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Personalized Routing Dynamically Adjusted to Avoid Adverse Situations

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ABSTRACT

Routes that are optimal in general for a particular travel need may at times be unsuitable in a specific instance because of various factors such as construction, weather, accidents, rush hour traffic, road surface conditions, presence of crowds, etc. The impact of such factors on a person's travel plans can depend on the specifics of the person's travel circumstances, such as travel mode, vehicle characteristics, etc. This disclosure describes techniques to proactively deliver travel routing guidance personalized to a user, based on user-permitted contextual factors. If the user permits, the personalized routing guidance is adjusted to avoid one or more of a number of dynamic factors that can adversely impact specific routes at the time of the user's travel. With user permission, route guidance can be generated passively, without an actual request from the user, and notifications or alerts can be proactively provided to the user.

KEYWORDS

- Dynamic routing
- Personalized navigation
- Navigation planning
- Digital maps
- Travel hazard
- Hazard awareness
- Vehicle characteristics
- Edge-ranking algorithm
- Proactive notification

BACKGROUND

Traveling is an integral part of an individual's everyday life. People engage in travel in a variety of modes, such as walking, driving, biking, taking public transportation, etc. Oftentimes, people routinely engage in travel with similar parameters, such as routes, modes, times, etc. For instance, people typically commute to and from work on weekdays at roughly the same times, following roughly the same route via the same mode.

People frequently use digital maps, e.g., available via map or navigation applications, to seek routing guidance. Such applications enable users to specify various travel parameters, such as transportation mode, user preferences, etc. Based on user input, the applications determine and present up to route options that are well-suited for traveling between the user's specified origin and destination.

However, routes that are optimal in general for a particular journey need may sometimes be unsuitable in a specific instance because of various factors, including but not limited to: construction, weather, accidents, road blocks installed due to special events such as concerts/ sporting events, etc., rush hour traffic, road surface condition, presence of crowds, etc. For instance, a person going to the grocery store may want to avoid portions of the usual route that intersect with the route of a parade taking place at that time. In most cases, individuals receive no advance notice of potential adverse factors impacting a given travel route and therefore cannot proactively avoid routes with potentially problematic travel parameters.

In some cases, the impact of such factors on a person's travel plans can depend on the specifics of the person's travel circumstances, such as travel mode (e.g., walking, biking, driving, etc.), vehicle characteristics (e.g., weight, height, fuel efficiency, powertrain capabilities, etc.), physical abilities (e.g., visual or hearing impairments, mobility restrictions), etc. However, routing guidance from navigation applications is not personalized to such specifics of the user's travel circumstances.

DESCRIPTION

This disclosure describes techniques to deliver travel routing guidance personalized to a user. To provide personalization, user permission is obtained to access user-specific parameters related to travel routing. Users are provided with options to choose the parameters to permit access to and to deny access entirely and turn off personalization with permission. If users permit, the personalized guidance is based on various specifics of the user's travel circumstances such as physical abilities, vehicle characteristics, etc. For instance, with permission, users with mobility restrictions can be shown routes with wheelchair accessible walkways and gentler inclines. Similarly, if the user permits, routes with presence of bridges or other structures with required clearance lower than the height of the user's vehicle can be avoided.

With user permission, route selection can be based on any of a number of vehicle characteristics. For example, routes that avoid long stretches without charging stations and/or routes that include charging locations with high-speed chargers can be preferred for electric vehicles, and shorter routes with slower speeds can be suggested for vehicles with speed limitations. Similarly, route guidance for bicycle users can give preference to routes that maximize the presence of dedicated bicycle lanes and differ based on whether the user plans to travel using a road bike, mountain bike, or gravel bike. For instance, a mountain bike can be deemed suitable for off-road travel paths and handle curb jumping, if required.

If the user permits, the personalized routing guidance is further adjusted to avoid one or more of a number of dynamic factors, such as weather, that can adversely impact specific routes at the time of the user's travel. For example, high-profile vehicles, such as Recreational Vehicles

(RVs), can be routed around roads currently experiencing high winds, and routes with snowy weather can be avoided (or such portions minimized) for vehicles with drivetrains that would necessitate the use of chains to traverse the route. Similarly, the routing guidance can help users avoid potential hazards resulting from weather-induced changes in road surfaces, such as underpasses and overpasses that accumulate ice or snow. Such dynamic adjustments can also route around temporary-but-extended dangerous conditions such as fires, floods, disease outbreaks, etc.

The dynamic adjustments can be applied to any travel mode, including walking. For instance, a user can be suggested a route that avoids walking directly into the wind, especially on a cold and/or rainy day, even if the route requires walking longer by walking around buildings or hills that help block wind and/or rain. The routing guidance can be pet-friendly (if the permitted parameters indicate that the user is walking a pet), suggesting routes suitable for walking with pets. For instance, routes with shade can be preferred when walking with a dog on a hot day in order to avoid the risk of the dog's paw burning on paved surfaces exposed to direct sunlight.

The routing adjustments can incorporate dynamic events and activities other than the weather. For instance, if users permit, route guidance for any travel mode can avoid suggesting routes that are likely to be temporarily blocked and/or crowded because of ongoing situations such as parades, concerts, protests, sporting events, etc. Many such situations often recur periodically and are known in advance, such as celebrations connected to public holidays such as Independence Day, games at sporting stadiums, concerts at venues, exhibitions at museums, etc. Proactively avoiding routes that cross such events can be more efficient because the routing change can take place even before the area experiences event-related traffic jams.

Additionally, the dynamic adjustments to routing guidance can be based on typical characteristics of the route and the areas it passes through. Such characteristics can include: crime levels, crowdedness, noise, pedestrian traffic, air quality (pollution, smog, etc.), frequency of accidents, number of distractions (e.g., billboards), etc. For instance, routes with increased pollution and smog can be avoided for regular biking activity, with preference given to routes that pass through nature and have better air quality. On days with acute air quality problems, such as smoke from wildfires, users can be warned to avoid biking and provided car routes that bypass congested highways.

The routing guidance can be personalized by taking into account user preferences and relevant contextual information, such as the user's residence, current location, routines, etc. if access to such information is permitted by the user. For instance, route selection can differ across users based on differences in risk tolerance or routine experiences. For example, a first group of users may be more accepting of routes that pass through areas with high levels of crime while a second group of users may prefer to avoid such routes. Routing guidance for the first group of users can provide routes that pass through such areas under normal circumstances, but can route around these areas when there is an ongoing situation, such as a police chase, helicopter search, suspect on the loose, etc., while the second group of users are always provided routes that avoid high crime areas. Users can provide such preferences, and in the absence of known preferences, routes with higher safety ratings are prioritized.

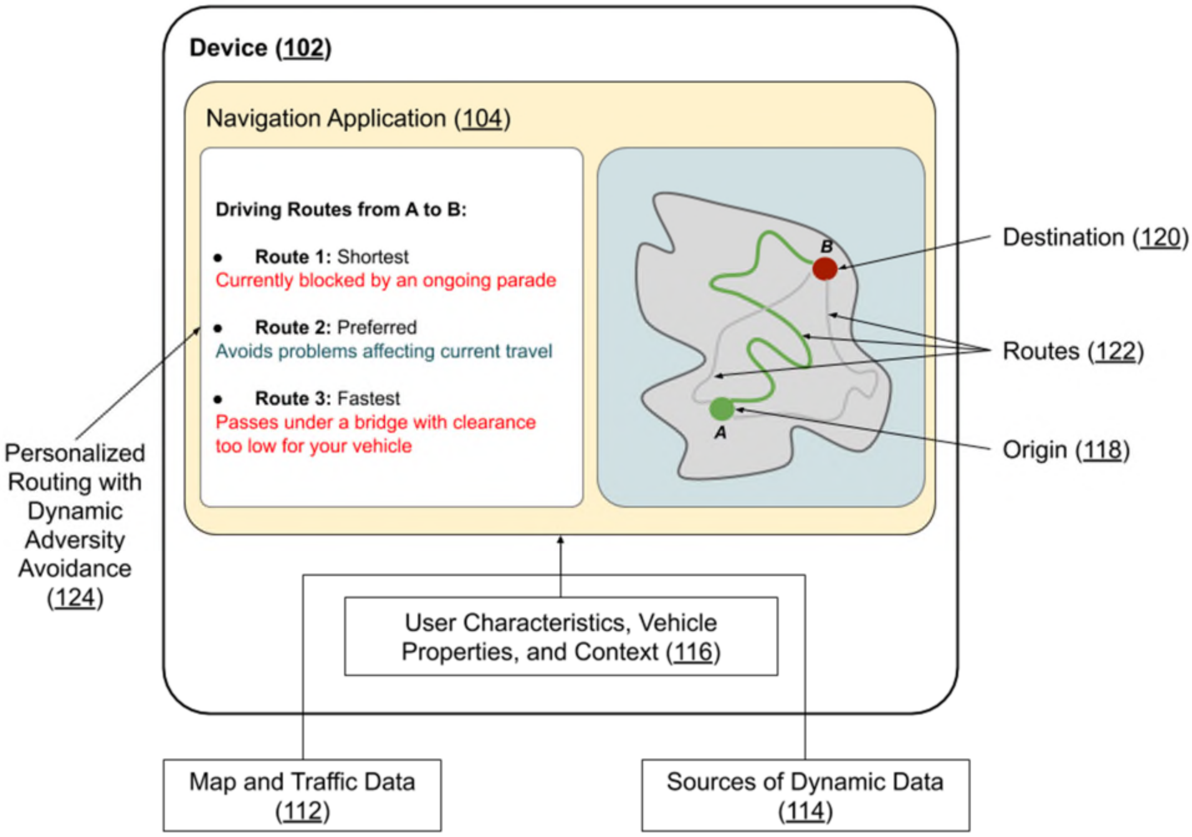

Fig. 1: Personalized routing guidance that avoids adverse situations

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure. A user seeks routing guidance to drive from an origin (118) to a destination (120) within a navigation or digital maps application (104) on a device (102). With the user's permission, the application provides personalized routing that dynamically avoids current adverse situations (124) based on taking into account user characteristics, vehicle properties, and context (116), obtained with permission and combining them with map and traffic data (112) and other relevant data on dynamic situations (114), such as weather, social media feeds, police alerts, etc. As Fig. 1 shows, the recommended route (route 2) avoids the shortest route currently blocked by a parade (route 1) and the fastest route that crosses a bridge too low for the user's vehicle (route 3).

The techniques described above can be realized by employing suitable edge-scoring and edge-ranking functions that take into account the various user characteristics and situational characteristics mentioned above, accessed with user permission, and determine optimal paths suitable for the specific requirements and current conditions. For instance, the edge-scoring function can assign a lower weight to intersections that are likely to cross the route of the upcoming marathon or sidewalks that are likely to be hotter because of a lack of shade. The dynamic edge scores used by the functions can be derived via any suitable technique, such as telemetry collection, machine learning, social media feed scraping, police radio scans, etc.

Information regarding such dynamic personalized adjustment to upcoming and/or ongoing travel routes can be delivered to users in appropriate visual and/or auditory and/or tactile form. For instance, spatial audio played in earbuds can convey direction of potential problems along the route and provide spoken instructions on routing adjustments along with the rationale for the change. Similarly, haptic feedback delivered by smartphone and/or smartwatch vibrations can indicate the degree of difficulty due to upcoming change in conditions, such as changing from asphalt to gravel when biking or driving into snowy weather. With user permission, the optimal delivery mechanism can be determined via suitable algorithms such that the user is not flooded with simultaneous notifications on numerous devices. Further, if it is detected that the user is utilizing an augmented reality/ mixed reality device, e.g., wearable glasses, notifications and/or routing guidance as augmentations in the user's field of view.

Such multimodal notifications can also be proactively pushed to one or more user devices by inferring the intended upcoming route based on contextual information, such as current location, movement, routine travel patterns, day and time, etc., obtained with the user's permission. If users permit, the push notifications can be generated even without users seeking explicit routing guidance via a navigation application. The notifications can be particularly useful in such cases because the user is otherwise unlikely to be aware of unexpected adverse circumstances currently affecting a route they usually traverse without encountering the specific problems.

The techniques described in this disclosure operate in a manner opposite to approaches that recommend scenic routes to create aesthetically pleasing travel experiences. In contrast, the described techniques help users avoid routes with various contextual and dynamically altering adverse aspects based on user characteristics, preferences, and contextual travel parameters. The described techniques can be implemented within any application, platform, service, or device that provides routing guidance between an origin and a destination. For example, the techniques can be implemented in a digital maps/navigation service, a search engine, a virtual assistant, or other suitable software. Implementation of the techniques can improve the quality and effectiveness of routing guidance, thus enhancing the user experience (UX) of travel.

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 travel, route history, route search, calendar, a user’s preferences, or a user’s current location), and if the user is sent content or communications (e.g., notifications, alerts) 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

This disclosure describes techniques to proactively deliver travel routing guidance personalized to a user, based on user-permitted contextual factors. If the user permits, the personalized routing guidance is adjusted to avoid one or more of a number of dynamic factors that can adversely impact specific routes at the time of the user’s travel. With user permission, route guidance can be generated passively, without an actual request from the user, and notifications or alerts can be proactively provided to the user. The route guidance can be obtained by employing suitable edge-scoring and edge-ranking functions that take into account the various user characteristics and situational characteristics and determine optimal paths suitable for the specific requirements and current conditions.