Innovative Applications of Technology for Pedestrian Safety

PRESENTED BY:
NATHAN MOZELESKI, PE
The Problem?
Keeping Pedestrians Safe

- Orlando recently named the “deadliest” city for pedestrians in the county
- From 2008-2017, a total of 656 registered pedestrian fatalities
- Major factors include lack of pedestrian facilities and streets designed for vehicles, not pedestrians
Additional Concerns

• Unexpected crossings at non-signalized/marked locations
• Lack of visibility/warning for both driver and pedestrians
Local Case Study
Completed in February 2018

• Orange County requested pedestrian safety study
• Focused on roadways near University of Central Florida (UCF) campus:
  • SR 434 (Alafaya Trail)
  • University Boulevard
  • McColluch Road
• Total 250 vehicle-pedestrian and vehicle-bicyclist incidents between 2006-2016
  • 11 fatalities, 207 injuries reported
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- Suggested improvements include:
  1. Geometric intersection improvements (e.g. reduction of turn radii, widening sidewalk, landscaping, etc.)
  2. Signal operation and timing changes
  3. Addition of mid-block pedestrian crossing of SR 434 (Alafaya Trail) and University Boulevard
TECHNOLOGY

OPTIONS FOR PEDESTRIAN SAFETY
Current State of the Industry

• FDOT District 5 project to survey the present state of the industry, design and deploy a test case solution for segments of the SR 434 (Alafaya Trail) corridor.

• Vendors demonstrated solutions at the Traffic Engineering Research Lab (TERL) in Tallahassee including:
  • Passive Pedestrian Detection
  • Computer Vision and Machine Learning
  • Connected Vehicle (CV)
Most of these technologies and/or applications are in the infancy stages of development.

Very few large-scale, proven deployments to date. Most projects are pilot projects, test beds, or research-based efforts.

Over time there is an expectation of technology maturity leading to more reliable results and scalable deployments.
Passive Pedestrian Detection

Historically, pedestrians request permission to cross an intersection leg with a pedestrian pushbutton.

The pushbutton sends the request to the signal controller to activate the appropriate pedestrian crossing phase.

Actuated pedestrian crossings require appropriate pedestrian involvement for
Passive pedestrian detection systems identify pedestrians and send requests for crossing phases automatically, without the interaction of the user. Can be accomplished in a number of manners: radar, video, etc.

FLIR Trafisense is a thermal imaging detector that can be deployed for passive pedestrian detection for both intersection and midblock crossings.

System can be utilized for pedestrian and/or bicyclist detection, dependent upon need.
Passive Pedestrian Detection

**Benefits:**

- Reduction of crossings during “DON’T WALK” phases
- Provide earlier warning to drivers of approaching pedestrians

**Challenges:**

- Increased false calls
- Enhanced cost
Computer Vision is the process of identifying the presence of predefined objects, like a pedestrian, from an image, such as a video feed.

Machine-Learning is a branch of artificial intelligence in which systems continually identify patterns in data in order to independently adapt with minimal human interaction.

Together these two concepts are capable of detecting, classifying, and tracking pedestrian movements for actions and analysis.
Computer Vision and Machine-Learning

MioVision TrafficLink systems utilizes software and video feeds from a bug-eye camera to detect, classify, and track objects, including pedestrians.

System is able to differentiate cars, trucks, bicyclists, and pedestrians for classification.
Computer Vision and Machine-Learning

System provides the ability to obtain real-time and historical pedestrian data.

Available data sets include pedestrian volumes, relative origin-destination, and more.
Computer Vision and Machine-Learning

Benefits:
- Extend pedestrian WALK intervals when necessary
- Provide accurate, real-time data sets
- Determine potentially dangerous trends in pedestrian movements

Challenges:
- To date very few proven deployments for pedestrian safety in the US
Connected Vehicles

The implementation of technology that allows vehicles to communicate with the driver, other vehicles, roadside equipment, the “cloud”, or any other desired device by various communication methods.

Connected vehicle (CV) technology can be utilized in any number of applications providing benefits in safety and efficiency.
Connected Vehicle Terminology

- **BSM** – Basic Safety Message
- **DSRC** – Dedicated Short-Range Communication
- **OBU** – On-Board Unit
- **PSM** – Personal Safety Message
- **RSU** – Roadside Units
- **V2V** – Vehicle to Vehicle
- **V2I** – Vehicle to Infrastructure
- **V2P** – Vehicle to Pedestrian
• **Dedicated Short-Range Communications (DSRC) –** two way, short-to-medium range wireless communication utilizing the 5.9 GHz radio band

• **Roadside Unit (RSU) –** device with a fixed position relative to the roadway capable of transmitting and receiving DSRC-based messages to vehicles

• **On-Board Unit (OBU) –** vehicle mounted device capable of DSRC communications in order to transmit and receive messages from roadside equipment and other vehicles
Vehicle-to-Vehicle (V2V) – system to wirelessly transmit and receive basic safety message information between vehicles, defined by Society of Automotive Engineers (SAE) Standard J2735.

Basic Safety Messages (BSM) - data structure containing a timestamp and vehicle size, position, speed, heading and acceleration transmitted 10 times a second.
Vehicle-to-Infrastructure (V2I) – system to wirelessly exchange safety and operational information between vehicles and static roadside infrastructure
Personal Safety Message (PSM)

Similar to the BSMs for cars, personal safety messages (PSM) provide the location, heading, speed, acceleration of a vulnerable road user with a timestamp.
TravelSafely by Applied Information is a smartphone-based solution providing connected vehicle applications to pedestrians, bicyclists, and motorists.

By using cellular communications and data transfer via the “cloud”, TravelSafely provides users V2V and V2P applications without the need for installation of OBUs.
Benefits:

Provides CV capabilities simply by downloading a smartphone application

Existing application alert both the driver and the bicyclist or pedestrian

Challenges:

Limited penetration of the TravelSafely app with drivers, bicyclists, and pedestrians
Connected Vehicle

Tampa Hillsborough Expressway Authority (THEA) is currently in the process of implementing a CV pedestrian detection and warning system.

Deployment for the midblock crossing for the Hillsborough County Courthouse on E Twiggs Street connecting the parking facility to the building.
THEA deployed a system of Quanergy LIDAR (Light Range and Detection) sensors in order to detect, classify, and track pedestrians in the midblock crossing.

Once detected, a high visibility beacon begins flashing to alert the drivers of an impending pedestrian crossing.

Additionally, SIEMENS RSUs transmit Traveler Information Message (TIM) to the heads-up display on approaching vehicles outfitted with an OBU as part of the THEA CV Pilot project.
Present Issues with Connected Vehicle

• Lack of OBU penetration in vehicles interacting with the systems
• Lack of proven large-scale deployments, infancy of technology
• Limited number of CV applications, still in concept “phase”
PedSafe (District 5)

Along SR 434 (Alafaya Trail) near the UCF campus, multiple pedestrian detection and warning technologies are being deployed:

1. LIDAR detection and RSU
2. OBU emulator development
3. Passive pedestrian detection w/ thermal imaging

Deployments will be located at signalized intersections and along corridor between.

Provide advanced notification to drivers when approaching pedestrian in roadway.

NOTE: This effort is a primarily research-based, UCF will conduct analysis post-deployment.
LiDAR Detection

X, Y Positional Tracking of Pedestrians w/ Time-Stamp

Processing Unit

Roadside Unit (RSU)

OBU Emulator

Broadcasts Application Messages (BSM, PSM)

Pedestrian in Signalized Crosswalk
Warns the driver if a pedestrian is crossing in a signalized intersection

Pedestrian Warning!

Receives Application Messages, Visual/Audio Alert to Motorists, Pedestrians
Questions?

THANK YOU FOR LISTENING.