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Research Results

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Trespass on Railroad Rights-of-Way

SUMMARY

A June 1997 incident in which two teens were fatally injured by a train on a bridge in Pittsford, NY, spurred the U.S. Department of Transportation's (USDOT) Federal Railroad Administration's (FRA) Office of Safety to conduct research into trespass prevention at railroad rights-of-way (ROW). The USDOT/Research & Innovative Technology Administration's (RITA) John A. Volpe National Transportation Systems Center (Volpe Center), under the direction of FRA, conducted a 3-year demonstration of an automated prototype railroad infrastructure security system on a railroad bridge. This commercial-off-the-shelf (COTS) technology system was installed at the bridge in Pittsford, NY, where the two teen fatalities had occurred.

This video-based trespass monitoring and deterrent system, shown in Figure 1, has the capability of detecting trespass events when an intrusion on the railroad ROW occurs. Once a trespass event occurs, the system transmits audible and visual signals to the monitoring workstation at the local security company, where an attendant validates the alarm by viewing the live images from the scene. The attendant then issues a real-time warning to the trespasser(s) via pole-mounted speakers near the bridge, contacts the local police, and, if necessary, the railroad police. All alarm images are stored on a wayside computer for evaluation. The system was installed in August 2001 and evaluated over a 3-year period, ending in August 2004.

The safety benefits of this prototype system were reviewed and found to be very favorable. At least 5 lives were potentially saved during 3 separate trespassing incidents over the 3-year evaluation period. This interactive system can serve as a model for railroad infrastructure security applications at other railroad ROW or bridges prone to intrusion. After the evaluation period was completed, FRA formalized a technology transfer agreement with CSX Transportation (CSXT) that handed over control of the wayside system to the railroad.

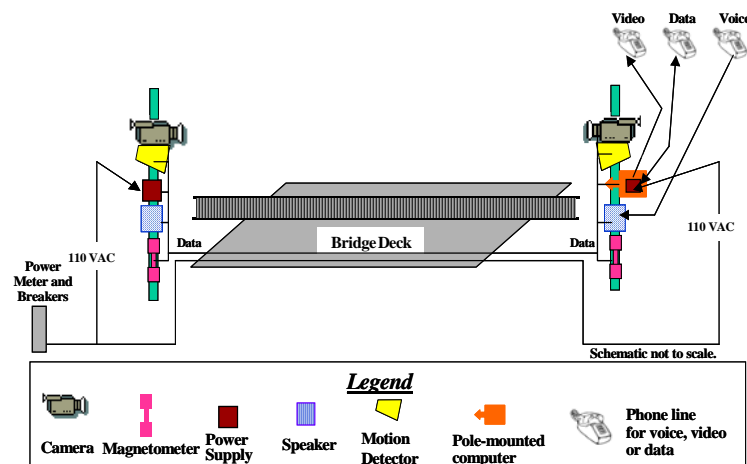


Figure 1. Illustration of the surveillance system technology



BACKGROUND

Railroad ROW trespass has long been a safety concern. Over the past 25 years, railroad crossing-related incidents have been declining; however, trespassing fatalities have remained constant at approximately 500 annually. Since 1996, trespass-related fatalities have outnumbered crossing-related fatalities. Another growing concern is railway security.

Louise Slaughter, the U.S. Congresswoman from Pittsford, initiated the drive for the selection of the bridge where the teenagers were struck by a train as the site for the FRA trespass detection demonstration project. The bridge, shown in Figure 2, was built in 1918 and is owned by CSXT. A pedestrian walkway under the bridge on the eastern approach provides easy access.

The bridge is situated about 800 feet east of the Monroe Avenue railroad crossing and spans the Erie Canal. It was originally double-tracked, but



Figure 2. Pittsford, NY, railroad bridge chosen for demonstration project

only one track remains in place. The route serves as a mainline freight bypass around the city of Rochester, NY. An average of approximately 9 freight trains use the bridge every day, at speeds up to 60 mph. Before installation of the security system in 2001, the bridge experienced frequent trespass events, including teenagers looking for a meeting location and area residents seeking a shortcut or a place for recreational fishing.

RESEARCH OBJECTIVES

The main objectives of this project were to:

- Demonstrate a stand-alone video-based trespass monitoring and deterrent system for

railroad infrastructure applications using COTS technology.

- railroad infrastructure applications using COTS technology.
- Evaluate the system's operational performance.
- Tabulate the initial deployment and life-cycle costs associated with the system's implementation.
- Estimate the number of lives potentially saved by the system during the initial 3-year deployment.

RESEARCH METHODS

- Measure the number of alarm events, including both positive and false activations.
- Track equipment, operating, and maintenance costs over the three system hardware and software configurations.
- Record close-call events in which a train arrives within 5 minutes of a trespass alarm and use as a metric to estimate lives saved.
- Quantify the potential benefits of this system.

Planning and design began in 1999, and the system was installed in August 2001. As shown in Figure 3, the system is composed of video cameras, motion detectors, infrared illuminators, magnetometers, and speakers mounted on two poles, one on each end of the bridge monitoring the bridge entrance. A central processing unit (CPU), located on one of the poles and equipped with a remote video surveillance software package, receives all of the inputs from these components and serves as a communication point to the monitoring station, as well as a repository for alarm images.

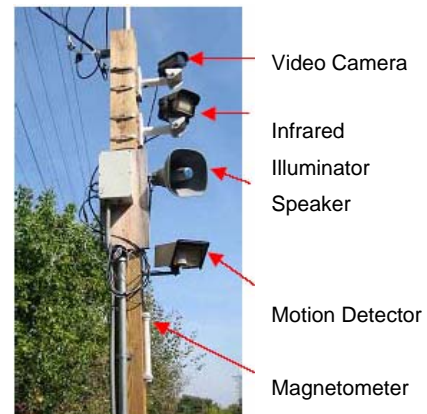


Figure 3. Pole configured with monitoring and detection components



The system digitally records pre-alarm and post-alarm video on the pole-mounted CPU and transmits video and data via a broadband connection to the monitoring station upon alarm activation. In case of a malfunction, the system can be re-booted remotely.

Volpe Center contracted Doyle Security, a local security company, to implement an incident detection procedure. When the motion sensors are activated, the security attendant observes the video. If a trespasser is present, the attendant speed-dials the bridge loudspeakers to warn the trespasser that he/she is trespassing, is in danger of being struck by a train, and should leave the area immediately. If the trespasser leaves, the incident is documented. Otherwise, the local sheriff and CSXT police are notified, and the trespasser is warned again. During the evaluation period, Doyle Security transmitted weekly event logs to the Volpe Center for review and analysis.

FINDINGS AND CONCLUSIONS

The main objective of this research prototype was to install an intrusion detection system that allows real-time monitoring of the railroad bridge and real-time verbal warnings to trespassers. The demonstration proved that this could be accomplished using standard non-intrusive COTS components installed outside the railroad ROW and not tied into track circuitry. Upon the conclusion of the evaluation period, a technology transfer agreement was formalized in September 2005 between FRA and CSXT. This agreement transferred control of the wayside system to CSXT, effectively extending the safety service it demonstrated during the 4-year period under Volpe Center control.

Operational Performance

Several remediation measures were employed to lower false alarm occurrences, as shown in Figure 4. Component reliability also became a major concern due to the long downtime periods generated by most component failures.

The prototype system design dates back to 1999, before the 9/11 terrorist attacks. Since then, new technologies, such as intelligent video, digital video recording, and broadband communications, have evolved significantly.

In addition, entire integrated detection systems have been developed within the past few years, mainly

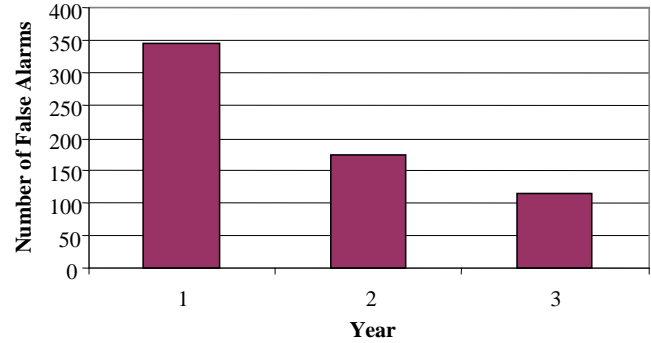


Figure 4. Number of false alarms during the first 3 years of operation

for emerging applications related to Homeland Security. Much of today's driving force behind railroad asset monitoring, both fixed and moving, stems from security concerns related to high-risk shipments and routes. Although not specifically designed for pedestrian or trespass safety, most of these systems have the ability to address this safety issue.

Life-Cycle Costs

The cost of prototype development is usually significantly higher than just the combined cost of design and installation. As such, onetime expenditures attributed with non-recurring engineering (NRE) of this prototype railroad infrastructure security system increased design and installation costs to approximately \$200,000. Assuming no NRE is required, the cost associated with duplicating the system at other locations is estimated at \$40,000. Table 1 lists the total system life-cycle cost over the 3-year evaluation period.

Table 1. System life-cycle costs

Service	Cost
Design and Installation	\$40,000
Equipment	\$13,500
3-Year Operations and Maintenance	\$37,980
Total	\$66,166

Safety Benefits

A total of 173 trespassing events were logged during the 3-year evaluation period. Of those, at least two involved a total of four trespassers departing the bridge just minutes before the arrival of a train. A third event involving one trespasser



occurred just after the conclusion of the evaluation period. Figure 5 shows one of these close-call events.



Figure 5. Top—Two trespassers who are warned. Bottom—Train arrives 1 minute later

USDOT has estimated the value of a human life at \$3 million. As such, the 4 deaths or serious injuries that were potentially prevented during the evaluation period yielded projected societal benefits in the \$12 million range.

Lessons Learned

Ultimately, this prototype system could be used as a template for future railway asset monitoring systems. This platform could be adapted for use with new technologies and components to form next-generation intrusion detection and warning systems.

This project demonstrated that monitoring, relaying real-time information to safety officials, and warning trespassers could be achieved by

the use of COTS components. Furthermore, this could be accomplished off the railroad ROW, meaning that it could be installed and used by railroad companies, as well as by local governments or other public entities whose interests include higher railroad safety, security, and mobility. The Volpe Center is developing a set of performance guidelines for these types of railway safety and security systems for use by railroads in reducing trespassing along their ROW.

REFERENCES

[1] *Railroad Infrastructure Trespassing Detection Systems Research in Pittsford, New York*. Da Silva, M., Baron, W., Carroll, A. Final Report. August 2006. DOT/FRA/ORD-06/203. DOT-VNTSC-FRA-05-07.

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