Mobile Sensing Based Alternate Route Recommendation for Cyclists

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Introduction: Explanation of the main ideas

Project Cyclesense

- **Participatory Sensing and Cycling**

CycleSense is a technology to help bikers plan safe routes and collect data to improve these routes. Bikers carry a mobile phone equipped with GPS during their commute. These tools upload information about the commuter's bike ride and the commuter can then view their route on their website.

Alternatively, bikers can input in feedback about certain roads with our web interface. After feedback has been entered, safer and more convenient routes can be found for cyclists

Background / Related Work

- **Dartmouth BikeNet project**
  - Extensive mobile sensing system to record cyclist experience
  - Measures fitness, environment, performance and others
- **Google Maps, Yahoo Maps, Mapquest**
  - Google has developed route-finding for walkers
  - Biking routes not done yet due to complexities with bike paths
- **User Feedback**
  - Users are looking towards sharing information between themselves
  - Campaignr allows us to use community data to obtain user feedback

Problem Description: Current mapping applications aren't tailored towards cyclists needs

Secondary Problem: Many projects often need GPS traces, which take time simulating.

- **Current mapping applications do not provide good routes for cyclists.**

This is because there are a huge variety of bike paths and it is difficult for mapping applications to import all that data in.

- **Takes a lot of time to get the GPS traces necessary for different projects, including CENS projects dealing with Selective Hiding.**

Proposed Solution: Route generation with user feedback

Explanation of Route Generator

Methodology

Users go out biking, they can input rankings into Campaignr or input rankings into our website. Then this data will be uploaded onto Sensorbase, and the next time someone tries to generate a route our RouteGenerator algorithm will consider all of the user data when generating routes

By treating this path finding problem as a graph search, we are able to an A*/Greedy search hybrid. The costs of the road include the road's length, user rating, and whether or not it is a bike path. In the future, we would like to factor pollution and road conditions (gathered from audio and accelerometer sensors) into the cost.

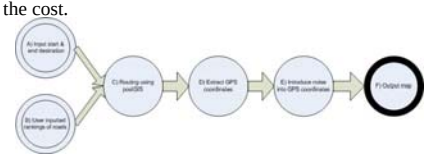

Figure 1: A system schematic: start & end destinations are considered along with the rankings that different cyclists contributed. Our algorithm generates a route and outputs it.

Ranking system:

Update ranking formula: $R = R(\frac{V}{V+1}) + N(\frac{1}{V+1})$

R is Ranking, V is number of votes, N is the New Ranking

Cost of road segments:

5/Ranking x length of road x weight

After routing is finished, then the GPS traces are extracted from the routes and noise is introduced to create realistic traces.

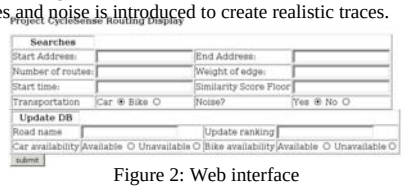

Figure 2: Web interface

Results, Graphs, figures, picture etc.

- To test the RG algorithm, we first generated a test route, then went out biking on this route. Using Nokia N95's, we ran Campaignr and gave Westwood Blvd. low ratings. The next time we ran the RG algorithm, it took into account our feedback and generated a different route.

Figure 3: Route before road ratings considered

Figure 4: Route after road ratings considered (Westwood Blvd was rated poorly)

Figure 5: Google Maps car route

Figure 6: Google Maps walking route

Discussion

As can be seen from the results, the algorithm will take into account poor road ratings and generate new routes accordingly. This can be seen in Figures 3 and 4: Figure 3 shows the initial bike route generated by the Route Generator algorithm before a user ranked the road, Figure 4 then shows the new route generated after a user gave Westwood Blvd. poor ratings. The ability of the system to generate multiple paths allows the biker to choose his desired route.

The bike routes outputted by our algorithm will be better for bikers compared to the car/walking routes generated by Google Maps in Figures 5 and 6. While neither Google Maps car route or walking route will follow bike paths, our Route Generator algorithm will follow the bike routes .

Conclusion and Future Work

We propose a new system that utilizes participatory sensing for route generation. It takes into account user feedback about certain roads and finds between two locations. For some projects, collecting GPS trace data, a time consuming process, is necessary to test the effectiveness of the project. This project can also be used as a GPS trace simulator to aid in the testing and implementation of participatory sensing projects.

Since the bike-ability or availability of a road can vary with time, we plan to implement 'events' which take these into account. i.e. If a road is closed every Monday, our algorithm will avoid that road on Mondays.

In the future, we also would like to include other forms of public transportation. A-Train, a NPO in Atlanta, has developed an open source application for this. We could implement our user feedback and GPS trace system with this.