Method and Apparatus for Creating Map Data for Calculating Commute Time Using Public Transit Information

Field of Invention

The present invention relates to a method and apparatus for creating map data using public transit information to calculate commute time and presenting alternatives within a geographical area in accordance with user's search query and preferences. Particularly, the present invention relates to using the public transit information to create the map data for use in calculating commute time in accordance to a commute mode which is not limited to public transit mode.

Background

When people search for alternatives such as jobs or properties, location is a key consideration. While distances between locations provide certain indication to users performing location-based searches, they are insufficient. For example, a smaller distance may actually require a longer travel time. The amount of time it takes to travel to the alternative is thus a better indicator. Some map service providers, such as Google Map, have already provided services of computing commute time between any two specified locations. However, they are unable to present to the users a qualified region that can be reached from a specific location by a specific commute mode within a specific commute time.

One of the difficulties in providing the above feature is that the required computation resources are huge so that it usually takes a significant amount of time to generate the qualified region. The travel map built according to the entire road networks in the cities is extremely large because of the various commute modes and the numerous roads available.

There is a need for a method and apparatus capable of computing commute time efficiently.

Summary

The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

In one exemplary technique of the present disclosure, there is provided a method for creating map data for calculating commute time between locations with respect to a specific commute mode, the method comprising steps of obtaining public transit information; generating a directed graph of the public transit; creating, for the specific commute mode, map data for calculating commute time between locations using the directed graph of the public transit; and storing the map data for the specific commute mode.

The map data for calculating commute time between locations for the specific commute mode may be created by modifying the directed graph of the public transit in accordance with the specific commute mode.

The public transit information may include public transit stations and routes between public transit stations, each route being associated with a mode of public transit and a travel time by the mode of public transit.

The directed graph of the public transit may include nodes representing the public transit stations and edges connecting the nodes representing the routes between public transit stations, each edge being associated with the mode of public transit for the corresponding route and a weight representing the travel time by the mode of public transit for the corresponding route.

The mode of public transit may be one of bus, subway, ferry and light rail.

The specific commute mode may be one of using public transit, walking, cycling and driving.

When the specific commute mode is walking or cycling, the step of creating the map data may include removing edges that are not allowed for walking or cycling from the directed graph of the public transit and modifying the weight of each remaining edge to represent a travel time by walking or cycling.

When the specific commute mode is driving, the step of creating the map data may include removing edges in which the mode of public transit is not bus from the directed graph of the public transit and merging a graph of highways with the directed graph having only edges in which the mode of public transit is bus.

In another exemplary technique of the present disclosure, there is provided a method for calculating a commute time from a first location to a second location with respect to a specific commute mode, the method comprising steps of creating map data for the specific commute mode; and calculating a commute time from the first location to the second location using the map data.

The map data for the specific commute mode may include nodes and edges connecting the nodes, the edges representing routes for the specific commute mode and each edge having a weight representing a travel time by the specific commute mode, and the calculating step may comprise adding a first location node and a second location node to the map data, the first location node representing the first location and the second location node representing the second location; selecting a set of first nodes and a set of second nodes from the nodes of the map data, the first nodes being nodes within a predetermined distance from the first location node and the second nodes being nodes within a predetermined distance from the second location node; adding edges connecting the first location node to each of the first nodes and edges connecting each of the second nodes to the second location node to the map data, each added edge having a weight representing a travel time by the specific commute mode; and calculating a shortest commute time from the first location to the second location using the map data having the added nodes and the added edges.

In another exemplary technique of the present disclosure, there is provided a method of providing location-based alternatives in a region specified by a user, comprising steps of receiving input of a first location, a first commute mode and a first commute time from the user; and generating a first region reachable from the first location by the first commute mode within the first commute time using map data created for the first commute mode, the map data being created using a directed graph of public transit and the first region being the region specified by the user.

The method may further comprise steps of receiving input of a second location, a second commute mode and a second commute time from the user; generating a second region reachable from the second location by the second commute mode within the second commute time using map data created for the second commute mode, the map data being created using the directed graph of public transit; and obtaining an intersection or a union of the first region and the second region as the region specified by the user.

The method may further comprise steps of obtaining location-based alternatives in the region specified by the user; receiving input of matching criteria from the user; calculating, for each location-based alternative in the region specified by the user, a matching score indicating a degree of match with the matching criteria.

The matching score may be calculated considering learned preferences of the user based on user behaviors.

In another exemplary technique of the present disclosure, there is provided an apparatus for creating map data for calculating commute time between locations with respect to a specific commute mode, comprising a processor configured to obtain public transit information, generate a directed graph of the public transit, and create, for the specific commute mode, map data for calculating commute time between locations using the directed graph of public transit; and a data storage medium configured to store the map data for the specific commute mode.

Brief Description of the Drawings

Embodiments of the method and the apparatus will now be described with reference to the accompanying figures in which:

Fig. 1 shows a schematic diagram of a system that enables a user to search for location-based alternatives within a qualified region that is reachable from a specific location by travelling on a specific commute mode within a specific commute time;

Fig. 2 is an example of a screen display displayed to a user who is searching for alternatives using the system;

Fig. 3 is an example of a location selection screen display that allows the user to specify a location, a commute mode and a commute time for the generating of a qualified region;

Fig. 4 is a flowchart illustrating an example of a method of using public transit information to create map data for calculating commute time with respect to a commute mode and calculating commute time using the map data;

Fig. 5 shows an example of a part of a directed graph generated using the public transit information;

The computer function as the server 102 may comprise a processor for executing the one or more computer programs, and may include input modules such as a computer mouse, keyboard/keypad, and/or a plurality of output devices such as a display. The computer may comprise a memory which functions as the database 106.

The processor may be connected to the networks 110, for instance, the Internet, via a suitable transceiver device (i.e. a network interface), to enable access to e.g. the Internet or other network systems such as a wired Local Area Network (LAN) or Wide Area Network (WAN). The processor may also be connected to one or more external wireless communication enabled devices via a suitable wireless transceiver device e.g. a WiFi transceiver, Bluetooth module, Mobile telecommunication transceiver suitable for Global System for Mobile Communication (GSM), 3G, 3.5G, 4G, 5G or any emerging telecommunication systems, or the like.

One or more of the computer programs may be stored in any machine readable medium. The machine readable medium may include storage devices such as magnetic or optical disks, memory chips, or other storage devices suitable for interfacing with a general purpose computer. The computer program when loaded and executed on such a general-purpose computer effectively results in a system (e.g. 100) that implements the steps of the data processing in examples described later.

Fig. 2 shows an example of a screen display 200 displayed to a user who is searching for alternatives, for example, properties for rental as shown, using one electric device 104 of the system 100. The user is able to specify a desired region by clicking a button 202 provided on the screen display 200 which leads to a location selection screen display 300 as shown in Fig. 3.

In the location selection screen display 300, a text box 302 is provided for the user to specify a location of an origin of travel; a mode selection box 304 is provided for the user to specify a commute mode; and a time selection box 306 is provided for the user to specify a commute time. As shown in Fig.12, the user specifies driving as the commute mode and 10 minutes as the commute time. Other commute modes that can be selected by the user include using public transit, walking, cycling, etc., and the commute time may be specified in the order of 5 minutes. An approximate commute time, in the order of 5 or 10 minutes, is used in the embodiment of the present invention as such approximation

Claims

1. A method for creating map data for calculating commute time between locations with respect to a specific commute mode, comprising steps of

obtaining public transit information;

generating a directed graph of the public transit, the directed graph of the public transit including nodes and edges connecting the nodes, wherein each edge represents a route between two nodes travelled by a mode of public transit and being associated with a weight;

creating, for the specific commute mode, map data for calculating commute time between locations using the directed graph of the public transit; and

storing the map data for the specific commute mode,

wherein the specific commute mode includes driving, and the step of creating the map data for driving includes:

removing edges in which the mode of public transit is not bus from the directed graph of the public transit to obtain a modified directed graph having only edges in which the mode of public transit is bus; and

merging a graph of highways with the modified directed graph of the public transit by connecting nodes corresponding to highway exits with nodes in the modified directed graph of public transit that are adjacent the nodes corresponding to highway exits.

2. The method according to claim 1, wherein the map data for calculating commute time between locations for the specific commute mode other than driving is created by modifying the directed graph of the public transit in accordance with the specific commute mode other than driving.

3. The method according to claim 1 or 2, wherein the public transit information includes public transit stations and routes between public transit stations, each route being associated with a mode of public transit and a travel time by the mode of public transit.

4. The method according to claim 3, wherein the nodes representing the public transit stations and the edges connecting the nodes representing the routes between public transit stations, each edge being associated with the mode of public transit for the corresponding route and a weight representing the travel time by the mode of public transit for the corresponding route.

5. The method according to claim 3 or 4, wherein the mode of public transit is one of bus, subway, ferry and light rail.

6. The method according to any one of claims 1 to 5, wherein the specific commute mode further includes one of using public transit, walking, and cycling.

7. The method according to claim 6, wherein when the specific commute mode is walking or cycling, the step of creating the map data includes removing edges that are not allowed for walking or cycling from the directed graph of the public transit and modifying the weight of each remaining edge to represent a travel time by walking or cycling.

8. The method according to any one of the preceding claims, the method comprising: calculating a commute time from a first location to a second location with respect to the specific commute mode using the map data created.

9. The method according to claim 8, wherein the map data for the specific commute mode includes nodes and edges connecting the nodes, the edges of the map data for the specific commute mode representing routes for the specific commute mode and each edge having a weight representing a travel time by the specific commute mode, and the step for calculating the commute time from the first location to the second location comprises:

selecting a set of first nodes and a set of second nodes from the nodes of the map data for the specific commute mode, the first nodes being nodes within a predetermined distance from a node of the first location and the second nodes being nodes within a predetermined distance from a node of the second location;

computing edges connecting the node of the first location to each of the first nodes and edges connecting each of the second nodes to the node of the second location , each of the computed edges having a weight representing a travel time by a second specific commute mode; and

calculating a shortest commute time from the node of the first location to the node of the second location by considering the weights of each of the computed edges and weight of each edge representing a route between each of the first nodes and each of the second nodes.

10. The method according to any one of the preceding claims, wherein the directed graph of public transit for calculating commute time between locations with respect to the specific commute mode is used to determine location-based alternatives in a region reachable from a first location within a first commute time by the specific commute mode,

wherein the first location, the specific commute mode and the first commute time are specified by a user.

11. The method according to claim 10, wherein the directed graph of public transit for calculating commute time between locations with respect to a second commute mode is used to determine a second region reachable from a second location within a second commute time by the second commute mode, wherein the second location, the second commute mode and the second commute time are specified by the user, the method further comprising obtaining an intersection or a union of the first region and the second region as a qualified region which can be reached from the first location and the second location by commuting on respective commute modes within respective commute times specified by the user.

12. An apparatus for creating map data for calculating commute time between locations with respect to a specific commute mode, comprising

a processor configured to:

obtain public transit information;

generate a directed graph of the public transit, the directed graph of the public transit including nodes and edges connecting the nodes, wherein each edge represents a route between two nodes travelled by a mode of public transit and being associated with a weight; and

create, for the specific commute mode, map data for calculating commute time between locations using the directed graph of public transit; and

a data storage medium configured to store the map data for the specific commute mode,

wherein the specific commute mode includes driving, and the step of creating the map data for driving includes:

removing edges in which the mode of public transit is not bus from the directed graph of the public transit to obtain a modified directed graph having only edges in which the mode of public transit is bus; and

merging a graph of highways with the modified directed graph of the public transit by connecting nodes corresponding to highway exits with nodes in the modified directed graph of the public transit that are adjacent the nodes corresponding to highway exits.