# Using AI at Non-Signalized Crossings to Improve Safety

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# AI/Sensors – Making Physical Infrastructure Smarter

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# AI + Sensors and Traffic Operations

Intersections: Safety Analytics, Signal Timing, V2X Messaging

Highway and Arterial Road Network: Wrong Way Detection, Incidents, Congestion, Weather Conditions

Vehicles: ADAS ; Lane Departure Warnings, Automatic Emergency Braking, Forward Collision Warnings, Self Driving

# Away from Signalized Intersections

70%+ of Pedestrian deaths and severe injuries

60% of Bicyclist deaths and severe injuries

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# Non-Signalized Crossings: Challenges

## Mid-Blocks, Trail Crossings, Schools Zones, Non-Signalized Intersections

- Traffic devices are not smart
- Push buttons are often ignored
- Not enabled with sensors
- Drivers often ignore beacons
- No risk data

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# RRFBs and PHBs/HAWKs Safety Risks

- Manual activation –> No press = VRU unprotected
- No sensors to detect presence of VRUs or approaching Vehicles
- ADA challenges
- Bicycle unfriendly
- Fixed default clearance times -> Risks for disabled, elderly, and others
- Drivers fail to yield -> Beacons flashing … VRUs have crossed? … ignore flashers

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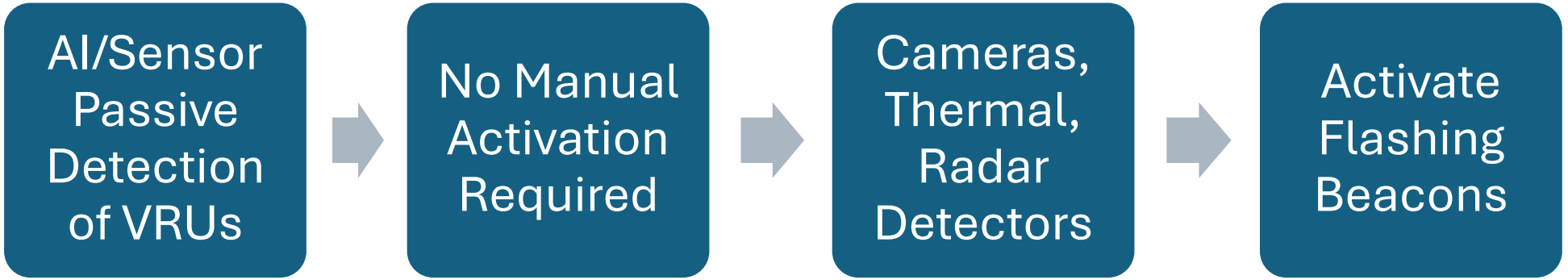
# Applying AI at Non-Signalized Crossings

First Generation – AI Computer Vision

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# Applying AI at Non-Signalized Crossings

First Generation Challenges

- Insufficient Detection Accuracy – Higher rates of false positives, false negatives
- Hardware costs too high; Power consumption challenging for solar panels
- Partial Solution – Activate Beacons, but nothing else
- No data collection/safety insights for decision makers

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# Current State

Expanded Detection with Higher Accuracy

- Detect VRUs
- Detect Vehicles

Expanded Activation and Controls

- Beacon Activation to Alert Vehicles
- Illumination Activation
- V2X Safety Messages
- Audio/Visual Alerts for VRUs
- Dynamic Clearance Deactivation

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# Industry Challenges

Controlling Costs

- Sensors
- Edge Computing
- Solar Power/Panel Requirements
- Install and Integrate
- Data Collection and Insights

Favorable Economic Trends:
Chip/Cloud Compute Costs Decline
Power Consumption Management More Efficient
Easier to Install/Integrate than Intersection Equipment

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# Industry Challenges

False Positives

Avoid Falsely Activating and Deactivating
Beacons, Signals and Other Alerts

AI models continuing to learn and improve
Sensors delivering higher resolution data/classification details
Remote configuration/management of detection zones for adjusting to location characteristics
Less challenging environment than intersections (ie. turning movements)

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# Industry Challenges

Human Behavior

Trained to Push Ped Call

Signage – “Automatic Activation – No Button Needed”
Retain Button as Redundant Option

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# Additional Safety Capabilities

| | | |
|---|---|---|
| Risk | VRUs not paying attention to approaching traffic | AI Detect – Activate Audible and Video Warnings for VRUs when at Risk of Approaching Vehicles |
| Risk | Vehicles ignore flashing beacons and violate yield | AI Detect – Deactivate Warnings when VRUs Complete Crossing (Adjustable Beacon Duration) |

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# Additional Safety Capabilities

| | | |
|---|---|---|
| Risk | Default Crossing Time Too Short for Elderly, Disabled, Large Event Flows, School Peak | AI Detect – Extend Warnings until all VRUs Complete Crossing |
| Risk | Traffic operations/planning have no data insights into RRFB/PHB safety impact | AI Analytics – Near Misses, Vehicle Yield Compliance, Speeds, Counts, Trajectories |

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# AI Detection Example at Crossing


Multiple and configurable detection zones with different algorithms and rules

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# Wrap Up

- AI Benefits Can Be Extended to Non-Signalized Crossings
- Without Data, How Do We Know Sites are Optimized for Safety?
- Dumb Devices are Becoming Smart /Add Value Across our Lives
- Costs are Declining for Sensors/AI/Control Systems

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