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Route Selection Based On Sunlight Exposure

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ABSTRACT

Digital maps provided via websites, mobile apps, in-car navigation systems, etc. include features to provide route guidance. Currently, such maps compute routes based on parameters such as travel time, cost, transport mode, type of roadway, etc. This disclosure describes techniques that enable digital map applications to provide routing information based on expected exposure to sunlight along the route. The sunlight exposure information can be displayed to users and utilized in route selection to minimize or maximize sunlight exposure depending on travel parameters. For example, higher sunlight exposure may be preferred by users who drive vehicles with solar panels while lower sunlight exposure may be preferred by users who walk to their destination.

KEYWORDS

- Digital maps
- Navigation
- Routing
- Sunlight exposure
- Shade
- Solar panels

BACKGROUND

An important and frequent use case for digital maps, e.g., available via websites, as mobile apps, or as part of an on-board navigation system of a vehicle, is to provide routing to particular destinations. Route options provided by such digital maps take into account available relevant information such as start and end locations, distance, travel time, transportation mode,

cost, etc. Users can compare the provided options along one or more of these parameters and choose the route per their preference. For example, users who prioritize time constraints may choose a route that minimizes travel time but has toll roads. In another example, tourists may choose scenic routes over fastest routes.

Users may benefit from considering sunlight as one of the parameters for obtaining and comparing routes. For instance, users who are walking to their destinations may wish to avoid exposure to the sun to protect themselves from sunburns, heat exhaustion, etc., especially during the hotter months. In contrast, those who own a vehicle with solar panels may wish to maximize exposure to sunlight in order to charge the solar panels, even if that requires compromising on distance or time by taking a slightly longer route. However, current digital map applications lack the functionality to use exposure to the sun as a consideration when selecting, displaying, and comparing various possible routes between an origin and a destination.

DESCRIPTION

This disclosure describes techniques that enable digital map applications to provide routing information based on expected exposure to sunlight along the route. With user permission, the expected exposure to sunlight can be calculated by taking into account various pieces of relevant information regarding the route segments, such as presence of trees, buildings, and tunnels based on satellite data and street images; angle of the sun based on the user's location; strength of sunlight based on season; weather and atmospheric conditions; mode of travel (i.e., driving, walking, etc.), etc.

Each potential route between an origin and a destination is associated with a measure of likely exposure to sunlight along the route based on combining the various pieces of relevant information mentioned above with user permission. For instance, information on the angle of the

sun combined with the presence of buildings and trees can indicate the level of shade offered by a sidewalk along the route.

If users permit, the sunlight exposure information for a route is coupled with the user's other travel parameters, such as the mode of travel, when selecting the optimal routing option for the user's needs. For instance, routes with shady sidewalks and minimal sunlight exposure are determined as the most suitable option for those who are walking to their destination. In such cases, the routing guidance can indicate the side of the street where the user should walk to minimize exposure to the sun. Similarly, driving routes with lower exposure to sunlight can be suggested for those whose vehicles lack air conditioning.

In contrast, those who drive vehicles with solar panels can be recommended routes that optimize solar panel charging based on likely sunlight exposure along the route. If users permit, the route guidance can further take into account relevant additional information, such as make and model of the vehicle, manufacturer of the solar panels, angle and direction of the solar panels, etc., to determine the route with sunlight exposure that is likely to maximize the charge gained along the route.

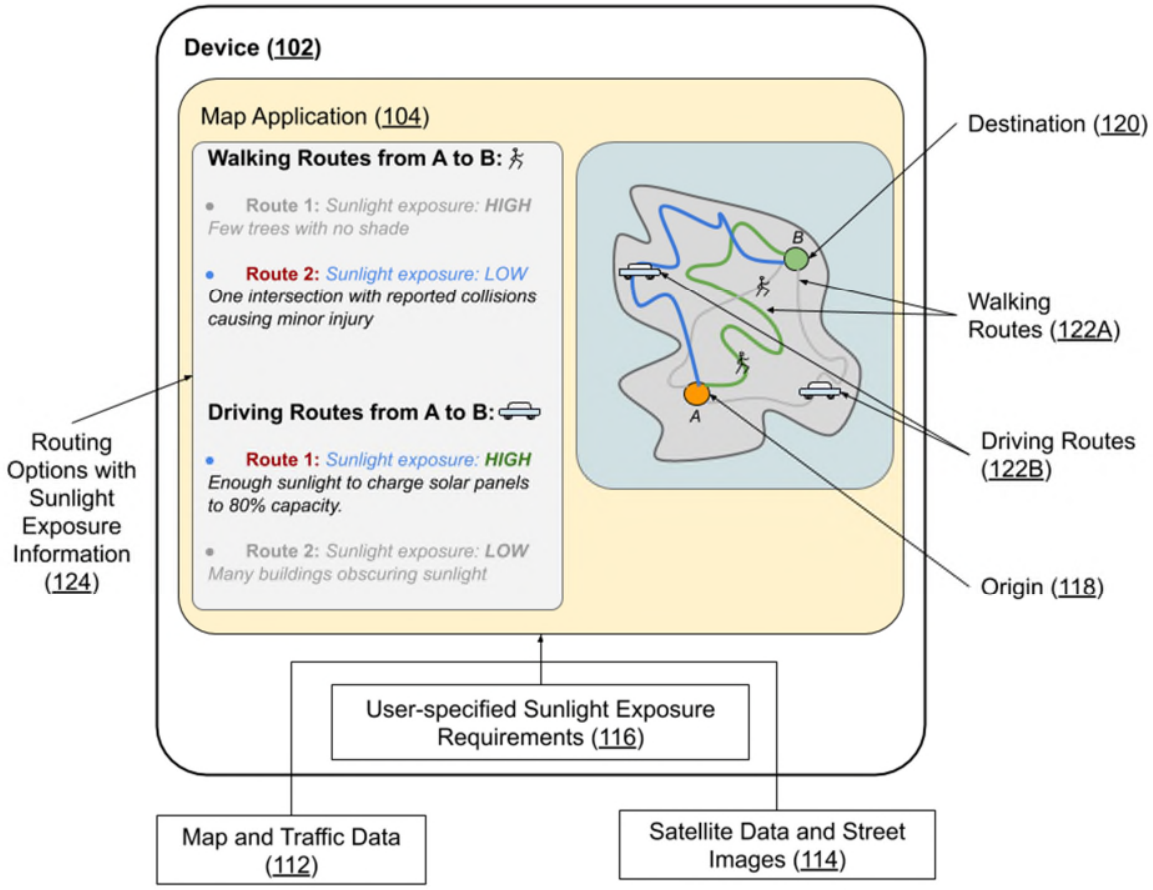

Fig. 1: Choosing a route between an origin and destination based on sunlight exposure

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure. A user uses a digital map application (104) on a device (102) to seek routes (122) to go from an origin A (118) to a destination B (120). Along with map and traffic data (112), satellite data and street images (114) and user-specified sunlight exposure requirements (116) are taken into account by the map application to determine available routes and calculate safety ratings.

For instance, Fig. 1 shows two possible walking routes (122A) between an origin A and a destination B, and two additional driving routes (122B) between A and B. Of these, Route 1 among the walking options and Route 2 among the driving options are highlighted based on

sunlight exposure information (124). The other two routes (Route 2 for walking and Route 1 for driving) are grayed out in the list and in the map to indicate that these are less suitable and may not meet the sunlight exposure criteria for the corresponding mode of transportation compared to the other alternative within each transportation mode.

Each route shown within the digital map application can show the corresponding sunlight exposure as one of its characteristics (along with factors such as distance, time of travel, etc.). The amount of sunlight exposure along a route can be represented in any suitable form, such as levels (e.g., high, medium, or low), ratings (e.g., a number on a scale), etc. Upon user request, additional sunlight exposure information related to the route, e.g., presence of trees, angle of the sun, etc., can be provided to the user. The user interface of the digital map application can show different routes with associated sunlight exposure information, along with factors such as distance, time of travel, etc.

If the user permits, the routing option with the optimal sunlight exposure can be chosen directly by the digital map application based on parameters specified by the user and/or provided by the developers and/or determined dynamically at runtime. Alternatively, the user can select the route manually based on sunlight exposure information presented along with each potential route shown as a possible option.

The techniques described herein can be implemented within any digital map platform or application that provides navigation assistance. Similarly, the techniques can support any vehicle that incorporates solar panels, including self-driving vehicles. Implementation of the techniques can enhance the user experience (UX) of digital map applications by enabling route selection more optimally suited to user needs and/or enable solar-powered vehicles to operate in a more sustainable and environmentally friendly manner.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's current location, route preference, mode of travel, or a user's preferences), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

Digital maps provided via websites, mobile apps, in-car navigation systems, etc. include features to provide route guidance. Currently, such maps compute routes based on parameters such as travel time, cost, transport mode, type of roadway, etc. This disclosure describes techniques that enable digital map applications to provide routing information based on expected exposure to sunlight along the route. The sunlight exposure information can be displayed to users and utilized in route selection to minimize or maximize sunlight exposure depending on travel parameters.