may be provided by a user who provided the request. In another example, the filter may be defined by a route planning system provider, such a filter may be provided as a default filter that can be modified by a user or a client. A filter may include or exclude transportation structures based on one or more characteristics related to a transportation structure, such as age, type of construction, design, etc.

[0036] At 508, one or more inspection reports are accessed one or more of the identified transportation structures. Inspection reports may be accessed from a safety or inspection database, such as the safety database 118. Inspection reports may be accessed from one or more sources. For example, in an embodiment, the method 500 accesses a single inspection database, such as a federal inspection database. In another embodiment, the method 500 access several inspection databases (e.g., federal, state, and local) and compiles the results.

[0037] At 510, the inspection reports are used to identify transportation structures that fail to meet the minimum acceptable safety rating. As mentioned above, the minimum acceptable safety rating may be provided in the request. In some embodiments, the minimum acceptable safety rating is, set at a system-level, accessed from saved user preferences or options, or otherwise obtained. The one or more inspection reports may be analyzed to determine whether key words, such as “deficient” or “recommend replacement” exist in the inspection report. Finding such keywords may influence the safety rating of the corresponding transportation structure. As another example, an inspection report may be analyzed for historical changes, such as a change in classification of a transportation structure or other changes in use or characterization of a transportation structure. For example, a bridge may have a safety rating of five out of ten when classified for 1-ton trucks. However, when analyzing the inspection reports for the bridge, it may be found that the bridge had a safety rating of two in its original classification for 2-ton trucks and that a

re-classification was done to effectively increase the safety rating. Such evidence may be used to influence the effective safety rating of the bridge.

[0038] At 512, the temporary routes are modified to remove portions of the route that include transportation structures that fall below the minimum safety rating. At 514, the modified transportation routes are presented as one or more proposed routes.

[0039] FIG. 6 is a user-interface 600, in accordance with an example embodiment. The user-interface 600 includes a parameter input portion 602, a map display portion 604, a route selection portion 606, and a route directions portion 608. The parameter input portion 602 includes a starting location input control area 610, a destination location input control area 612, and a preferences control area 614. The preferences control area 614 may be used to provide one or more preferences that may be used to affect the routes considered, as described above. The map display portion 604 may display a portion or all of the currently selected route, as identified from the route selection portion 606. The map display portion 604 may be manipulated by the user, for example, panned, scrolled, or zoomed, to display a map in more or less detail. A map of the route displayed in the map display portion 604 may include indicia identifying transportation structures that are included in the displayed route. The indicia may include graphical icons to indicate one or more characteristics of a transportation structure (e.g., a safety rating), or a pop-up window or pop-up element to display additional information about a corresponding transportation structure. Other user-interface elements may be used to assist the user to quickly and effectively identify transportation structures and characteristics of the transportation structures. User-interface elements may be provided for transportation structures found anywhere on the displayed map or for only those transportation structures found along the displayed route. The route selection portion 606 may list one or more proposed routes. The proposed routes may be ranked or ordered according to various criteria, such as by distance, travel time, relative safety, or combinations of criteria. An indication of the relative safety of a route may be displayed to correspond with the route. For example, a ranking according to distance may also include a relative safety rating, for example, using a percentage value where 100% indicates relatively completely safe in a parenthetical summary after a route description. The route directions portion 608 may be used to display general or detailed directions corresponding to a portion or all of a selected route.

[0040] FIG. 7 is a simplified block diagram of a machine in the example form of computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed. In alternative embodiments, the machine operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine may operate in the capacity of a server or a client machine in server-client network environment, or as a peer machine in a peer-to-peer (or distributed) network environment. Further, while only a single machine is illustrated, the term “machine” shall also be taken to include any collection of machines that individually or jointly execute a set (or multiple sets) of instructions to perform any one or more of the methodologies discussed herein.

[0041] The example computer system 700 includes a processor 702 (e.g., a central processing unit (CPU), a graphics

processing unit (GPU) or both), a main memory 704 and a static memory 706, which communicate with each other via a bus 708. The computer system 700 may further include a video display unit 710 (e.g., a plasma display, a liquid crystal display (LCD) or a cathode ray tube (CRT)). The computer system 700 also includes an alphanumeric input device 712 (e.g., a keyboard), a user interface (UI) navigation device 714 (e.g., a mouse), a disk drive unit 716, a signal generation device 718 (e.g., a speaker) and a network interface device 720.

[0042] The disk drive unit 716 may include machine-readable medium 722 on which is stored one or more sets of instructions and data structures (e.g., software 724) embodying or utilized by any one or more of the methodologies or functions described herein. The software 724 may also reside, completely or at least partially, within the main memory 704 and/or within the processor 702 during execution thereof by the computer system 700, where the main memory 704 and the processor 702 also constitute machine-readable, tangible media.

[0043] Software 724 may further be transmitted or received over network 726 via network interface device 720 utilizing any one of a number of well-known transfer protocols (e.g., HTTP).

[0044] While machine-readable medium 722 is shown in an example embodiment to be a single medium, the term “machine-readable medium” should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term “machine-readable medium” shall also be taken to include any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of the present application, or that is capable of storing, encoding or carrying data structures utilized by or associated with such a set of instructions. The term “machine-readable medium” shall accordingly be taken to include, but not be limited to, solid-state memories, optical and magnetic media, and carrier wave signals.

[0045] Although an embodiment has been described with reference to specific example embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description. For example, one functional, computational, or hardware module may be implemented as multiple logical modules, or several modules may be implemented as a single logical module. As another example, modules labeled as “first,” “second,” and “third,” etc., may be implemented in a single module, or in some combination of modules, as would be understood by one of ordinary skill in the art.

[0046] In the appended claims, the terms “including” and “in which” are used as the plain-English equivalents of the respective terms “comprising” and “wherein,” respectively. Also, in the following claims, the terms “including” and “comprising” are open-ended, that is, a system, device, article, or process that includes elements in addition to those

listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms “first,” “second,” and “third,” etc. are used merely as labels, and are not intended to impose numerical requirements or a particular ordering on their objects.

[0047] The Abstract of the Disclosure is provided to comply with 37 C.F.R. §1.72(b), requiring an abstract that will allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in a single embodiment for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment.

What is claimed is:

1. A method comprising:

presenting, by a processor-based system, on a display of the processor-based system, a user-interface comprising:

a user input portion;

a map portion; and

a route directions portion;

receiving, via the user input portion, a safety preference indicating an acceptable structural safety rating of a type of a transportation structure;

calculating a temporary route that accommodates the acceptable structural safety rating;

presenting the temporary route in at least one of the map portion and the route directions portion; and

presenting, in the map portion, information related to a transportation structure along the temporary route.

2. The method of claim **1**, wherein the information related to the transportation structure comprises at least one of: a safety rating, a construction date, or a construction type.

* * * * *