AIM Innovation Showcase Application

# Sponsor

**Nominations must be submitted by an AASHTO member DOT willing to help promote the innovation.** If selected, the sponsoring DOT will be asked to present the innovation at the Innovation Showcase during the AASHTO Spring Meeting.

1. Sponsoring DOT (State): Texas Department of Transportation (TxDOT)

2. Name and Title: Michael Bolin, P.E, Deputy District Engineer

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# Innovation Description (30 points)

The term “innovation” may include processes, products, techniques, procedures, and practices.

3. Name of the innovation:

Using AI to Detect Blocked Railroad Crossings

4. Please describe the innovation.

An artificial intelligence (AI) solution approach was constructed using machine learning (ML) and image recognition to provide a flexible blocked railroad crossing detection and monitoring system. The solution is implementable off railroad right-of-way (ROW) and information is made available to a wide range of users, including emergency services who had no previous insight into a blocked crossing until their arrival. This innovation saves significant and precious response time and results in increased safety and positive outcomes for emergency calls. While the specific current application relates to blocked railroad crossings, the solution can be applied to other scenarios where it is desirable to monitor for blocked infrastructure in urban and rural areas that do not have a fully built-out traffic management system.Click or tap here to enter text.

5. What is the existing baseline practice that the innovation intends to replace/improve?

A pre-emption signal based on the short-circuit of railroad track circuits due to an approaching rail vehicle is the standard mechanism for providing advanced notice of an impending railroad crossing. However, this pre-empt is not always available, can take years to implement with railroad bureaucracy, and is only effective into the traffic signal controller, if one is present. Alternative concepts are necessary to provide a much more robust and wider awareness outside of signalized intersections. Users such as emergency services that depend on non-signalized crossings for critical routes have no awareness of the crossing being blocked until they confront the crossing arm. Additionally, this awareness must be generated outside of railroad right-of-way to minimize interference and time delay in setting it up.

6. What problems associated with the baseline practice does the innovation propose to solve?

(1) Baseline practice only works at signalized intersections. (2) Baseline practice is costly and can take significant time to implement. (3) Baseline practice has no capability to provide alerts outside of the localized signal site.

7. Briefly describe the history of its development.

The project concept was generated after the City of Nolanville, TX, experienced multiple delays in on critical services routes for emergency service calls, due to the presence of a train at an unsignalized intersection. The City reached out to TxDOT, who in conjunction with a research partner, developed , trained, and implemented an artificial intelligence machine learning approach using standard low-cost CCTV cameras located off railroad ROW. Coupled with cellular communications and cloud-based processing, the system provides a robust and flexible approach that can be implemented anywhere a clear line of sight (even angled or on the other side of the grade crossing arm) is available. Power can be solar or utility based on the availability of local resources.
The project initiated with a site review of the two critical crossings identified by Nolanville from provided insight into potential camera positions and power locations. Discussion was also had with the City Emergency Services Departments (EMS) to identify their needs and where and how they wanted to be provided alerts. The first location underwent testing with a portable trailer that could easily be moved to different locations to ascertain the best position for permanent deployments. This trailer also recorded the video which was used to conduct the training set for the ML algorithms. After initial deployment and extensive testing, the system was deployed at the two critical sites within the City that have a substantial and negative impact of EMS response if blocked. Current status of these intersections along with other information pertaining to the event, such as amount of time the crossing has been blocked, etc., is published in real-time to a web page that is accessible to EMS and the public.

8. What resources—such as technical specifications, training materials, and user guides—have you developed to assist with the deployment effort? If appropriate, please attach or provide weblinks to reports, videos, photographs, diagrams, or other images illustrating the appearance or functionality of the innovation below (if electronic, please provide a separate file). Please list your attachments or weblinks here.

Communication documents were developed that included a single-page PowerPoint™ overview for general concept awareness, a project innovation brief that provided additional details on the key tasks, and a detailed technical report that provided the technical project information.
Available on request: PowerPoint™ overview slide
Available on request: Innovation Brief
Reference: Nolanville EMS Web Site: http://gradecrossing.tti.tamu.edu/

# State of Development (10 points)

Innovations must be successfully deployed in at least one State DOT. The AIM selection process will favor innovations that have advanced beyond the research stage, at least to the pilot deployment stage, and preferably into routine use.

9. How ready is this innovation for implementation in an operational environment? Please select from the following options. Please describe.

[ ]  Innovation is fully functional and yet to be piloted.

[ ]  Innovation has been piloted successfully in an operational environment.

[ ]  Innovation has been deployed multiple times in an operational environment.

[x]  Innovation is ready for full-scale implementation.

This innovation is ready to be deployed at other locations where the same/similar situation exists. Project outreach is underway so that similar needs across the state can be identified and implemented.

10. What additional development is necessary to enable implementation of the innovation for routine use?

None

11. Do you have knowledge of other organizations using, currently developing, or showing interest in this innovation? [x]  Yes [ ]  No

If so, please list organization names and contacts.

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **Name** | **Phone** | **Email** |
| City of San Marcus, TX | Click or tap here to enter text. | Click or tap here to enter text. | Click or tap here to enter text. |
| City of West, TX | Click or tap here to enter text. | Click or tap here to enter text. | Click or tap here to enter text. |
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# Potential Payoff (30 points)

Payoff is defined as the combination of broad applicability and significant benefit or advantage over baseline practice.

12. Identify the top three benefits your DOT has realized from using this innovation. Describe the type and scale of benefits of using this innovation over baseline practice. Provide additional information, if available, using quantitative metrics, to describe the benefits.

|  |  |
| --- | --- |
| **Benefit Types** | **Please describe:** |
| Improved Safety | Notification of blocked crossings reduce transit time for EMS responders providing critical support. |
| Organizational Efficiency | EMS is substantially more aware of their full route and any necessary changes prior to leaving their station resulting in faster response times and reducing the time to first aid. |
| Improved Operation Performance | AI detection of crossing status applies to all intersection types, not just signalized intersections (as opposed to the traditional method of a pre-empt), allowing for a much more robust awareness, reporting, and implementation across the entire system to improve both operations of the surface transportation system and the response agencies.  |

Provide any additional details below:

Click or tap here to enter text.

# Deployability (30 points)

The AIM selection process will favor innovations that can be adopted with a reasonable amount of effort and cost, commensurate with the payoff potential.

13. What challenges and/or lessons learned should other organizations be aware of before adopting this innovation?

* Using video as a sensor allows for great flexibility in sensor location away from the railroad.
* The view should minimize objects with similarity to railroad objects (crossings gates, freight cars, locomotives) to avoid false positive detections.
* The background should be evaluated day and night. Harsh lighting from background object is detrimental
* The video camera needs to provide a good view in inclement weather. For example, water droplets on the lens greatly distorts the image.

14. Please provide details of cost, effort, and length of time expended to deploy the innovation in your organization.

**Cost**: Field equipment approximate cost is $3500 and installation costs will be similar to the cost of deploying a new CCTV camera

**Level of Effort**: A new CCTV site will need to be deployed in the field. The AI model will need some additions to optimize the detection reliability for the specific site. The additions should take a few days of collection and incorporation.

**Time**: Overall time from conception through testing and validation was less than 4 months.

15. To what extent might implementation of this innovation require the involvement of third parties, including vendors, contractors, and consultants? If so, please describe. List the type of expertise required for implementation.

The AI model vendor/maintainer will need to add some specific images from the new location to optimize the detection reliability but the effort is minimal.