Towards Establishing a Testbed for Vehicle-to-Pedestrian (V2P) Technology

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Background

- Nearly 7,000 pedestrian and bicyclist fatalities in 2016 (18 percent of total traffic fatalities).
- Conditions known to increase risk of incidents:
  - Crowded urban settings (occlusion by vehicles/objects).
  - Low visibility (inclement weather, dusk/dawn, nighttime).
- Vehicle-to-Pedestrian (V2P) technologies use external sensors to detect at-risk pedestrians.
- System may alert the driver or intervene to reduce risk or severity of a crash.
- Sensors used include:
  - Visual cameras/computer vision.
  - Light detection and ranging (LIDAR) sensors.
  - Millimeter wave radar.
  - Direct wireless communications.
- Capability assessment of diverse and emerging V2P technologies is ongoing.

Project Goals

Establish a testbed for emerging V2P technologies at Turner-Fairbank Highway Research Center (TFHRC)

Phase I: Develop a test plan strategy and identify V2P systems currently available on the consumer market

Technology Scan

Access the Tech Scan Online

- Identified 86 known V2P technologies. (*https://www.its.dot.gov/press/2015/v2p_tech.htm*)
- Very few mature, market-ready, and publicly accessible products.

Eligibility Criteria for testing at TFHRC:

- Perform in at least one of four test case scenarios.
- Deliver some measurable communication output delivered to driver/vehicle or pedestrian/bicyclist.
- Function within the environment provided (TFHRC or offsite).

Assessment Plan developed from common V2P features to assess technology accuracy, reliability, safety features, and market readiness, and accessibility

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Phase II: Assess safety effectiveness of market-ready V2P systems validating the test plan strategy from phase I

Assessment Plan

- Identified four **scenarios** common to vehicle-pedestrian collisions.

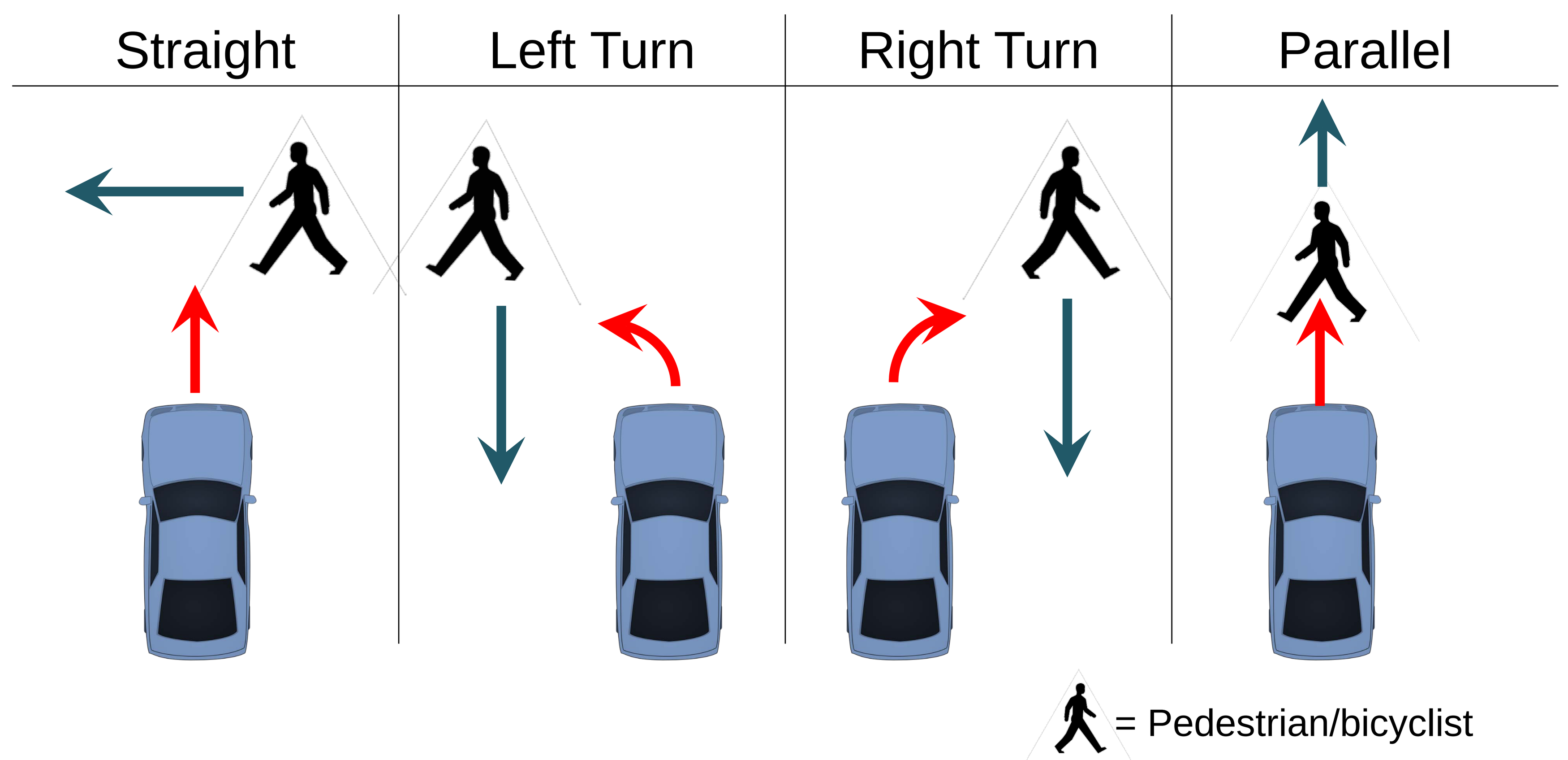

Figure 1. Four test cases
Source: FHWA

Assessment Plan Validation

- Acquired camera-based after-market safety device with pedestrian detection feature.
- Computer vision algorithms detect human form; analyze movement, direction, and distance to identify crash risk.

System characteristics:

- Communicates to driver only.
- Visual alert displayed when pedestrian is detected.
- Visual alert color change and audible alert when high risk of crash detected.
- Driver's responsibility to intervene in response to alert.

Source: FHWA
Figure 2a and 2b. Testing the validation system with simulated walking pedestrian (left) and bicyclist (right).

Results

Alert and Response Distances

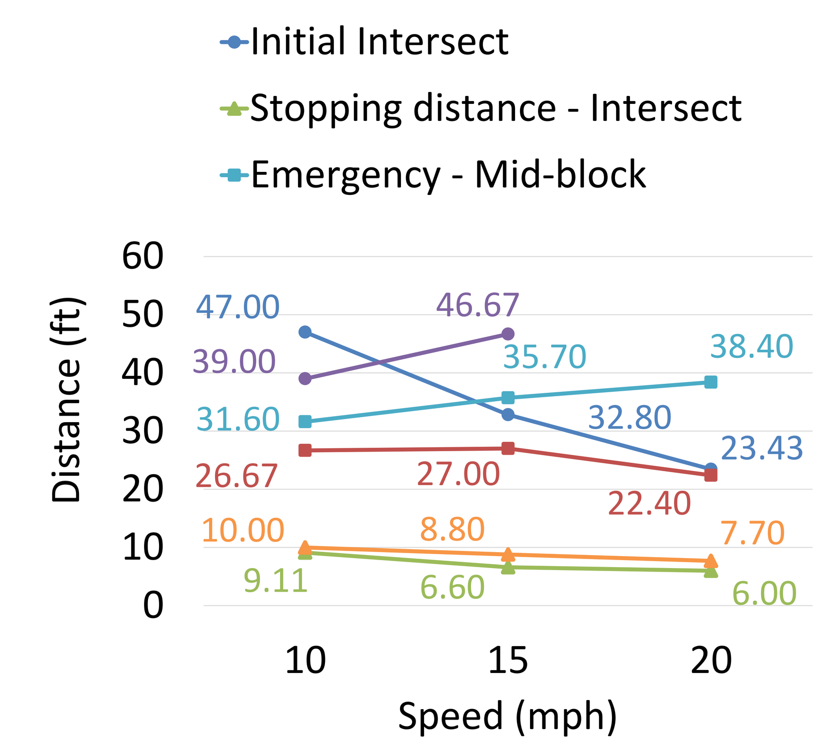

Figure 3. Pedestrian (Straight Test Case)

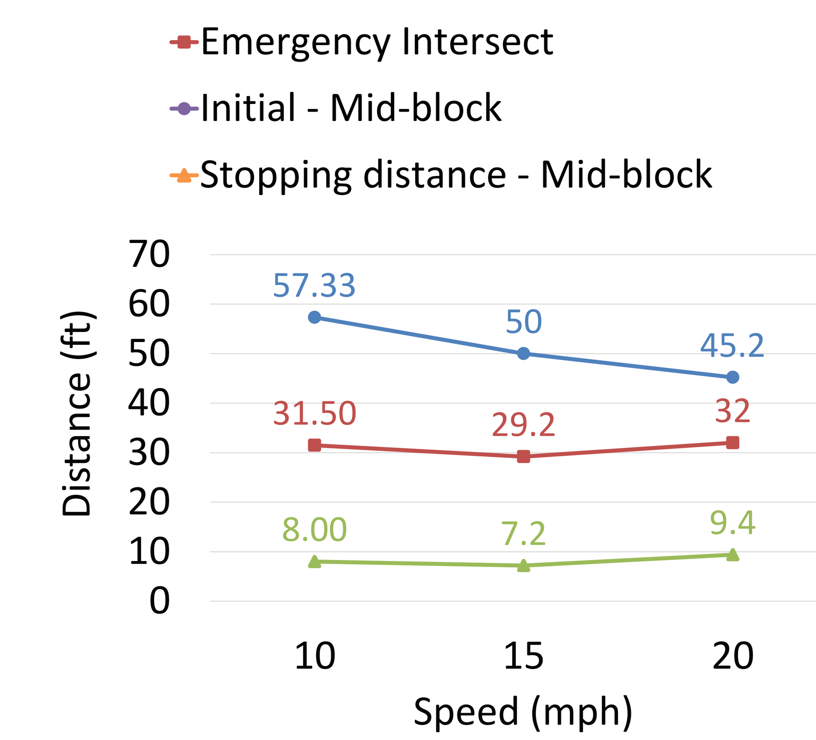

Figure 4. Bicyclist (Parallel Test Case)
Source: FHWA

Measure	Result
Alert clarity	• Visual and audio alerts are clear and easy to understand.
User access to technology	• On the market and available for installation at multiple locations. • Affordable at less than $1,500 for purchase and installation. • Device is not widely advertised.
Readiness	• Fully market-ready.
Institutional and infrastructure requirements	• None required for pedestrian detection.
Known nonfunctional situations	• Low-light or nighttime. • Low visibility (e.g., fog). • Vehicle traveling over 31 mph. • Direct sunlight into camera. • Cyclist traveling perpendicular to vehicle.
Additional discovered nonfunctionality	• Unable to detect simulated pedestrian in turning test case scenarios.*
Human factors assessment	• Clear warning prompts appropriate action. • Symbols and audio are easy to interpret. • Straightforward operation and use. • Purpose of initial alert may be unclear without proper knowledge. • Drivers must be properly informed of performance limitations.

*Note: Developer team indicates this is not the case in on-road tests.

Source: FHWA

Conclusion

- General testing plan validated with camera-based system.
- Simulated pedestrian characteristics limit some test cases.
  - System did not perform in turning test cases.
- Specific technologies require tailored test approach.

Next steps: Acquire 3–5 additional V2P technologies, assess features, and test with customized plan.