Automatic/Passive Pedestrian Detection

Jim Lampe Control Technologies
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Introduction to CT (Control Technologies)

- Since 1980 - Based in Sanford, FL with regional offices/stocking warehouses in Baltimore & Houston
- US Eastern Distributor for Traficon since 1993
- Registered - ISO 9001:2008 & 14001:2004 (Environmental Steward)
- Other products include:
  - CT- manufactured assemblies
    - Cabinets, enclosures, etc.
    - APS, BBS, Ped Beacon Products
  - McCain Traffic
  - Lighting Technologies
    - LED lighting (street, decorative, parking garage, indoor)

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Traficon Video Detection Agenda

- Background on Traficon
  - Presence Detection
  - Incident Detection
    - Beginnings of ped detection

- Passive Pedestrian Detection
  - Background, MUTCD, Funding
  - C-Walk (Moving Peds)
  - SafeWalk (Waiting Peds)

- New Warning Beacons

Please stop by booth #8
Background
Traficon Video Detection
Introduction to Traficon

- Manufacturer of video-vehicle detection systems, located in Belgium with offices/representatives worldwide
- TraficonUSA (Las Vegas) handles North America
- First systems installed in 1982 and now have close to 100,000 detectors worldwide
- Pioneered tunnel-incident detection systems and evolved to data collection, presence detection
- 20+ software engineers involved in R&D
- 20% of sales re-invested in R & D
Traficon Video Detection
Introduction to Traficon

1979: 1st gen.
University of Leuven

1982: 2nd gen.

1987: 3rd gen.
VIP 2, 3, 7, 21, 22, 41, 23...

2000: 5th gen.
VIP3D/I/D

VIP/T

2008: 7th gen.
Traficam

2009-10: 8th gen.
C-Walk/ SafeWalk

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Intersection Presence Detection

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Intersection Presence Detection
DC Speed Detection Application
Application Spotlight
DC Over-speed detection

- Washington, DC (various locations)
  - Speed limit (25 mph)
  - Changed road configuration many times, considered auto enforcement.

- Deployed VIDS
  - Detects vehicle exceeding 30 mph
  - Sends contact closure to downstream intersection calling RED phase.
  - Sign posted- “Speeding triggers RED light.”
Application Spotlight
DC Over-speed detection

Signal at 30th Pl.

Location- East of 27th St.

Over speed Detection Zone Location and Direction of Travel Detected

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Application Spotlight
DC Over-speed detection

Please stop by booth #8
Application Spotlight

DC Over-speed detection

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Automatic Incident Detection
Improving Road Safety via AID
Automatic Incident Detection

Please stop by booth #8
Improving Road Safety via AID
Automatic Incident Detection

Traficon installed in over 400 tunnels worldwide
Flow/Incident Data

- 5 Levels of Service (LOS)
  - Normal
  - Dense
  - Delayed
  - Congested
  - Heavily Congested

- User-definable LOS thresholds

- Vehicle data per class, per lane
  - Count, Speed, Occupancy, etc.

- Data archived in central server
  - Predetermined intervals
    - From 5 to 3600 seconds (1 hour)
Passive Pedestrian Detection Systems

Traffic Flow Data

Traffic Flow (by color)

Live Alarm Image from Cameras

Alarm Video

Pop-up Messages/Alarm Event Stack

Enter comments on event

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Disabled Vehicle

Fallen debris, right lane closed
AID / VIDS - Video Clips- Pedestrian Detection

Implementation of pedestrian detection for in Automatic Incident Detection applications

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Passive Pedestrian Detection- Background

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Pedestrian Crash Facts

- In 2007, 4,654 pedestrians killed in traffic crashes
  - Children 14 and younger accounted for 7%
- On average, a pedestrian is killed in a traffic crash every 113 minutes and injured every 8 minutes.
  - 70,000 injured in 2007
  - Children 14 and younger accounted for 20%
- Most fatalities in 2007 occurred
  - Urban areas (73%)
  - Non-intersection locations (77%)
  - Normal weather conditions (90%)
  - At night (67%)
- More than 2/3 (70%) of pedestrians killed in 2007 were male

*Insurance Institute for Highway Safety
*NHTSA- National Center for Statistics & Analysis
Passive Pedestrian Detection

Background

- Common practice is to install pedestrian pushbuttons (PPBs) to activate ped signal
- Installation & maintenance practices can often leads to non-use (FHWA, Zegeer et al. 1985)
  - PPBs located away from crosswalk and out of view or reach
  - PPB signing nonexistent or confusing. Not clear which PPB was associated with each crosswalk
  - Some PPBs were inoperable during part of day with no message to indicate that to the pedestrian
- All of the above result in a lack of confidence by pedestrians which leads to non-use of PPBs

*www.walkinginfo.org*
Passive Pedestrian Detection

Background

- Crossing distance & time can be an issue
  - MUTCD assumes a 3.5ft/sec walking speed to establish pedestrian signal timings.
- Establishing ped timings can be difficult as crossing speeds vary widely
  - Predominate speed of slower pedestrians is often used
  - When faster pedestrians use crossings, unnecessary delays to motorists
  - If faster times used, slower pedestrians may not have enough time to cross

*www.walkinginfo.org
Passive Pedestrian Detection
FHWA Article

☐ Why Pedestrian Monitoring/Detection?

☐ Can help avoid potential harm to pedestrians when collision avoidance measures or emergency vehicle preemptions are imposed when pedestrians are present.

☐ Can help reduce delays, minimize fuel consumption, and limit vehicle emissions by facilitating traffic control optimization when pedestrians are absent.

Common issues/habits of pedestrians

- At signalized intersections and midblock crosswalks, pedestrians use PPB’s to request a WALK signal.
- In many cases, after pressing the button, peds do not wait for the signal but instead cross when they see a break in traffic.
- When WALK signals finally appears, peds may no longer be in the crosswalk and the vehicles needlessly stop.
- OR peds do wait and cross quickly making vehicles idling for no reason.
- OR if a ped is slow (and crosswalk time often fixed) more time may be required to cross.

Passive Pedestrian Detection
FHWA Article

- Both applications (reducing and extending crosswalk times) require a ped monitoring device.
- When device detects peds in the crosswalk, it sends a signal to the traffic signal controller, which extends the walk phase.

Sec 4E.06-Pedestrian Intervals and Signal Phases

Guidance- Except as provided in paragraph 8 (next slide), the pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the curb or shoulder at the end of the WALKING PERSON signal indication to travel at a walking speed of 3.5ft/second to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait.
Passive Pedestrian Detection
2009 MUTCD

☐ Sec 4E.06-Pedestrian Intervals and Signal Phases

☐ Option- A walking speed of up to 4ft/second may be used to evaluate the sufficiency of the pedestrian clearance time at locations where an extended PPB press function has been installed to provide slower peds an opportunity to request and receive a longer ped clearance time. Passive ped detection may also be used to automatically adjust the ped clearance time based on the ped’s actual walking speed or actual clearance of the crosswalk.
Passive Pedestrian Detection
“PUFFIN” Crossings (UK)-

- “Pedestrian User-Friendly Intelligent” crossing
- Waiting detectors
  - Pedestrian pushes PPB
  - Detectors confirm the presence of pedestrians standing near the crossing
  - If pedestrian leaves before the onset of the Walk interval, the call for the ped phase is canceled.
- Crosswalk detectors (detect peds in crosswalk and...)
  - A preset extension is added to the ped clearance
  - Late-starting or slow-moving pedestrians have more time to clear the intersection
  - Driver waiting time is reduced if the pedestrian crosses in a gap in traffic instead of waiting (J-walk ?)

*www.walkinginfo.org
Passive Pedestrian Detection
Transportation Enhancement Funds

- "Communities across America are using Transportation Enhancements (TE) funds from the federal government to expand travel choice, strengthen the local economy, improve the quality of life, and protect the environment."

- Twelve (12) activities eligible for Transportation Funds
  - (Pedestrian & Bicycle Facilities)
    - New or reconstructed sidewalks, walkways, or curb ramps, Bike lane striping, wide paved shoulders, Bike parking and bus racks, New or reconstructed off-road trails, Bike and pedestrian bridges and underpasses.
  - Passive detection can help compliance with ADA.

http://www.enhancements.org
Passive Pedestrian Detection
Traficon Product Options

(moving peds) (waiting peds)

Please stop by booth #8
Passive Pedestrian Detection - “C-Walk”

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Passive Pedestrian Detection
Introduction to Traficon “C-Walk”

• Video-based, passive pedestrian detector
  • C-Walk (moving peds)

• C-Walk based on Traficam II platform & form factor

• Pedestrian algorithm based on Traficon’s VIP-T incident detection system (2006)
Passive Pedestrian Detection

Introduction- Pedestrian Algorithm

Initial Incident

Pedestrian Alarm

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Passive Pedestrian Detection

Introduction to Traficon “C-Walk”

- Provides detection for pedestrians approaching & moving within the crosswalk
- Directional sensitivity to avoid false calls
- Delay/Extend
- Image recall/failsafe
- One unit can cover crosswalk approach and 2 lanes, 2 models
  - 2.1 mm - 0-36’
  - 6 mm - 33-66’
- Required illumination - 15 lux (soon 5 lux)

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Passive Pedestrian Detection
Introduction to Traficon “C-Walk”

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Passive Pedestrian Detection
C-Walk- Deployment

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Passive Pedestrian Detection

C-Walk Setup

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Passive Pedestrian Detection
C-Walk Setup

Show Offline Network

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Passive Pedestrian Detection
C-Walk Functionality

1 Traficam C-Walk Unit covers 2-3 lanes

Please stop by booth #8
Passive Pedestrian Detection
C-Walk Functionality

1 Traficam C-Walk
Unit covers 2-3 lanes

SCHOOL

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C-Walk Installation
Virginia Beach, VA

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Passive Pedestrian Detection
C-Walk- Test Site Virginia Beach, Feb 2009

Virginia Beach Convention Center

Issue: Problems with microwave ped detector

Intersection
Crosswalks
Virginia Beach Convention Center
Additional Site Photos

Please stop by booth #8
Previously microwave detectors were being used to detect pedestrians. Too many false detections. Traficon C-Walk detectors are presently installed on these same poles.

Both crosswalks are identical

booth #8
Virginia Beach Convention Center
Nighttime Light Readings

Light readings

10.7 lux

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Passive Pedestrian Detection
C-Walk- Test Site Virginia Beach, Feb 2009

Please stop by booth #8
Passive Pedestrian Detection
C-Walk- Test Site Virginia Beach, Feb 2009

Go To VLC Video #1

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C-Walk Installation
Prince Georges County, MD
(Colleage Park)
Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

Issue: PPB non-use

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Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

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Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

Light readings

23 lux
24 lux

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Please stop by booth #8
Traficon C-Walk Installation

New Detection Area/Coverage

Existing Push Button

Traficon C-Walk Sensor
Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

Traficon C-Walk Sensor

New Detection Area/Coverage

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Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009
Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

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Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

- Debate between county council and public works about installing a traffic signal here.
- May go with RRFB or HAWK as compromise.
- DPW Director observed C-Walk in action recently. PPB non-use.
Passive Pedestrian Detection
C-Walk- Test Site PG County MD, June 2009

Go to VLC Video #2
C-Walk Installation

Salem, OR

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Passive Pedestrian Detection
C-Walk- Salem, OR Jan 2010

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Passive Pedestrian Detection
C-Walk- Salem, OR Jan 2010

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Passive Pedestrian Detection
C-Walk- Durham, NC (April 2010)

Issue: Complaints from joggers/cyclists

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Passive Pedestrian Detection Systems

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Passive Pedestrian Detection
C-Walk- Durham, NC (April 2010)

C-Walk Interface Panel
Passive Pedestrian Detection
C-Walk- Durham, NC (April 2010)

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Please stop by booth #8.
Passive Pedestrian Detection
C-Walk- Durham, NC (April 2010)

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Passive Pedestrian Detection
C-Walk- Durham, NC (April 2010)

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Passive Pedestrian Detection
C-Walk- Durham, NC (April 2010)

Go To VLC Video #3, #4

Please stop by booth #8
C-Walk Installation
Washington, DC

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Passive Pedestrian Detection
C-Walk- Washington, DC (April 2010)

Issue: There are no PPB’s at this location. System in ped recall and ties up traffic during peak times.
Passive Pedestrian Detection
C-Walk- Washington, DC (April 2010)

C-Walk Interface Panel

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Passive Pedestrian Detection
C-Walk- Washington, DC (April 2010)

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C-Walk

North Side

Detection Area

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Passive Pedestrian Detection
C-Walk - Washington, DC (April 2010)
Passive Pedestrian Detection
C-Walk- Washington, DC (April 2010)

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Please stop by booth #8 Detection Area

South Side

C-Walk

Jefferson Memorial
Passive Pedestrian Detection
C-Walk- Washington, DC (April 2010)

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Passive Pedestrian Detection
C-Walk- Washington, DC (April 2010)

Go To VLC Videos #5, #6, #7

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Passive Pedestrian Detection

C-Walk References in Europe

- Europe:
  - Portugal:
    - Braga: 5 units
  - Ireland:
    - Dublin: 1 unit
  - United Kingdom:
    - Dudley & Berkshire: 1 unit
  - Switzerland:
    - Zürich: 3 units

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Passive Pedestrian Detection Systems

Passive Pedestrian Detection - “SafeWalk”

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Passive Pedestrian Detection
Introduction to Traficon “SafeWalk”

- Next level of pedestrian algorithm
- Video-based, passive pedestrian detector
  - SafeWalk (Waiting peds)
- “Stereovision” increases detection accuracy
- Directional
- Detection area is directly under sensor (0-20’) (wide angle)
- Min illumination- 10 lux
Passive Pedestrian Detection

Introduction to Traficon “SafeWalk”

- IP 68 housing
- CMOS 1/3” 3mm
- 24 – 48 V AC/DC
- Digital output
- Ethernet
- Junction box
- Mounting bracket
- Optional IR spot 24V

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Passive Pedestrian Detection
Introduction to Traficon “SafeWalk”

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Passive Pedestrian Detection
Introduction to Traficon “SafeWalk”

Eyes & Brain

Camera & Computer

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Passive Pedestrian Detection
Why 3D?

“Stereo Vision” can measure depth

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Passive Pedestrian Detection
3D examples

“Detection Images” on right (dark area) do not measure flat surface

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Passive Pedestrian Detection
SafeWalk Lab Videos

Go to VLC Videos #8, #9
Passive Pedestrian Detection

Concept

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Passive Pedestrian Detection

Concept

Please stop by booth #8
Passive Pedestrian Detection

Concept

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Passive Pedestrian Detection
Concept

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Concept

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Passive Pedestrian Detection

Concept

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Passive Pedestrian Detection
Photos

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Passive Pedestrian Detection
Reference: Celle
Video examples
Passive Pedestrian Detection

What’s Next?

- Testing continues with positive results
  - “Ground Truth” tests planned
- Early discussions with MUTCD and NEMA sub committees on developing standards
  - Where to deploy/how
  - How do you alert the pedestrian they’ve been detected?
- Agencies have various ideas on applications and there is discussion on public education related to passive detection.

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Warning Beacons
RRFB- Rectangular Rapid Flashing Beacon

- Alternating, quick flashing
- Indications for pedestrian as well as motorist
- FHWA- July 2008- “Interim Approval for Optional Use of RRFB- IA-11”
- Initial sites in FL found “yield to pedestrian” compliance rates at “close to 100%” (15 months later) versus 15-20% for standard beacon.
- Show RRFB VLC video
Pedestrian Hybrid Beacon—Formerly “HAWK”

- Dark signal until activation.
- Upon activation:
  - Flashing Yellow
  - Solid Yellow
  - Solid Red ("WALK")
  - Flashing RED (Ped Clearance)

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Pedestrian Hybrid Beacon-
Formerly “HAWK”

<table>
<thead>
<tr>
<th>What Drivers See</th>
<th>What Pedestrians See</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DARK</td>
<td>Push the button.</td>
</tr>
<tr>
<td>2. FLASHING</td>
<td></td>
</tr>
<tr>
<td>3. STEADY</td>
<td></td>
</tr>
<tr>
<td>4. STEADY</td>
<td>Start crossing.</td>
</tr>
<tr>
<td>5. ALTERNATING (like RXR)</td>
<td>Continue crossing.</td>
</tr>
<tr>
<td>6. DARK</td>
<td></td>
</tr>
</tbody>
</table>

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For more info please stop by booth #8

Thank You!

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