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Vehicle Route Suggestions In Snow Conditions

ABSTRACT

This disclosure describes techniques for a navigation system to present suggested driving routes for a vehicle that may include roads subject to snow conditions. Under weather conditions that include snow, road conditions such as presence of snow on the road, road steepness, and road width are checked to determine the safety of a road and whether the road is preferable under the weather conditions. Described features inform and guide a user in determining a safe and quick route for a vehicle in potentially unsafe travel conditions.

KEYWORDS

- Car navigation
- GPS navigation
- Digital maps
- Driving conditions
- Weather aware navigation
- Road conditions
- Snow conditions
- Snow mode
- Route finder

BACKGROUND

Drivers of cars and other vehicles often use global positioning sensor (GPS) enabled navigation features, e.g., available via in-car navigation systems, smartphones, or other devices to determine their geographic location and obtain a route to a destination. Such devices typically display a map with the vehicle's current location and suggest routes over particular roads to destinations specified by the user. In some cases, a device may utilize data regarding current vehicle traffic on nearby roads and calculate and display the fastest routes to the destination that take into account delays that may be caused by the current traffic conditions.

However, when determining the fastest routes, current navigation guidance techniques do not take into account road conditions such as the presence of snow or ice on the road. Snow- or ice-covered roads can be dangerous for driving; for example, snow may cause a vehicle to get stuck, or snow and/or ice may cause a vehicle to slide out of control, especially when the road is on a grade such as a hill. Snow- or ice-covered roads may even trap a vehicle if the road is narrow and there is no room to turn the vehicle around, or if an inexperienced driver cannot reverse direction for a sizable distance.

DESCRIPTION

This disclosure describes features enabling a navigation device to calculate and display suggested vehicle routes to a particular destination taking into account road conditions such as the presence of snow or ice on the road. Features also include the device additionally taking into account other conditions when determining suggested routes, such as steepness of roads, road width, traffic, and current weather. The described features can be built into an in-car dedicated navigation system, incorporated into a navigation or mapping app (e.g., on a smartphone), or provided as a separate app in communication with other apps.

The described techniques are implemented upon specific user permission to access a user's data, e.g., current location, destination, route request, user preferences, vehicle size and/or capabilities, etc. Users are provided with options to grant and/or deny permissions to access such data, as well as to disable the features entirely. The user can enable or disable techniques discussed herein for particular vehicles, locations, time periods, or for other conditions.

Determining Suggested Driving Routes

A suggestion mechanism can be implemented on a user device such as a smartphone or navigation device to provide vehicle route suggestions. For example, the user can input

commands and/or information that indicate a particular destination and request suggestions as to which route to take to the destination. In some cases, the user can also input information that indicates preferences that may influence the routes that are suggested for the user, such as a request for the fastest route to the destination, the shortest route to the destination (in distance), routes that exclude freeways, etc.

Potential routes to the specified destination are determined based on these input commands and information. For example, if the user has requested a fastest route to the specified destination, suggested routes are determined by checking the distance via different roads to the destination and also checking road conditions such as traffic that may affect the time of travel to the destination.

Road conditions may be checked by obtaining road condition information. For example, such information can be retrieved from data sources on a wireless network and/or internet, e.g., map and traffic data from a map source, road condition information from state or municipality sources, information from other users (obtained with specific permissions and aggregated by an app), etc. An estimated time of arrival at the destination is calculated for each potential route based on the distance of the route, a particular speed of travel (e.g., at speed limits of the roads), current traffic conditions, etc. In another example, if the user has requested a shortest route in distance, routes are determined based on the lengths of roads to the destination and without considering travel time. If the user requests non-freeway routes, routes are determined that exclude freeway roads.

Per techniques of this disclosure, the user can also input a preference (e.g., a command to enter a “snow mode”) that requests that suggested routes exclude roads that are likely affected by

snow conditions. In some cases, snow mode causes exclusion of roads that have icy conditions or similar conditions as well, or the user can specify to exclude such roads.

If the snow mode is requested by the user, information that indicates snow conditions of the roads that are included in routes to the specified destination is accessed. The information can be obtained from various available data sources, e.g., weather information, local road information, etc. Such information can be obtained over wireless networks and the internet, e.g., at the time the snow mode is commanded by the user, or can be preloaded to local storage of the user device at an earlier time, e.g., before the current trip was started, at a previous location in the current trip, etc. The information can include the amount of snow that has fallen or is expected to fall. Road information, such as state and municipality information about road cleaning and plowing, including a list of roads that are prioritized for such operations, and/or which roads have been recently plowed and cleared of snow is obtained.

Based on the accessed information, roads that have current snow conditions are excluded when determining suggested routes, and/or routes that include snow-condition roads are excluded from a set of suggested routes that are presented to the user. Alternatively, e.g., based on settings specified by the user, routes that include such snow condition roads can be reduced in priority and ranked lower than other routes in a list of suggested routes presented to the user. In some examples, the excluded roads may include roads that are unplowed or uncleared snow-covered roads, and/or snow-covered roads that have not been plowed for at least a threshold amount of time during snowfall weather conditions. For example, a set of the three fastest routes to the specified destination may be determined such that none of the routes include snow-covered roads.

In some cases, e.g., based on user-specified preferences or settings on the device, roads are excluded or included in the suggested routes based on the degree of snow condition and/or based on other road conditions or characteristics. Some examples of the degree of snow conditions include the amount of snow that has fallen. For example, if more than a threshold amount of snow has fallen on the road (e.g., 1 inch), the road is excluded from suggested routes. Some system settings exclude roads with any amount of snowfall, and other settings exclude roads with snowfall that has turned to ice, e.g., which can be determined based on weather conditions, comments from other drivers (obtained with respective permission), etc. If less than a threshold amount of snow has fallen on a road, such roads may be included in the suggested routes, along with a notification about the amount of snow.

Another example of a road condition that may cause a road to be excluded from suggested routes is one or more hills being present on the road. A steep hill on a road in snow or ice conditions can be difficult or dangerous for driving, e.g., may cause a vehicle to uncontrollably slide when stopping or starting from a stop. Information that indicates the steepness of hills on roads, e.g., map and altitude data, is accessed and utilized to identify such roads. If a road has greater than a threshold steepness and also has a snow condition, it is excluded from suggested routes. User options can cause roads to be excluded if the steep hills on those roads are uphill in the direction of travel, while roads having steep hills in a downward direction in the direction of travel may be included in the suggested routes.

Another example of a road condition that may cause a road to be excluded from suggested routes is a small width of a road. The width of roads along various determined routes can be checked e.g., based on accessed GPS data and/or other information, and routes that include roads having less than a threshold width and which have snow conditions are excluded,

thus avoiding routes with narrower roads which are often less likely to have been plowed and thus may be less safe. Users may choose options to always exclude a narrow road having snow conditions, e.g., since there is less room to turn a vehicle around and reverse its direction if obstacles (e.g. vehicle accidents) occur on the road. User settings may also allow the width of the road to be ignored if information is available that indicates that the road has been recently plowed or is otherwise clear of snow.

In some cases, road cleaning priority information, e.g., state or municipality information, may be accessed and utilized for route determination. Based on the priority of the road to be cleaned or plowed, the relative safety of the road is estimated, e.g., a high priority road is more likely to be safe.

Another example of a road condition that may cause a road to be excluded from suggested routes is a high amount of traffic on the road. Traffic conditions can be checked, e.g., based on traffic data and/or other information that indicates a current amount of travel speed on various roads. Routes that have snow conditions and have a threshold amount of traffic, e.g., as indicated by traffic that causes a threshold amount of delay in travel time, are excluded. Traffic information is also used to determine whether a road is difficult to travel. If a road is subject to snow weather and has a large traffic delay that is out of proportion with delays on nearby roads, or out of proportion with historic delays on that same road at equivalent times (as indicated in available historical data), it is determined that snow conditions may be severe on that road. The road is then excluded from suggested routes.

After determining suggested routes based on road information and snow conditions as described above, the suggested routes are provided to the user.

Examples of Outputting Suggested Route Information

The output of the suggested routes by a navigation device can be provided via visual display and/or audio output, and in various formats, e.g., map format, turn-by-turn directions in text or words, etc. For example, suggested routes can be displayed overlaid on a map that is displayed on a display screen of the device or connected to the device. One suggested route can be displayed (e.g., the top ranked route), or multiple suggested routes can be displayed, e.g., a number of top ranked suggestions that fit the user's settings and criteria (shortest, fastest, etc.). If multiple routes are displayed, a user can select a route by tapping or otherwise selecting a particular displayed suggested route. This causes additional information related to the selected route to be displayed, e.g., travel time, expected time of arrival, current traffic, etc.

Some device settings can allow the device to display visual markings and information for suggested routes that have roads with various conditions. For example, steep grades can be marked with appropriate information, and/or snow and ice can be distinguished on the display. This enables the user to take into account such information when selecting a particular route from the provided routes.

Fig. 1 shows an example user interface (100) that includes suggested routes to a destination and other information related to the suggestions. The display is provided on a display screen of a user device such as a navigation device in the user's vehicle or a smartphone or other device of the user. In this example, the vehicle is currently at a starting location (101) and the user has requested the fastest vehicle route to a destination location (102). Furthermore, the user has enabled the "snow mode" which specifies settings to exclude roads in snowy conditions and that are steep and/or are narrow roads.

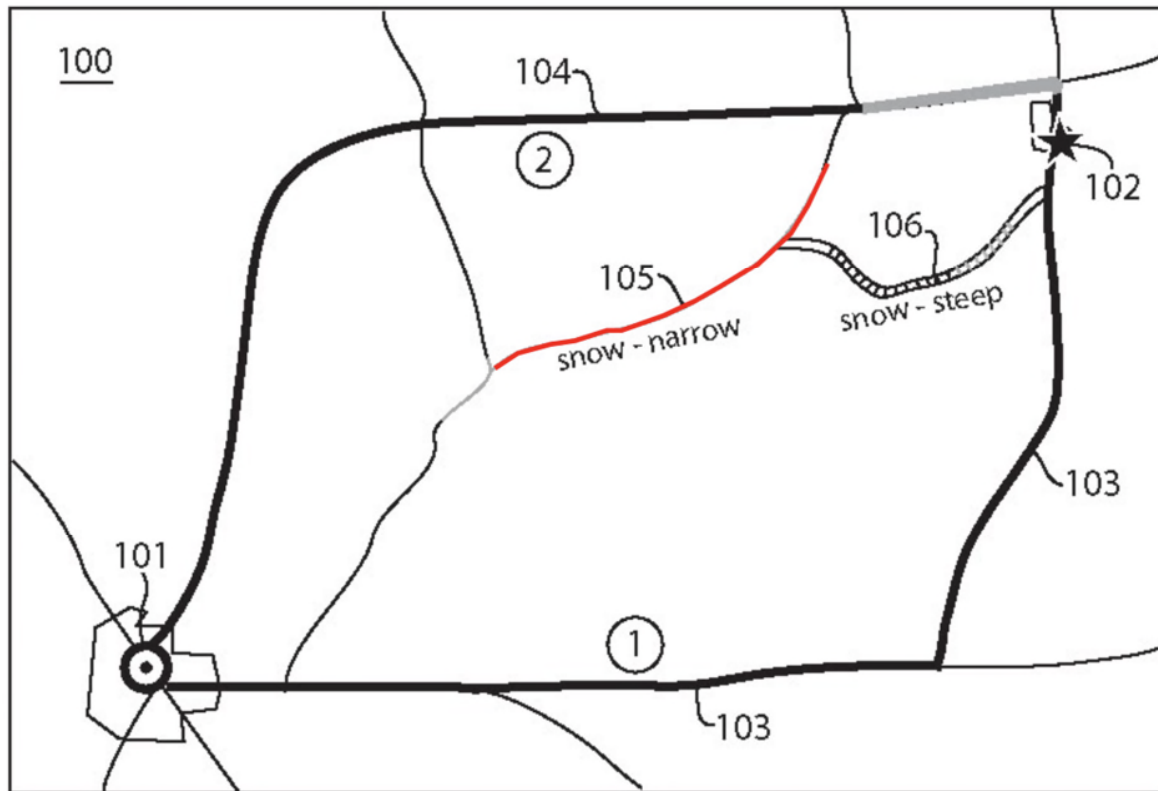


Fig. 1: Example user interface with suggested routes in snow conditions

Different types of information, as listed above (e.g., the current speed of travel on various roads, other traffic information, current weather and road conditions), etc. is accessed and utilized to calculate routes that have the lowest travel time and which meet the other conditions preferred by the user (e.g., avoid snowy roads, avoid steep roads, etc.).

Two suggested routes are presented that meet the specifications, Route 1 (103) and Route 2 (104) to the specified destination. Route 1 that is subject to snow weather is provided based on determination that it has been plowed within the last half hour and thus is clear, and traffic is moving well on this route. Route 2 is not subject to snow weather but has traffic delays near the destination, and so has a longer travel time than Route 1. Route 1 is presented as the first ranked suggestion and Route 2 is presented as the second ranked suggestion.

Information about other roads in the area that were excluded from suggested routes is also presented, if appropriate. For example, one road (105) is displayed including a portion having a different color (shown in red) to indicate snowy conditions (e.g., snow has not been cleared recently), and also has an associated label indicating that the road has snowy conditions and is a narrow road. Another road (106) is displayed including a marked area to indicate snowy conditions as well as steepness. In this example, uphill steepness (e.g., uphill in the direction toward the destination) is displayed in one color and downhill steepness is displayed in a different color. Further, this road has an associated label that indicates the snowy condition and steepness. The user can review this information and judge individually which of the routes to take in view of the road conditions..

The driving route suggestion techniques as described herein identify suggested routes using information from various sources that relate to weather, travel time, traffic, and road conditions. The techniques can be implemented on a user device, e.g., a mobile device, an in-vehicle navigation system, etc. If user permission is obtained, the techniques can be implemented on a server that is in communication with a user device.

The route suggestion techniques are implemented with specific user permission to access user data that serves as input. Users are provided with options to indicate permission or denial of permission for access to various data, e.g., contextual factors of the user such as time, location, etc. Certain techniques are not implemented if the user denies permission.

Further to the descriptions above, a user is 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., a user's current location, destination, routes viewed, routes taken, speed 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

This disclosure describes techniques for a navigation system to present suggested driving routes for a vehicle that may include roads subject to snow conditions. Under weather conditions that include snow, road conditions such as presence of snow on the road, road steepness, and road width are checked to determine the safety of a road and whether the road is preferable under the weather conditions. Described features inform and guide a user in determining a safe and quick route for a vehicle in potentially unsafe travel conditions.