Smart bike pedals toward accident prevention

January 8 2014, by Angela Herring

The housing and mount for the smart bike system were 3D printed in Mavroidis' lab. Credit: Brooks Canaday

Every day, about two people in the U.S. succumb to fatal cycling accidents while more than 130 suffer harmful injuries. But in an era of increasing concern for the environment, cycling is an important mode of transportation, one that could begin to replace gas-guzzling cars, trains, and buses. Indeed, Americans could save the nation an estimated $7 billion in commuting costs if they biked instead of drove to neighborhood destinations such as the bank, post office, or grocery store.

In an effort to make cycling safer—and thus a more desirable mode of transportation—students in Distinguished Professor Mechanical and Industrial Engineering Constantinos Mavroidis' Biomedical Mechatronics Laboratory have created a "Smart Bike," which they call

the Interactive Bicyclist Accident Prevention System, or iBAPS.

The project was part of the undergraduate student Capstone Design course, in which five senior mechanical engineering students worked with two of Mavroidis' doctoral candidates to create the prototype.

The system is comprised of two 3-D printed consoles affixed to the front and back of the bicycle. Each console contains two proximity sensors that detect a cyclist's distance from nearby objects. Laser lights project a virtual bicycle lane on either side of the bicycle to stress the cyclist's safe zone on the street. If other vehicles intrude on this zone, the lasers will blink.

If an intruding vehicle gets close enough and the bike is traveling fast enough, the sensors will then trigger a built-in speaker to alert both cyclist and driver to a potential collision.

Alexander Pepjonovich rides a bicycle equipped with iBAPS (Interactive Bicyclist Accident Prevention System), which combines multimodal features to alert both the cyclist and nearby vehicles to danger. Credit: Brooks Canaday

The system is also equipped with two vibrators, built-in to the front console and in contact with the handlebars. If cyclists speed up as they approach an intersection—one of the most dangerous areas for biking—the handlebars will vibrate.

The front and back consoles are Bluetooth enabled to communicate with each other and with a smartphone application, which tells the system where it is on the map and also records the cyclist's interactions with other objects. Upon further development, the team hopes the app will provide longitudinal data to show cyclists how their behavior changes over time and indicate their level of safe biking habits. The system also includes a visual turn signal. While the system incorporates a variety of existing technologies, "the key is it's interactive, which makes it a novel idea," said student Philip Lena.

For example, student Marietta Alcover explained that "the smartphone app will work with the phone's GPS to send a signal to the front console every time the bicycle is approaching an intersection and not slowing down."

The project earned the iBAPS team the MIE Capstone Award for biggest impact, as well as a $5,000 Provost Undergraduate Research Award. Next semester, four of the students—doctoral candidates Amir B. Farjadian and Qingchao Andy Kong and undergraduates Alexander Pepjonovich and Carlo Sartori—will join forces with an entering graduate student, Mahsa Hayeri, to carry on the work. They plan to further develop the smartphone application, test the prototype, collect

field data, and improve the design.

The student-researchers have patented several parts of the system with the help of the Center for Research Innovation and are looking into commercializing their product. "I truly believe this has huge commercial potential," Mavroidis said. "It is an innovative and useful tool that is needed by the market."

Provided by Northeastern University