Bicycle Safety Systems

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Photo: Courtesy of Jaime Sullivan, WTI

Description: Bicycle safety systems are intelligent transportation systems that increase the visibility and safety of a bicyclist. Some bicycle safety systems include:

- Bicycle warning systems (tunnels, bridges, roadway crossings)
- Protected yet concurrent signal phasing,
- Green wave programs (corridor signal coordination),
- Red light cameras, and
- Automated speed enforcement systems.

The first step in these safety systems is bicycle detection, used to identify the presence of a bicycle. Bicycle detection can be installed as either an automated device (loop detector, video, microwave, radar, etc.) or as a push-button.

Rural Transportation Critical Needs

- ☑ Crash Countermeasures
- ☐ Emergency Services
- ☑ Operations & Maintenance
- ☐ Rural Transit & Mobility
- ☐ Surface Transportation & Weather
- ☑ Tourism & Travel Information
- ☑ Traffic Management

Issues Addressed

- ☐ Road Geometry Warning
- ☐ Highway-Rail Crossing Warning
- ☑ Intersection Collision Warning
- ☐ Pedestrian Safety
- ☑ Bicycle Warning
- ☐ Animal Warning
- ☑ Collision Avoidance
- ☐ Collision Notification

Strategies Achieved

- ☑ Road User
- ☑ Road
- ☑ Vehicle
- ☑ Safety Culture
- ☑ Engineering
- ☐ Emergency Response
- ☑ Enforcement
- ☑ Education

Applicability

- In a rural context, bicycle safety systems might be more prevalent in small urban areas. A bicycle safety system increase the visibility of bicyclists by drawing the attention of drivers and reminding them of the potential presence of a bicyclist on or crossing the roadway therefore increasing bicyclist safety and decreasing the risk for crashes. If localities are not familiar with how such modifications can be made, they should consult their local Federal Highway Administration (FHWA) representative for possible technical assistance.

Partnerships

- Applications benefit from collaboration among numerous agencies, which may include:
  - Departments of transportation (local, state, federal)
  - Bicycle advocacy groups
  - Metropolitan/Rural Planning Organizations

Key Components

- Bicycle detection system
  - Sensor for automatic detection (inductive loop, pneumatic road tube, magnetometer, infrared, radar, video image processor, microwave) or push button for passive detection
  - Signal and data processing devices
- Bicycle warning system
  - Beacon
  - Static sign or dynamic message sign
  - In-pavement LEDs *(optional)*
  - Pavement markings (*optional*)
  - Trail crossing signal and/or sign (*optional*)
- Protected yet concurrent signal phasing
  - Right-turn lanes, traffic controller that enables 8 phases
- Green wave signal coordination
  - Signal lights in proximity for coordination
  - Signal light controllers with this capability
- Red light running cameras and automated speed enforcement
  - Cameras
  - Vehicle registration information
  - Review of violations and fine delivery

Useful Tips

While an educational campaign is not required with any of these solutions, it is recommended to improve effectiveness and safety. Secondly, making changes to traffic signal controllers already installed are often low-cost solutions. Lastly, the camera feeds for video detection could be posted to an integrated traveler information system so that the public can view traffic conditions.

Examples of Implementation

- **Protected-Yet-Concurrent Phasing**

Portland, Oregon investigated how to incorporate into its signal systems and roadway configurations better provisions for bicyclists utilizing cycle tracks (also found in small urban areas). Portland, Oregon is using its signal systems to address conflicts between bicyclists using these facilities and high right turn volumes or speeds by implementing a protected-yet-concurrent phasing scheme that provides independent phases for right turns and left turns.

- **Bicycle Tunnel Warning System**

A bicycle tunnel warning system was installed on a highway near Chelan, Washington by the Washington State Department of Transportation. A bicyclist presses a push button activating a message sign displaying: "PEDS/BICYCLES IN TUNNEL WHEN FLASHING." Sign deactivation occurs at a set time interval.

- **Bridge Bicycle Warning System**

An electric bicycle warning system, using loop detectors to identify the presence of a bicyclist, was installed on a narrow bridge in Appleby (New Zealand).

- **Northfield, Minnesota Bicycle Detection**

The Minnesota Department of Transportation pilot tested a bicycle traffic signal detector at the intersection of Highway 3 and 2nd Street. When a bicycle approaches the intersection, the green light phase will trigger and provide 10 seconds for the bicyclists to cross the intersection.

- **Pleasanton, California Radar Bicycle Detection**

Intersectors are devices that uses a combination of microwave radar and in-pavement sensors to detect vehicles or bicycles. The in-pavement sensor is marked with a bicycle or a "wait here for green" sign so that bicyclists know where to wait to trigger the system. Intersectors have been installed at 8 intersections in Pleasanton, California, allowing for the adjustment of signal timing (additional time if a bicyclist is detected) when necessary.

- **Portland Springwater Corridor Trail**

The City of Portland installed bicycle loop detectors at four high-volume signalized intersections along the Springwater Corridor Trail. Since the installation of detectors at these crossings there have been no reported collisions and trail users noted that they felt safer.

- **Bikescout**

Bikescout uses radar to detect the presence and speed of a bicycle approaching an intersection to calculate when the bicyclist will arrive at the intersection and alert drivers using Light Emitting Diode (LED) lights installed in the pavement. This system is extremely useful in areas with poor visibility of approaching

Opportunities for Future Expansion

- Many studies are being conducted on bicycles and technology including: Connected Bicycles Tell Cars: Don't Run Me Over, Development and Testing of Prototype Instrumented Bicycle for Prevention of Cyclist Accidents, and How will new technology affect bike safety? Congress wants to know.
- The iBike is an instrumented prototype bicycle system under development in England. The intent of the iBike is to address heavy vehicle/bicycle collisions. Low-cost micro-electromechanical (MEMS) sensors allow data collection of a bicycle's steering angle, tilt angle and speed, thereby allowing for an understanding of the bicycle's trajectory. Using a wifi link, this information can be communicated to the driver of a heavy vehicle
- Vehicle manufacturers are working to improve bicycle safety using V2V communications. Ford has begun research on "Info Cycle," an aftermarket sensor system for bicycles that can record data on the bicycle location, speed, ambient light, temperature, altitude, etc. This research will study how bicyclists travel through a city to assist in bicycle infrastructure planning. Jaguar Land Rover is working on "Bike Sense" which will use vehicle sensors to improve a driver's awareness of bicycles by using in-vehicle bicycle bell sounds, lights and tap to alert the driver.

Implementation Considerations (Pro)

- Brings additional visibility to bicyclists (vulnerable road users).
- Helps to establish right-of-way.
- Encourages bicycling which is tied to health and environmental benefits.
- Some systems can be designed to serve pedestriansas well.
- Detection reduces delay for bicyclists waiting at an intersection, which can reduce the number of bicyclists that run red lights.

Implementation Considerations (Con)

- Motorists may resent the provisions for bicyclists.
- May cause potential delays for motorists.
- Red light running and automated speed enforcement are not well-received by the public (perceived as revenue generation or intrusive).
- Video detection can have issues during poor visibility conditions.
- In-pavement sensors can be damaged by snow plows and reduce the life-cycle of the pavement.

Additional Resources

- *Bicycle crash study could guide design of bicyclist detection systems*, found here: http://www.iihs.org/iihs/sr/statusreport/article/50/3/3
- *Automated Enforcement: A Compendium of Worldwide Evaluation of Results*, found here: http://www.trb.org/Main/Blurbs/159265.aspx
- *An Overview of Automated Enforcement Systems and Their Potential for Improving Pedestrian and Bicyclist Safety*, found here: http://www.pedbikeinfo.org/cms/downloads/WhitePaper_AutomatedSafetyEnforcement_PBIC.pdf
- *Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices*, found here: https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/global_benchmarking/global_benchmarking.pdf
- *BIKESAFE: Bike-Activated Signal Detection,* found here: http://www.pedbikesafe.org/BIKESAFE/countermeasures_detail.cfm?CM_NUM=36

Cost Range

(Cost/financial information, where noted, is based on 2016 dollars (unless otherwise specified). Cost/financial information is estimated, and will vary based on size and scope of project, number of units, etc. In general, capital costs include initial purchase costs of hardware, software, and other required equipment. Maintenance and operations costs include staff time to operate, monitor and maintain systems; data collection; system upgrades; evaluation; etc.)

Capital Costs: The total capital cost for this tool is low (Less than $50,000). The Pedestrian and Bicycle Information Center (PBIC) has estimated the average cost to install a bicycle detector (loop detector) at an intersection to be $2,009.53[1]. Intersectors like those used in the Pleasanton, California project cost between $4,182 to $5,227[2]. Another example, the Tunnel Warning System in Chelan, Washington cost $16,000 to build and install[3].

Operations Costs: The operations and maintenance cost for this tool are anticipated to be low (Less than $50,000). Power costs (unless solar although a back-up may be desirable), replacement lights and potentially signs are the anticipated operations and maintenance costs. An agency also needs to consider the costs to keep sensors cleaned and to close a roadway or lane of traffic for maintenance. In-pavement sensors may also reduce the life cycle of the pavement.

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