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Context aware routing for automobiles

Hilary Richardson

Maxwell Sills

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ABSTRACT

Routing of automobiles is typically based on user-provided input such as starting point, destination, intermediate point, etc. Such user-provided input itself arises from some user constraints, e.g., a meeting at the destination, a pick-up at the intermediate point, etc. Further, vehicle parameters, e.g., fuel level, can influence the route. This disclosure describes creation of vehicle routing plans based on user constraints and vehicular state. User constraints can be expressed directly by the user, e.g., to a virtual assistant, or determined based on permitted user data, e.g., from the user's calendar. Routing plans tailored to user context are more efficient and intuitive.

KEYWORDS

- route planning
- maps
- virtual assistant
- self-driving car
- calendar
- vehicle OS
- user constraints

BACKGROUND

Routing plans for automobiles, e.g., passenger cars, are determined based on user input, e.g., stated starting point, destination, etc., and are optimized for traffic conditions, with options for minimizing travel time or distance, etc. Routing plans are subject to user constraints. For example, a user selects a destination for specific purposes, e.g., to attend a meeting at that location. Routing plans also depend on the state of the vehicle. For example, if the vehicle is nearly out of fuel, the route changes to accommodate a visit to a refueling station.

DESCRIPTION

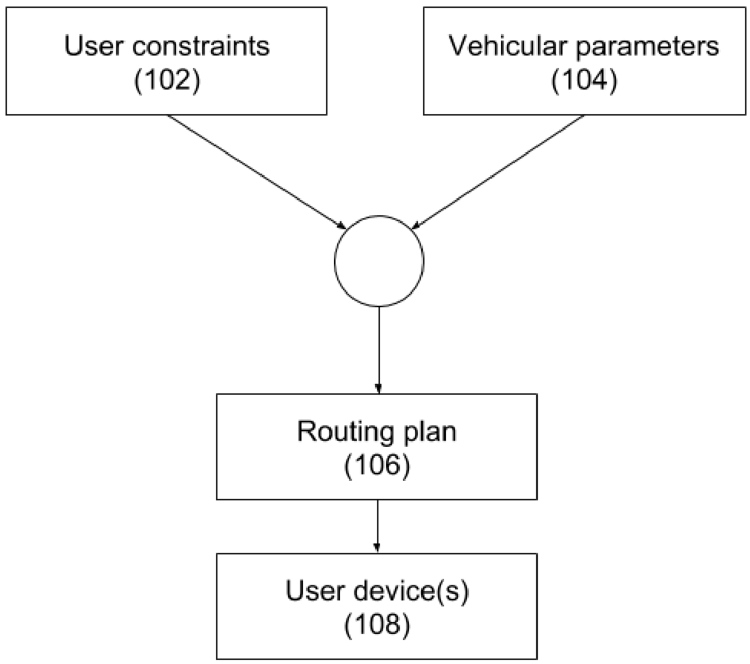

Fig. 1: Context-aware vehicle routing

Fig. 1 illustrates generation of a context-aware routing plan per techniques of this disclosure. User constraints (102) and vehicular parameters (104) are integrated to determine context for route plan (106). User constraints are determined based on permitted user data. The route plan is made available to one or more user devices (108). Examples of user devices include smartphone, smartwatch, virtual assistant, self-driving car, etc.

User constraints include constraints directly stated by the user to a route planner, e.g., start-point, destination, intermediate points, tasks to be carried out during the course of the route, events that are to be attended, etc. With user consent and permission, user constraints also include user data such as calendar, user preferences (e.g., shopping destinations), etc. Users control the user data that is used for determination of user constraints and are provided with options to deny use of user data. Data permitted by the user is utilized only for route planning purposes.

Vehicular parameters include parameters tracked by an onboard operating system, a paired mobile device (e.g., smartphone connected to automobile using Bluetooth), on-board computer vision system, etc. Examples of vehicular parameters include speed, fuel level (e.g., gas level, battery state, etc.), current location, currently planned route, traffic conditions, etc. Vehicular parameters also include local environmental parameters, e.g., traffic conditions, pedestrian crosswalks along the route, locations of beacon signals, etc. Vehicular parameters are obtained with consent and permission of the user of the vehicle.

Benefits of context-aware route planning, per techniques of this disclosure, are illustrated by the following examples.

Example 1: A user wishes to attend a meeting at work. The user instructs a virtual assistant "I need to attend a meeting at location X in half hour." The virtual assistant plans a route based on the user instruction and available information regarding local traffic conditions. The user's vehicle reports that it needs to be refueled. The virtual assistant assesses the available time for the user to reach location X to attend the meeting and determines that it is feasible to refuel prior to the meeting. The route is then automatically adjusted (if permitted by user settings) to include a stop at a refueling station and provided to the automobile. In this example, user constraints are stated directly to the route planner, and vehicular parameters include fuel level and traffic conditions.

Example 2: On the way to a destination where she is expected in an hour, a user instructs a virtual assistant thus: "I need to do my groceries." The virtual assistant assesses local traffic conditions and distance to destination, identifies the nearest preferred grocery store (based on permitted user preference data), and determines that a trip to the grocery store is feasible in the available time. It then calculates a route to include a stop at the grocery store and suggests to the user the available time for grocery shopping, using the modified route. If the user accepts the suggestion, the new route is provided to the automobile.

Example 3: User constraints can be specified by multiple users, with prior permission of each such user to apply their constraints jointly with each of the other users. Users Alice and Bob set up a meeting with each other on their calendars and shared their calendars with each other. With permission from both users, it is determined that the meeting is scheduled at a particular location. Further, in this example, Alice and Bob have each independently consented to share their locations with each other and permitted their respective virtual assistants access to the shared data for use in route planning. As the time for the meeting nears, each virtual assistant treats the scheduled meeting as a single constraint. Each virtual assistant alerts the respective user, plans routes to the meeting location, and informs each user of any delays experienced by the other user(s). In this example, user constraints arise from multiple users, and are obtained from a calendar of the respective user. Vehicular parameters used in this example include vehicle locations, traffic conditions, etc. of the users.

The routing plan, as determined by the techniques of this disclosure, includes providing information to the vehicle and suggestions to the user. Users are provided with options to select the suggested routing plan or to decline the suggested change.

Example 4: A self-driving car determines that it is low on fuel, and further that there is insufficient time to refuel prior to the user's scheduled meeting (determined, with user permission, from the user's calendar). The car provides a suggestion such as "OK for me to drop you at the meeting and go for a twenty-minute refueling stop?"

Example 5: A virtual assistant (implemented in coordination with a self-driving car) determines that walking a few steps to the meeting spot is likely faster than driving to the meeting spot. It offers a suggestion to the user: "You'll reach faster if you walk forty meters from drop-off point. I can self-drive myself to a closer pick-up point when you are done with the meeting."

In situations in which certain implementations discussed herein may collect or use personal information about users (e.g., user data, information about a user's social network, user's location and time at the location, user's biometric information, user's activities and demographic information), users are provided with one or more opportunities to control whether information is collected, whether the personal information is stored, whether the personal information is used, and how the information is collected about the user, stored and used. That is, the systems and methods discussed herein collect, store and/or use user personal information specifically upon receiving explicit authorization from the relevant users to do so.

For example, a user is provided with control over whether programs or features collect user information about that particular user or other users relevant to the program or feature. Each user for which personal information is to be collected is presented with one or more options to allow control over the information collection relevant to that user, to provide permission or authorization as to whether the information is collected and as to which portions of the information are to be collected. For example, users can be provided with one or more such control options over a communication network. 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. As one example, a user's identity may be treated so that no personally identifiable information can be determined. As another example, a user’s geographic location may be generalized to a larger region so that the user's particular location cannot be determined.

CONCLUSION

This disclosure provides techniques to determine the route of a vehicle in a context-aware manner, e.g., under constraints stated by the user and under present vehicular parameters. User constraints include explicit user instructions provided to the route planner and user permitted data such as calendar data, mapping data, user preferences, and data from other applications that the user consents to provide for the purpose of route planning. Vehicular parameters include parameters determined by an on-board operating system, computer vision system, GPS, etc. that are permitted for use during route planning. Route planning in a context-aware manner, per the techniques of this disclosure, provides a user options to avail of efficient routes that meet user constraints.