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# Using Digital Maps to Find Shelter for Pedestrians and Cyclists During Inclement Weather

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## ABSTRACT

Walkers, runners, hikers, and bicyclists or other travelers that use non-motorized vehicles are at risk of being caught in bad weather. Currently, such users of a road or hiking/bicycling pathway need to find shelters on their own or ask locals or fellow travelers for advice. This disclosure describes techniques that enable road or trail users to find nearby shelters to stay in during periods of bad weather or in other situations where they may need to take shelter. With user permission, data from observed points where stops are made during bad weather events, geographic data, reviews and other textual materials, etc. are used to train a prediction model to generate route recommendations that include shelters. The identified route is provided in a digital map provided to the user. The map includes markings for shelters that are determined based on the form of transport.



## KEYWORDS

- Non-motorized transport
- Hiking route
- Biking trail
- Route recommendation
- Weather shelter
- Weather preparedness
- Digital map
- Geographical visualization
- Geoinformatics


## BACKGROUND

Walkers, runners, hikers, and bicyclists or other travelers that use non-motorized vehicles are at risk of being caught in bad weather, which can be at best inconvenient and at worst life-threatening. Currently, such users of a road or hiking/bicycling pathway need to find shelters on their own or ask locals or fellow travelers for advice.

DESCRIPTION

This disclosure describes techniques that enable road or trail users to find nearby shelters to stay in during periods of bad weather or in other situations where they may need to take shelter. Shelters along the road or pathway can be marked on a digital map provided to the user such that the user is reassured that the path they are about to take has multiple shelters available, if necessary, e.g., if weather conditions change and force the person to seek shelter from rain, lightning, high winds, etc. The advice regarding available shelters is customized to the form of the user's transport, e.g., walking, cycling, etc. Provision of the digital map is based on techniques that can be divided into two phases, a *training* phase and an *operating* phase, described below.

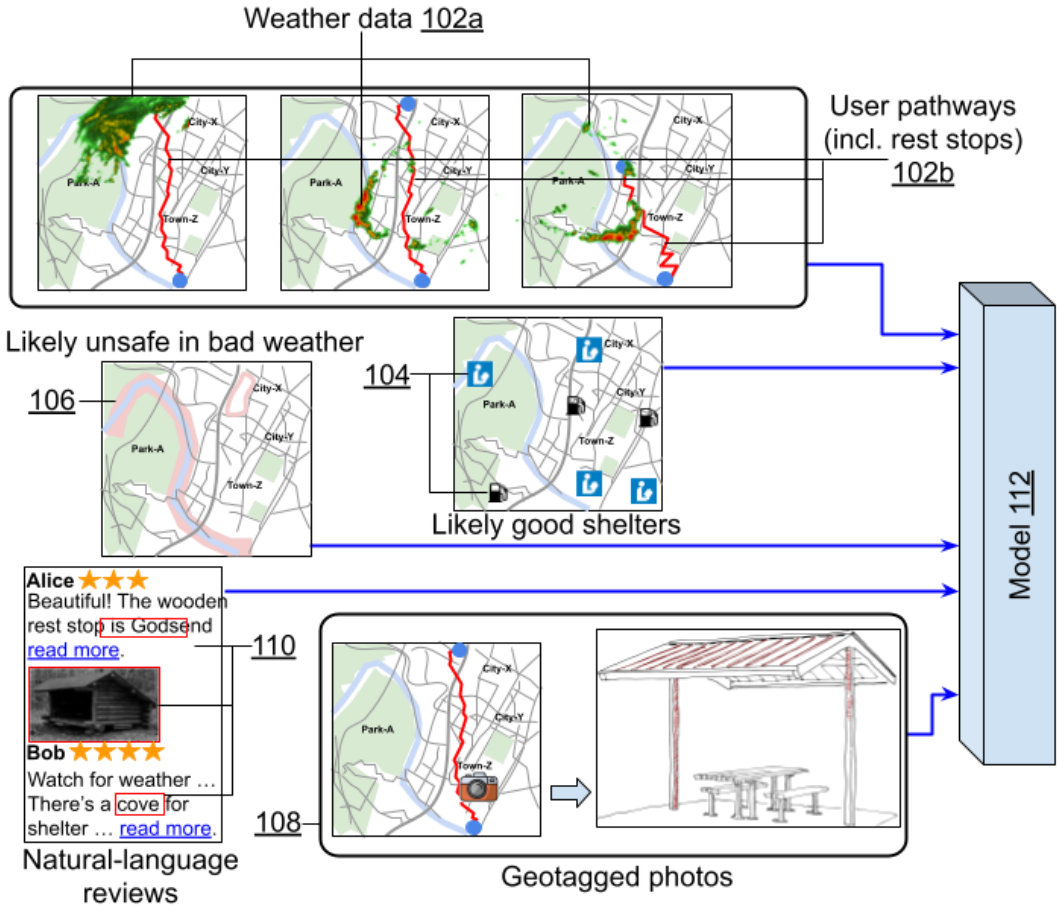
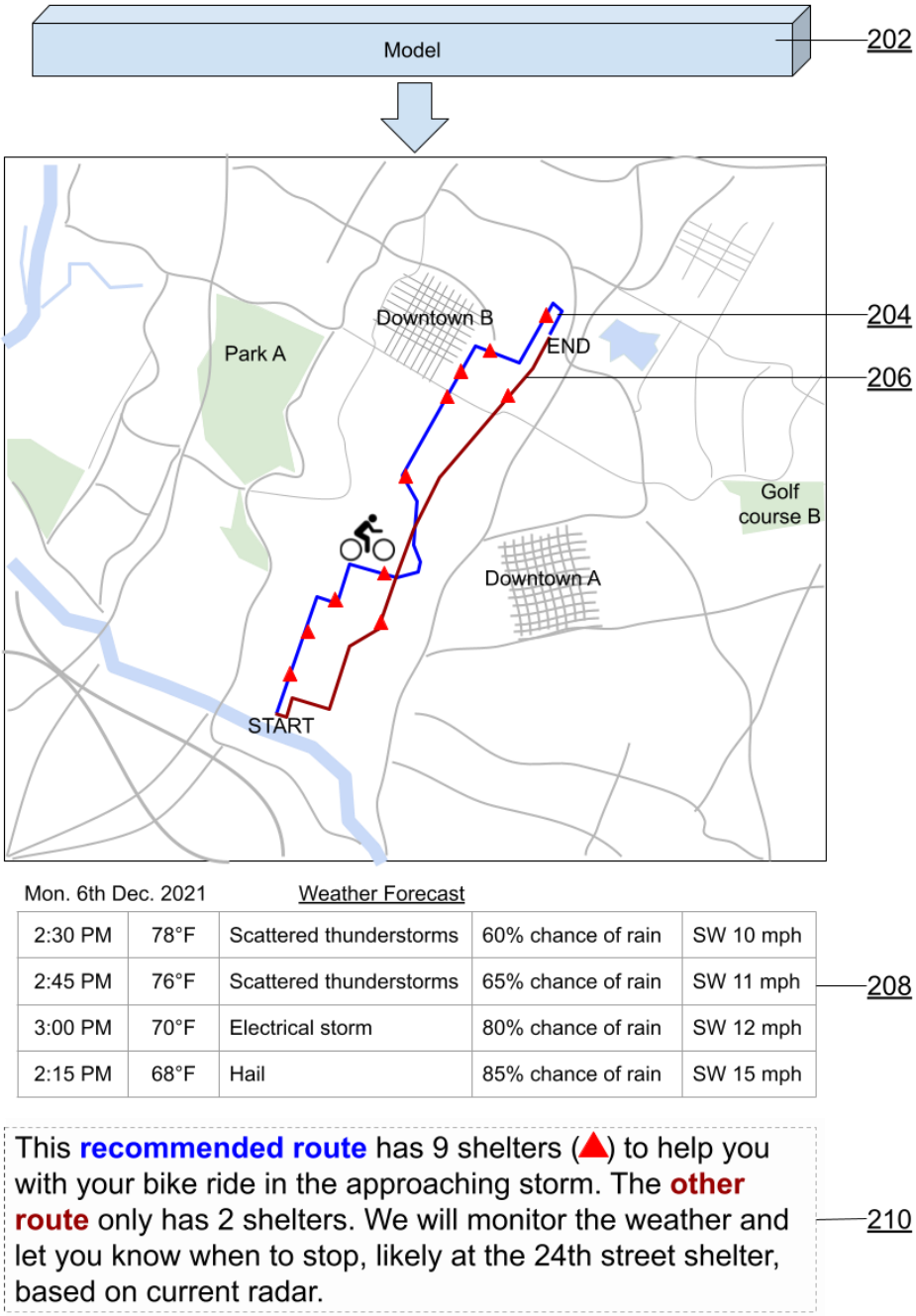



**Fig. 1: Training phase**

*Training phase*

During training, illustrated in Fig. 1, multiple types of data obtained with user permission are used to determine shelter locations suitable for walkers, cyclists, joggers, etc., and to train a machine learning model (112). Some types of data include:

- Observed points where users stop during weather events: With user permission, the paths taken by walkers, cyclists, joggers, and other non-motorized travelers (red, 102b) are noted alongside the weather data (102a) during their excursions to determine geographic points where users typically stop during weather events. The areas where users stop are associated (weighted) with particular weather events. Aggregation of these weights gives a crowd-sourced shelter map for a particular type of activity.
- Areas *likely* to be good shelters (104): Public information can be mined to find locations that are likely to be good shelters, e.g., public libraries, gas stations, etc.
- Areas *unlikely* to be good shelters (106): Geographic data, elevation data, proximity to rivers, etc., are mined to give negative weights (for the purposes of sheltering) to certain areas.
- Geotagged photos to determine shelters (108): Geotagged photo information from public and permitted information sources, such as those found in social media, public photo repositories, street images tagged on maps, reviews, etc. can be mined to determine where good shelters exist, such as the open ground floor atrium of a high-rise building, a covered park bench, etc.
- Natural language reviews (110): Natural language reviews of parks, commuter trails, businesses, or other entities are mined to find signals that a good shelter is available.




Mon. 6th Dec. 2021 Weather Forecast

| | | | | |
|---|---|---|---|---|
| 2:30 PM | 78°F | Scattered thunderstorms | 60% chance of rain | SW 10 mph |
| 2:45 PM | 76°F | Scattered thunderstorms | 65% chance of rain | SW 11 mph |
| 3:00 PM | 70°F | Electrical storm | 80% chance of rain | SW 12 mph |
| 2:15 PM | 68°F | Hail | 85% chance of rain | SW 15 mph |

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This **recommended route** has 9 shelters (▲) to help you with your bike ride in the approaching storm. The **other route** only has 2 shelters. We will monitor the weather and let you know when to stop, likely at the 24th street shelter, based on current radar.

210

**Fig. 2: Operating phase**

*Operating phase*

During the operating phase, illustrated in Fig. 2, a trained model (202) provides suggestions to users based on current and projected weather conditions. For example, a main route (blue, 204) is recommended that takes into account conventional metrics (distance, time,

gradient, etc.) as well as the number of shelters along the route. An alternative route (brown, 206) is also indicated, alongside a note (210) that the recommended route has better sheltering possibilities in case of a storm (208).

The training and operating phases can feed into each other to improve route and shelter recommendations over time. For example, a shelter recommended during operation that is observed to be frequently used provides a positive reinforcement for the utility of that shelter, and vice-versa. In this manner, feedback from the operating phase can improve the training of the machine learning model.

The described techniques advantageously provide non-motorized travelers, e.g., walkers, cyclists, etc., safe shelters during weather-related events or other situations in which there is a need to take shelter. The techniques are self-tuning in that new data are continually obtained when new shelters become available and, via the same training process, shelters that no longer apply are removed. Furthermore, recommendations can be made based on one or more of multiple data sources, e.g., observed points where users seek shelter, areas (public libraries, gas stations) likely to be good shelters, areas unlikely to be good shelters (low-lying regions), geo-tagged photographs, natural language reviews of trails and pathways, etc.

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 the collection of user information (e.g., information about a user's mode of transport, stops made along a path, 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 that enable road or trail users to find nearby shelters to stay in during periods of bad weather or in other situations where they may need to take shelter. With user permission, data from observed points where stops are made during bad weather events, geographic data, reviews and other textual materials, etc. are used to train a prediction model to generate route recommendations that include shelters. The identified route is provided in a digital map provided to the user. The map includes markings for shelters that are determined based on the form of transport.