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Contextually-Relevant Vehicle Advertising

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ABSTRACT

Existing approaches to adapt advertising messages on vehicle-mounted displays based on location rely on static demographic information about the area. Such approaches do not take into account changes in relevant contextual factors connected to the current location of the vehicle at a given time. This disclosure describes techniques to automatically select and display contextually relevant messages, such as advertisements, on vehicles. The messages are dynamically updated based on relevant changes in the vehicle's context, such as location, time of day, day of the week, people in the vicinity, local events, current advertising needs of businesses, etc. If the route of a vehicle is known in advance fully or partially, the set of messages for the route can be pre-selected. When the route for a vehicle is flexible, the techniques can be utilized to select routes based on advertising needs.

KEYWORDS

- Vehicle advertising
- Transit media
- Advertising sign
- Dynamic advertisement
- Contextual relevance
- Real-time advertising
- Geographical cell
- Advertising conversion

BACKGROUND

Moving vehicles, such as buses, taxis, trucks, ridesharing cars, etc., are often fitted with signs with various messages, such as advertisements, public service announcements (PSAs), etc. Such messages are static if they are permanently attached or painted. However, the messages can be dynamic if they are delivered via mechanisms such as electronic signs or billboards. However, such changes in the messages are typically performed using manual approaches or automation strategies based on relatively crude approaches, such as a timer.

The existing approaches to adapt the messages displayed on a vehicle rely on static demographic information about the area. Messages are typically not adjusted based on changes in relevant contextual factors for the current location of the vehicle at a given time, such as the people, ongoing events, advertising campaigns, and business needs at that location.

DESCRIPTION

This disclosure describes techniques to display contextually relevant messages, such as advertisements, on frequently moving vehicles, such as buses, taxis, trucks, ridesharing cars, etc. The messages are dynamically updated based on changes in the vehicle's context, such as location, time of day, day of the week, people in the vicinity, local events, current advertising needs of businesses, etc.

Such dynamically updated contextual messaging is constructed by partitioning relevant data (obtained with user permission) based on fine-grained cells or geographic regions, e.g., neighborhoods. Such data can be static, such as demographics of residents that live within the region; or dynamic, such as preferences, shopping history, web searches, etc., obtained with user permission. The latter type of data can be used, for instance, as an indicator of current trends and demands. The static and dynamic data for the cells relevant for the vehicle's current location and trajectory is used to select relevant messages to show on the vehicle's message display.

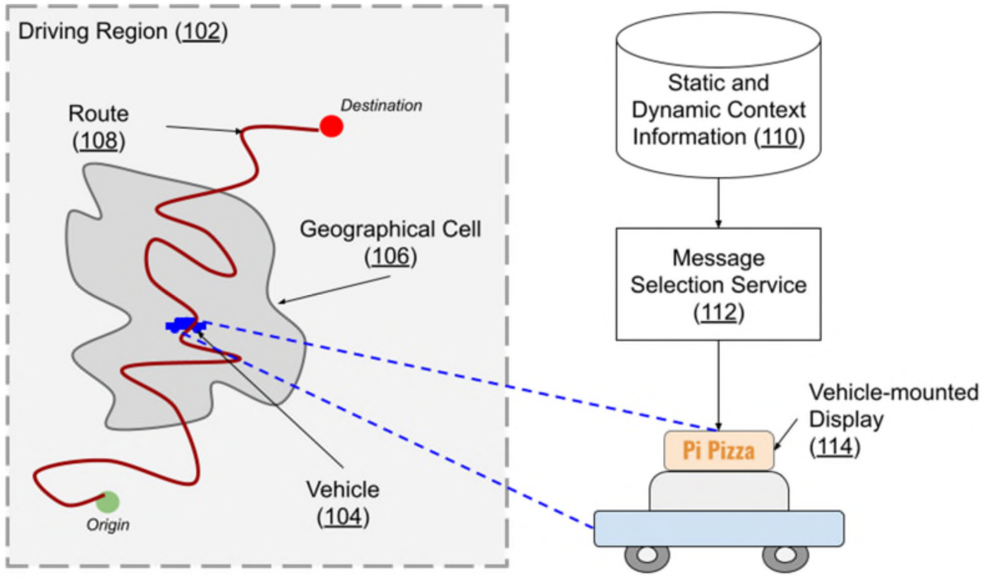

Fig. 1: Updating contents of a vehicle-mounted display with a contextually optimal message

Fig. 1 shows an operational implementation of displaying contextually optimized messages on a moving vehicle, per techniques described in this disclosure. A vehicle (104) is in a driving region (102), moving from an origin to a destination along a route (108) that passes through a geographical cell (106). The vehicle is mounted with a display (114) capable of showing messages that can be changed dynamically.

The message that is displayed at any given time is obtained from a message selection service (112) that selects a contextually optimal message based on static and dynamic context information (110) on the geographical cell. For example, such information can include aggregated information about people and businesses within the cell, obtained with appropriate permissions. In the example of Fig. 1, the message is an advertisement for a pizza restaurant “Pi Pizza:” that is within the geographical cell and has available capacity to serve customers for the upcoming lunch hour. As the vehicle progresses along the route, the message is automatically updated to a different message if the advertisement of the pizza restaurant is no longer relevant based on factors such as the vehicle's location, time of the day, occupancy of the pizza restaurant, etc.

With permission, the consideration of relevant context can be further narrowed by considering only the aggregate relevant static and dynamic information regarding individuals who can view the message displayed on the vehicle. For example, such narrowing can be achieved by the use of appropriate 3D models of the geographical area, including occlusions. With user permission, location of an individual relative to the vehicle can be used to determine whether the individual can view the displayed message. Such an approach can be used to enable businesses to specify advertisement delivery based on aggregated demographics of individuals who can view the message on the vehicle.

As mentioned earlier, if users permit, the displayed messages can be updated based on dynamic changes in the real-time conditions as the vehicle moves around. For instance, such updates can be based on changes in advertising needs of local businesses. For example, it might be more appropriate to advertise a restaurant with available seating than one that currently has a long wait. Such dynamic updates can be supported by permitting businesses to provide real-time bids for advertising purchases for specific times, with the advertisement to be displayed for a specific amount of time when shown. Alternatively, or in addition, the updates can be based on relevant local context data, with businesses bidding by setting threshold bid amounts based on real-time business conditions, such as occupancy, store footfall, etc.

If the route of a vehicle is known in advance fully or partially, the described techniques can be adapted to pre-select the optimal set of messages for the route. Apart from the contextual factors mentioned above, determination of relevance and display duration for a given message for known fixed routes can take into account route-related factors such as context information for geographic cells that the route passes through, trip length, stops, predicted conditions at the time of transit of the vehicle along a specific section of the route, etc. Businesses can bid on advertising based on various factors such as vehicle location, current time, advertising duration, etc. With such an approach, the message selected while the vehicle is passing through a residential neighborhood can be changed when the vehicle exits the neighborhood and enters a business district. Similarly, a restaurant advertisement can be restricted for display if the vehicle route passes through segments in the vicinity of the restaurant before typical meal times, or a hotel advertisement can be displayed late at night along routes near an airport.

When the route for a vehicle is flexible, e.g., as for an unoccupied ridesharing car or taxi, the techniques can be applied in a reverse manner, e.g.,, to select an optimum route for showing one or more messages. The route can additionally specify optimal stops along the route along with the duration of the stop. Such an approach can route the vehicle through specific areas that an advertiser wishes to reach.

For instance, a business can request that vehicles with its advertisements be routed through areas where their brand is used less and/or where rival brands are dominant. Such routing can be determined based on brand penetration and brand interest information. Any suitable algorithm can be used to determine a route and associated stops that maximize the expected relevance of viewing the advertisement along a given route. The approach is similar to navigation selection in map applications with the route between a given source and destination being selected based on one or more of the following criteria: advertising relevance, expected advertisement views, driving time, etc. Time constraints permitting, the navigation algorithm can be configured to add suitable stops along the route to maximize the time spent in the areas that are likely to generate the greatest advertising views.

Candidate routes of target fixed durations with recommended stops can be constructed using approximation algorithms (e.g., those used for NP-complete problems, such as traveling salesman). For example, a relevant question in this context is: given an amount of time T, and traveling for at most M miles, find the route that maximizes the sum of advertisement view-relevance scores (e.g., brand interest + 1/(brand penetration)) along that route. The contribution of each segment to the total score is the product of its ad view-relevance and the amount of time a vehicle spends driving on it or being parked on the side.

The geographical cells can be sorted by their ad view-relevance scores, the top N cells picked, and different pairs of these can be selected as source and destination. A standard navigation algorithm can then be applied, except that instead of distance metric ("driving time"), the metric "ad view-relevance score" is optimized. The best K routes for a given source and destination can then be picked. The amount of time spent on the highest scoring segment is increased until the total trip time meets a threshold. Extra unused time can be spent on a subset of the top segments to increase geographic diversity or to incorporate a decay factor for stopping, say after M minutes (e.g., after the extra score contribution from that segment becomes 0).

Given a graph with some assigned weights (ad metric scores) and expected travel times for each segment, the algorithm is configured to find the path that maximizes the sum of (weight_i *time_i). A variation is given target time T, find a path that maximizes the sum of weight_i * time_i, with the option to add extra time to any segment (in the form of stops), and optionally, have a decay factor for this extra time so as not to assign all of it to the segment with the highest weight.

With user permission, the dynamic contextual data relevant for a given cell can be obtained in real time and/or predicted via machine learning models trained on historical data regarding preferences and practices under given circumstances. For instance, the number of vehicles and people outside during the winter might be fewer compared to that during summer. Such real-time and/or predicted information can be used to set prices for advertisements within a given geographic cell at a given time. For instance, higher prices can be charged for cells with denser populations, special events, estimated high affluence levels, etc.

The price associated with a message selected via the above described techniques can be derived wholly or partly from factors such as amount of display time, estimated number of viewers, locations and routes, speed of the vehicle, etc. For instance, the speed of the vehicle can affect the readability of the advertisement, thus influencing its impact on viewers. The various pricing approaches can be used to incentivize and reward vehicle operators for following driving parameters optimally suitable for the displayed message. For example, vehicle operators can be provided compensation as a percentage of the pricing of the displayed message, thus creating an incentive to select routes, speeds, stops, etc. that can maximize the advertising revenue from the messages chosen to be displayed on the vehicle.

With permission, individual and/or aggregated actions of individuals that are performed within a specified period after potential viewing of a message on a vehicle can be used as an indirect measure of advertising conversion. For instance, a group of users exposed to an advertisement on a vehicle at a given time and performed actions relevant to the content of the advertisements can be compared to an equivalent group of users that were not exposed to the advertisement. Alternatively, or in addition, conversion can be estimated based on changes in measures of brand interest and adoption (e.g., searches and shopping for that brand) in relation to the advertising displays of that brand on vehicles within a geographical cell within a given time period. Further, measures and estimates related to advertising conversion can be used to improve the machine learning models used to determine contextually appropriate messages or routes.

The described techniques can be utilized for any vehicle capable of showing a message on a display that can be dynamically updated at any given time. Such vehicles can include those owned privately, used for public transportation (e.g., buses), employed for gigs or business purposes (e.g., ridesharing, deliveries), etc. Implementation of the techniques can improve the relevance and utility of messages on vehicle-mounted displays, thus increasing the efficiency and effectiveness of matching business interests with user needs and enhancing the value of vehicle advertising or transit media campaigns.

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 purchases, a user's preferences, or a user's current location), 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 to automatically select and display contextually relevant messages, such as advertisements, on vehicles. The messages are dynamically updated based on relevant changes in the vehicle's context, such as location, time of day, day of the week, people in the vicinity, local events, current advertising needs of businesses, etc. If the route of a vehicle is known in advance fully or partially, the set of messages for the route can be pre-selected. When the route for a vehicle is flexible, the techniques can be utilized to select routes based on advertising needs.

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