
Exterior Occupancy Sensor Development

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Content

• Legislation towards Energy Efficiency
• Exterior Sensors - Types & Technologies
• Testing Efforts / Field Demos
• Identified Gaps & Next Steps
CA Legislation affecting exterior lighting
AB32 / AB1109 / CA strategic Lighting Plan - Title-24

2008
• All outdoor lighting must have:
  1. Photocontrol OR
  2. Automatic scheduling control

2013
• All outdoor lighting must have:
  1. Photocontrol and/or
  2. Automatic scheduling
  3. AND Motion sensors

• Luminaires < 24 ft. from ground
  – Must have auto-on
  – Must have controls that reduce lighting power by at least 40%
  – Includes frontage areas, canopies, wall packs, building facades, outdoor dining, etc.
Exterior Sensors
Types & Technologies
Exterior Sensors – Types & Technologies

- Inductive loops / magnetic sensors
- Acoustic (passive or active)
- IR (Passive or active)
- Radar/Microwave ("CW", "FMCW")
- Image based / Video
- Laser
- “others”, mixture of sensors

Photos: Hypepark Sensorswitch, WattStopper, Comlight, Irisys, Hi-Tech Solutions, Philips, Totus Solutions, Thomas Net, Dallas Volvo
Exterior Sensors – Types & Technologies

Current sensors in use

• PIR

• Radar / MW

• Image / Video

Photos: WattStopper, CLTC, Hi-Tech Solutions, Totus Solutions
Exterior Sensors – Types & Technologies
Associated features & prices

- US.DoT “Freeway Management & Operations Handbook”
- Status 1999 – prices outdated? new technology available?

<table>
<thead>
<tr>
<th>Sensor Technology</th>
<th>Count</th>
<th>Presence</th>
<th>Speed</th>
<th>Output Data Occupancy</th>
<th>Classification</th>
<th>Multiple Lane, Multiple Detection Zone Data</th>
<th>Communication Bandwidth</th>
<th>Sensor Purchase Cost (each in 1999 US$)</th>
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</thead>
<tbody>
<tr>
<td>Inductive Loop</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low to Moderate</td>
<td>Low</td>
<td>($500 - $6000)</td>
</tr>
<tr>
<td>Magnetometer (two axis fluxgate)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low to Moderate</td>
<td>Moderate ($900 - $6,300)</td>
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<tr>
<td>Magnetic Induction Coil</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low</td>
<td>Low to Moderate ($2985 - $2,000)</td>
<td></td>
</tr>
<tr>
<td>Microwave Radar</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Moderate</td>
<td>Low to Moderate ($700 - $2,000)</td>
<td></td>
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<tr>
<td>Active Infrared</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low to Moderate</td>
<td>Moderate to High ($6,500 - $3,300)</td>
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<tr>
<td>Passive Infrared</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low to Moderate</td>
<td>Low to Moderate ($700 - $1,200)</td>
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<tr>
<td>Ultrasonic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low</td>
<td>Low to Moderate (Pulse model: $600-)</td>
<td></td>
</tr>
<tr>
<td>Acoustic Array</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low to Moderate</td>
<td>Moderate ($3,100 - $6,100)</td>
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<tr>
<td>Video Image Processor</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Low to High</td>
<td>Moderate to High ($55,000 - $26,000)</td>
<td></td>
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</tbody>
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Source: US Department of Transportation Handbook
Testing efforts / Field Demos

Test procedure & LD+A / 2\textsuperscript{nd} Street / UC Irvine / VVNBH
Testing efforts
Proof of concept

• CLTC Testing Grounds
• PIR sensor, 28 feet above ground
• Pedestrian, Bicycle, Motorcycle, Car
• Published in LD+A, Aug 2013
Field Demo – Davis, 2nd Street
Overview, planning stage

• Collector road: 35–45 mph speed limit
• Low Pedestrian Conflict Area
• Mounting Height: 28 feet

Retrofit 14x existing LED luminaires with controls
2 traffic lanes + turning lane + bike lane on both sides

Replace 12x HPS luminaires with LED luminaires + controls
2 traffic lanes + bike lane on both sides
Field Demo – Davis, 2nd Street

Process details

- Installed: November 2012
- LED luminaire, 6000K, Dimmable
- RP-8 recommended light levels are met
- Confirmed motion is reliably detected on both sides of the street
Field Demo – UC Irvine
Overview, scheduling, energy savings

• Installed: July 2013, 8x Academy Way & 9x West Peltason Drive
• Prototype Radar/Microwave sensor
Field Demo – VacaValley North Bay Hospital

Overview

• Multistory medical facility, Vacaville, CA

• 50-bed, non-profit hospital

• The exterior grounds cover approximately 150,000 square feet

• Mix of shoebox parking area luminaires, wall packs & ceiling lamp

• 54 luminaires - plasma, metal halide, high pressure sodium

Photos: CLTC
Field Demo – VacaValley North Bay Hospital
Planning, Lighting Zones & Sensor Coverage Area

- **S1**: South parking lot, for visitors

- **N1**: North parking lot, for general employee parking

- **E1**: East parking lot, dedicated for night shift ER nurses

- **ER1**: Emergency route, for immediate care drop off
Gaps & Next Steps

Installation / commissioning / lookout
Gaps
physical issues & commissioning

• Sensor integration @ factory
• Ext. sensor coverage
• Directional installation
• Validation procedure
• Commissioning strategies

Photos: CLTC
Next Steps
lookout

• evaluate image based sensors

• evaluate emerging Radar / MW products

• Stand-alone sensors  vs. “Sensor Systems”

• Lookout to other industries and research?
CLTC case studies adaptive lighting

Adaptive Exterior Lighting Guide

Adaptive LED Wall Packs at UC Davis

Wireless Integrated Photo Sensor and Motion Sensor Packs

Adaptive HID Wall Packs

Parking Garage Luminaires

Adaptive LED Parking Garage Luminaires

Curfew Dimming Parking and Area Luminaires

Bi-level Street and Parking Area Luminaires
Questions please!