

Background:

As gas prices rise, choosing to bike to work or school should be easy. But bike commuters must find feasible, pleasant, and safe routes. A ride's safety varies according to traffic congestion, likelihood of bike accidents, and average air quality of the route. A ride's quality depends on availability of bike routes and paths, the condition and comfort of those routes, and connections to public transportation [1, 2].

Objectives:

With the help of the Los Angeles County Bicycle Coalition (LACBC), UCLA's Center for Embedded Networked Sensing (CENS) is building CycleSense, a system to help bikers plan safe routes and collect data to improve those routes. CycleSense differs from standard mapping applications by harnessing widely available tools—mobile phones—for real-time distributed data collection.

CycleSense bikers carry a GPS-enabled mobile phone during their commute. The phone automatically uploads bikers' routes to a secure, private website. Participants can log in to see their route combined with existing data, including air quality, time-sensitive traffic conditions, and traffic accidents [3]. Participants can also use the system to share information about their routes with other riders. Bikers can document impediments by taking photos with the mobile phone or sending a text message to CycleSense. Participants can also record audio messages to remind them of hazards along the route. By combining existing Los Angeles conditions with biker-contributed data, CycleSense will enable area bikers to plan routes with the least probability of traffic accidents; with the best air quality; or according to personal preferences, such as best road surface quality or connections with public transportation. CycleSense will also encourage bikers to contribute information to improve the safety and well-being of the Los Angeles bike community.

Methods:

The CycleSense project includes: 1) participatory system design employing focus groups and design meetings with bike commuters; 2) system pilot to test data collection and processing functionality; and 3) evaluation through follow-up interviews with participants.

Interested participants can attend focus groups to help plan the CycleSense system [4]. These design sessions will ask cyclists to share challenges associated with their current commutes and envision methods to collect data to improve these routes. Researchers will collect qualitative data as users evaluate prototypes of the CycleSense system for utility and benefit.

Design meetings will culminate in a month-long system pilot. Participants will carry a GPS-enabled mobile phone during their commute. The phone automatically uploads *location data*—latitude and longitude coordinates—to a secure website. Phones also include automatic sensors such as microphones and accelerometers employed to measure traffic noise and the quality of road surfaces. Participants may use their phones' camera to take pictures of their route, or record short audio clips to remind themselves of hazards along the route. The phone will upload these annotations to the user's CycleSense profile. At the end of their commute, participants can log in to see their route map, photographs, and audio annotations alongside data such as air quality, traffic conditions, and traffic accidents along the route.

The pilot will evaluate several automatic data collection techniques. By comparing one-second audio clips of ambient noise recorded by the phones to ground truth about the traffic density of a route, we can construct and evaluate a real-time measure of route traffic. By comparing accelerometer

readings to ground truth about the surface quality of short stretches of road, we can develop and evaluate methods to classify abnormally bumpy routes.

Finally, we will conduct semi-structured interviews to assess riders' experiences with the CycleSense system. Evaluation of strengths and weaknesses of data collection methods, system purpose, and system function can improve future applications.

Results:

The planning, pilot, and evaluation of the CycleSense project will take place from July through September 2008. With the help of LACBC, we will recruit 10 bicycle commuters for the pilot data collection. Our poster will present results including success automatically detecting hazards such as high volume of traffic or frequency of rough pavement, and evaluation of the pilot system by users.

Conclusions:

Piloting the CycleSense system will reveal possibilities for automatic and manual data collection about bicycle routes using widely available mobile phone technologies. User feedback will assess whether the system can scale for use by thousands of bicycle commuters in the Los Angeles region. Our conclusions will indicate how data collection and communication enabled by the CycleSense system can encourage bicycling in the LA metro region.

Support:

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- [3] E. Agapie et al., "Seeing Our Signals: Combining location traces and web-based models for personal discovery," Napa Valley, CA: 2008.
- [4] K. Shilton et al., "Participatory design of sensing networks," *Proceedings of the 10th Conference on Participatory Design*, Bloomington, IN: ACM, 2008.