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MAKING CYCLING SAFER WITH NATURALISTIC STUDIES

Researchers use video to conduct naturalistic bicycling studies, which offer information that can improve cyclists' safety.

The Issue

Cyclists and pedestrians are the most vulnerable road users; collisions involving a vehicle and a cyclist or pedestrian often result in severe injuries and have high fatality rates compared with other types of collisions. This NITC project, "Utilizing Ego-centric Video to Conduct Naturalistic Bicycling Studies," developed a naturalistic method for bicycle safety research.

For motorized vehicles, the U.S. Department of Transportation has been developing portable, vehicle-based data collection technologies since the early 1990s. This approach allows researchers to gain insight into drivers' actual on-road experiences and learn what specific factors may lead to collisions. In bicycle safety research, however, not as much has been done with naturalistic methods. Studies like this one represent an important tool for bicycle safety analysis.

The Research

Researchers Feng Liu, Miguel Figliozzi and Wu-chi Feng from Portland State University developed hardware and software to capture the first-person cycling experience. Their report offers a successful method for integrating video and sensor data to record cyclists' comfort or stress levels along a route.

The research team fitted a bicycle helmet with four GoPro cameras to provide a 360 view of the cyclist's surroundings. They used GSR, or galvanic skin response, sensors to measure the cyclist's stress reactions, and collected detailed GPS data with a smartphone.

THE ISSUE

Cyclists are among the most vulnerable road users. Ego-centric video lets researchers see exactly what they encounter on the road.

THE RESEARCH

Researchers outfitted volunteer test riders with:

- A smart phone to collect GPS location data;
- Galvanic skin response sensors to measure stress;
- A 360° video, via cameras mounted on the helmet.

IMPLICATIONS

Naturalistic studies from the cyclist's point of view can shed light on the most dangerous spots along the route, and let planners see where changes might have the most impact.

Photo: First-person view of what a cyclist sees

Cycling effort and sweating may also affect reported stress levels. To offset this, the team instrumented a bicycle to measure speed, torque, and power along the cyclist's route. The bicycle used for this research was mounted with a power meter to measure the subject's cycling performance (power, torque, wheel speed and distance, and crank cadence). Performance data and temperature measures were collected to separate stress GSR from energy input GSR.

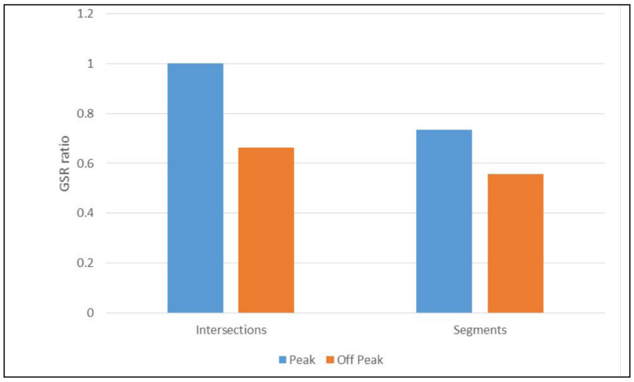
After each ride, all the data from the sensors were synchronized at the research lab. To help visualize and analyze the data, the research team developed an interactive software system. It can show multiple videos while displaying the corresponding sensor data and the cyclist's geographical position on a map.

The method lets safety researchers observe situations and environments that cause a cyclist to experience a stress reaction, thus offering unprecedented insight into which route conditions feel more dangerous and may be more likely to cause vehicle-cyclist collisions or other incidents.

Implications

The results offer a detailed understanding of cyclists' perceptions along the route they travel. Rather than having an average measure for the whole route or path, this method lets researchers precisely identify the places and/or situations that trigger a change in experience.

Investigators found that close encounters with vehicles, other cyclists, or pedestrians showed a marked increase in the cyclists' stress levels. In addition, obstacles on the road tended to generate stress. In general, the most stressful events were situations where a vehicle blocked the cyclist's movement or moved dangerously close to the cyclist. Stress while riding during peak hours was almost twice as high as at off-peak hours, on the same routes and facilities. Meanwhile, separated bicycle infrastructure such as multi-use paths showed the lowest stress levels, during both peak and off-peak hours.



Signalized intersection vs. segment GSR ratios

This graph shows that during both peak and off-peak hours, stress levels (galvanic skin response) for signalized intersections were significantly higher than stress levels for segments of the route.

Intersections are one of the most critical areas in a road network given the high number of conflicts and accidents occurring at these locations. In this study, signalized intersections were hotspots for cyclists' stress.

By measuring how different facility types and riding conditions affect the distribution of stress levels among users, transportation engineers and planners may in the future incorporate video and detailed sensor data to evaluate the real-world performance of different types of facilities.

PROJECT INFORMATION

TITLE: Utilizing Ego-centric Video to Conduct Naturalistic Bicycling Studies

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