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Office of Security Technology

Airport Perimeter Security Projects for FY08-09

FINAL REPORT

Bert Mooney Airport (BTM)

Intelligent Video/Neural Networking Solution

U.S. Department of Homeland Security
Transportation Security Administration
Office of Security Technology
Advanced Surveillance Program
701 South 12th Street
Arlington, VA 20598-6016

[redacted]

OVERVIEW

INTRODUCTION

In fiscal year (FY) 2006, the Transportation Security Administration (TSA) announced opportunities for general perimeter security enhancement projects at airports with typical configurations and existing barriers, such as fencing and concrete barricades. The announcement requested information from airport authorities on existing airport perimeter security vulnerabilities and proposals to mitigate those vulnerabilities through the inventive use of available technologies at intended perimeter access points (such as vehicle gates), perimeter boundaries, and terminals.

In FY 2008, TSA reissued the Airport Perimeter Security (APS) announcement to all airports, along with a second announcement addressing small to medium-sized airports with few or no barriers around their perimeters. The second announcement was for the Virtual Perimeter Monitoring System (VPMS) project intended to test a more elaborate solution that would better fit a smaller airport. The VPMS solution was developed by the Navy.

TSA requested airports provide white papers explaining the security deficiencies to be addressed and proposals, including technologies to be deployed and full life-cycle project cost estimates. 65 airports responded to the FY 2006 request and 35 airports responded to the FY 2008 requests. The airports proposed projects of varying complexity, from installation of a single piece of equipment to sophisticated, integrated systems.

Six airports were selected in FY 2006 to participate in the APS projects. In FY 2008 and 2009, TSA selected six additional airports for participation in APS and three airports for VPMS projects.

The attached report covers the test results of only one of the 15 total test sites. TSA plans to release each report singularly as the test results are completed and made available. Corrected

IMPLEMENTATION

This project pertained to the evaluation of the intelligent video/neural networking solution at the Bert Mooney Airport (BTM). BTM integrated an intelligent video/neural networking component that would both support the continuous monitoring of critical resources and provide additional access control at Security Identification Display Areas. A number of different pieces of video, network, management and monitoring equipment to include operating and Software Development Kit (SDK) development software were used to design and integrate the test system into the existing security operations. All tested components were commercial off-the-shelf (COTS) technologies and were designed to enhance their perimeter security capabilities. This innovative approach was designed to provide both continuous monitoring of critical resources

National Safe Skies Alliance (Safe Skies) provided independent verification and validation (IV&V) services and operated along with airport authorities to verify that the intelligent video/neural networking solution enhancements met the airport's security expectations. The IV&V was concluded December 10, 2010.

The Safe Skies Lead Test Engineer (LTE) generated a site survey document based on a preliminary survey of the locations prior to the deployment of the security technology improvements. The LTE developed operational testing procedures used as the basis for determining if the system met the security requirements of BTW airport authorities. Representatives of TSA, Safe Skies, and BTW convened to discuss and verify the system requirements prior to the implementation of evaluation procedures. The resulting operational data was analyzed by the Safe Skies statistical team and combined with the site survey information to generate the final report.

SUMMARY

From the data presented in the final report, it is clear that the intelligent video/neural networking solution had a positive effect on the BTM perimeter security efforts.

Installation of the system was reported to be relatively uncomplicated. All parties (vendors, installers integrators and tester) involved, were familiar with the climate at BTM, the requirements of the APS enhancement, and the importance in equipment selection and placement. Robust mounting hardware and environmental enclosures were selected to provide the most reliable performance under a wide range of weather conditions.

All nodes [redacted] and all data was successfully relayed back to the Human-Machine Interface (HMI). A KVM switch was used at the HMI console to toggle between different computers. However, it was not necessary to use the KVM switch for normal monitoring and operation tasks.

Most of the different components of the integrated system performed well with a few exceptions. The report data tables reflect all of the testing parameters by sub-system and testing locations throughout the airport perimeter.

Lastly, at the time of the evaluation, airport personnel had been trained in the operation of the system, but had not been actively using it at a level that would provide useful end user feedback. User surveys will be administered when personnel have enough experience to fairly assess the system.

[redacted]

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16. Supplementary Notes

This report was prepared by John Hunsucker of National Safe Skies Alliance.

17. Abstract

The Transportation Security Administration (TSA) established the Airport Perimeter Security (APS) program to provide U.S. airports with funding to purchase, install, and integrate commercial off-the-shelf technologies to enhance their perimeter security capabilities. Through APS, BTM integrated an intelligent video/neural networking component that would both support the continuous monitoring of critical resources and provide additional access control at Security Identification Display Areas. The project was managed by MSE Technology Applications, Inc., which was partnered with Industrial Automation Consulting, Inc. and Imagination Engines, Inc.

To comply with requirements of the APS program, BTM submitted the system for Operational Test and Evaluation, which was conducted onsite at BTM December 6-10, 2010. National Safe Skies Alliance collected performance data to determine the system's operational effectiveness.

18. Key Words

Access Control, APS, Bert Mooney Airport, BTM, Facial Recognition, Neural Network, Perimeter Protection, Perimeter Intrusion Detection Device, Video Analytics

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EXECUTIVE SUMMARY

National Safe Skies Alliance (Safe Skies) performed an Operational Test and Evaluation (OT&E) of the intelligent video/neural networking solution, which was installed at Bert Mooney Airport (BTM) under the Transportation Security Administration's (TSA) Airport Perimeter Security (APS) Program. During the period of December 6 – 10, 2010, Safe Skies evaluated the operational elements of the system to determine whether it resolved Critical Operational Issues (COI) identified in the baseline assessment, and the impact, if any, the system had on established security protocols and procedures.

SYSTEM INSTALLATION & INTEGRATION

The system was designed to provide enhanced monitoring capabilities within regions that the airport deemed critical to the safety and security of BTM. The intelligent video/neural networking solution consisted of the following main components:

- Self Training Autonomous Neural Network Object (STANNO), with three subsystems:
  - Ramp Anomaly Detection Application (RADA)
  - Entrance Area Identification Application (EAIDA)
  - Curbside Anomaly Detection Application (CADA)
- Closed-Circuit Television (CCTV) and Digital Video Recorder (DVR) equipment
- Human-Machine Interface (HMI)
- Verilook Software Development Kit (SDK)

The video streams and data were processed through the individual subsystems, and converged at the HMI, the system's primary control console. From the HMI, a user could monitor and control various aspects of the enhancement, including retrieving live video, reviewing history logs, adjusting cameras, acknowledging alarms, and monitoring the status of subsystems.

RESULTS SUMMARY

The **Ramp Area Detection Application (RADA)** component provided detection capabilities throughout the ramp region, where aircraft were parked [redacted]

Safe Skies performed 180 scenarios within the ramp region while the system was in alarm mode. Testing personnel approached the aircraft from various randomized angles. Output for these tests showed that RADA alarmed [redacted] of the time on scenarios performed in both the [redacted] ramp camera views.

The **Curbside Anomaly Detection Application (CADA)** component monitored the curbside region/loading zone at the front of the terminal on a 24-hr basis for vehicle parking violations. The evaluation team performed scenarios within the loading zone to determine if CADA was both detecting parking violations and reporting the alarm events to BTM security personnel. [redacted]

The **Entrance Area Identification Application (EAIDA)** component was installed to provide additional access control at two SIDA gates near the terminal. Because of personnel enrollment and authentication difficulties with the EAIDA, the APS project team had supplemented this software with a commercial off-the-shelf system, **Verilook SDK**. Verilook performed the personnel screening tasks at both SIDA gates at the time of the evaluation. [redacted]

Personnel Enrollment
Safe Skies evaluators were successfully enrolled into both the EAIDA and Verilook systems; the time required for enrollment varied between applications. Verilook, which required both a day- and nighttime enrollment image, required approximately 1-2 min to complete an enrollment for each image.

EAIDA enrollment was more intensive due to the complexity of the neural networking components. Enrollments in EAIDA required multiple images, or exemplars, of each individual under slightly different lighting conditions. The application required approximately 1 hr to train a single exemplar. Each of the 3 Safe Skies evaluators enrolled 6 exemplars with EAIDA, which required approximately 18 hr of training, or 6 hr per enrollment.

Personnel Authentication
Verilook [redacted]

In facial recognition tests at the pedestrian gate, EAIDA [redacted]

Vehicle Enrollment

EAIDA was responsible for screening vehicles at the SIDA vehicle gate. However, vehicle enrollment was more intensive than was practical for evaluation purposes, and could not be verified under the allotted schedule.

Vehicle Authenticatio[redacted]

Safe Skies utilized [redacted]

Human-Machine Interface

The HMI was designed to be simple and easy to use. Most system functionalities were possible from this single interface. All alarm-associated video was recorded and stored for 30 days, and was also easily accessible using the HMI.

BTM personnel, though trained in the normal operation tasks of the system, had not begun continuously using the system at the time of the evaluation. End-user information and general feedback could not be considered viable and was not collected.

ACRONYMS

APS	Airport Perimeter Security
BTM	Bert Mooney Airport – FAA designation
BMAA	Bert Mooney Airport Authority
CADA	Curbside Anomalous Detection Application
CCTV	Closed Circuit Television
COI	Critical Operational Issue
EAIDA	Entrance Area Identification Application
IAC	Industrial Automation Consulting, Inc.
IEI	Imagination Engines, Inc.
KPP	Key Performance Parameter
MOE	Measure of Effectiveness
MOP	Measure of Performance
MSE	MSE Technology Applications, Inc.
OT&E	Operational Test and Evaluation
RADA	Ramp Area Detection Application
SIDA	Security Identification Display Area
STANNO	Self-Training Neural Network Object
TSA	Transportation Security Administration

1. INTRODUCTION

National Safe Skies Alliance (Safe Skies), in support of the Transportation Security Administration (TSA) Airport Perimeter Security (APS) Program, performed the Operational Test & Evaluation (OT&E) of Bert Mooney Airport's (BTM) APS enhancement. This intelligent video/neural networking solution was designed to provide both continuous monitoring of critical resources and additional access-control screening at two Security Identification Display Area (SIDA) entrances along the perimeter.

1.1 Background

The TSA established the APS Program to provide U.S. airports with resources to purchase and implement commercial off-the-shelf security technologies intended to address specific perimeter security concerns or susceptibilities. Airport management personnel from Bert Mooney Airport Authority (BMAA) applied for APS Program support for their proposed enhancement in January 2009.

Safe Skies performed the baseline assessment and issued a report[1] for the areas in which the APS enhancement would be installed on December 7 – 11, 2009. The enhancement was installed and calibrated throughout 2010; in November 2010, the system was activated and accepted for airport use.

1.2 Purpose of Document

This document provides a detailed record of the Safe Skies OT&E effort. The following sections include the evaluation methodologies used to collect data, calculations of quantitative performance data, analysis, and documentation of observations.

2. SCOPE

Safe Skies performed the OT&E of the BTM intelligent video enhancement in accordance with Critical Operating Issues (COI), which were defined and approved in the project's Final Test Plan (*DHS/TSA 2600.02.01.10-068,* June 2010).

2.1 Testing Limitations

OT&E procedures were only performed in those areas of the perimeter where the intelligent video/neural networking hardware and software were installed and functional.

[1] *DHS/TSA 2600.02.01.10-018 Airport Perimeter Security (APS) Program – BTM Baseline Support Report*, February 2010

[redacted]

The system's alarm database was created to provide airport personnel with a reference to alarm instances in order to verify the time of the occurrence, the response time, and the person who responded to and acknowledged the alarm. In its current configuration, the database provides airport security personnel with information [redacted]

Resources were not available to sufficiently test the system's facial and vehicle recognition capabilities beyond basic proof of concept. Generating a true match rate, under INCITS standards[2], [redacted]

Vehicle and personnel enrollment into the EAIDA software was more intensive than originally anticipated. Personnel enrollments required several hours of training per person, and vehicles potentially required days of image gathering and training. [redacted]

Due to resource and time constraints, evaluation of the Curbside Anomaly Detection Application (CADA) deviated from the original test plan, which had listed [redacted] data points to be collected for this task. Only [redacted] scenario iterations were conducted.

Aircraft approach scenarios [redacted]

[redacted]

The APS enhancement was officially accepted by the BMAA in November 2010. However, there were some minor elements that required final modification. Final threshold settings had not

[2] Current Draft (Version 8.0) of INCITS 1602-D Part V: Biometric Device Performance Evaluation for Access Control (Section 5.7.2 and 5.7.3)

[redacted]

been established at the time of the evaluation, and the system had not been in continuous use by BTM personnel. Survey information was not collected at the time of the evaluation, as it would not reflect a fair assessment of the system's usability.

3. SITE AND SYSTEM DESCRIPTIONS

3.1 Site Layout

The intelligent video network was established at four detection locations throughout the BTM facility (Figure 1).

[redacted]

Figure 1. APS Enhancement Layout and Equipment Installation Sites

3.2 Intelligent Video/Neural Networking Solution

The intelligent video/neural networking solution was a partnered effort of MSE Technology Applications, Inc. (MSE), Imagination Engines, Inc. (IEI) and Industrial Automation Consulting (IAC). The system was designed to provide, at a relatively low operational cost:

[redacted]

3.2.1 Specifications

The Intelligent Video/Neural Networking Solution consists of seven main components:

- Self-Training Autonomous Neural Network Object (STANNO)
- Ramp Anomaly Detection Application (RADA)
- Curbside Anomaly Detection Application (CADA)
- Entrance Area Identification Application (EAIDA)
- Verilook Software Development Kit (SDK)
- Digital Video Recorder (DVR)
- Human-Machine Interface (HMI)

RADA, CADA, and EAIDA were proprietary software applications provided by IEI. Verilook SDK was the product of NEUROtechnology, Inc. Vendor-supplied specification sheets for the majority of the components are provided in the MSE Final Report[3].

3.2.2 Operating Principles

STANNO was the core processing element of the APS enhancement. This neural networking algorithm allowed the system to process data in ways designed to resemble human brain function. The algorithm processed both historical and current data to generate activity patterns, which it then used to classify alarms. This gave the system the capacity to learn from past data and train itself to make more accurate decisions in the future. An intelligent video/neural networking solution such as STANNO, in concept, should virtually eliminate nuisance alarms that typically plague video analytic systems.

STANNO was used to process data for three separate applications:

The **Ramp Area Detection Application (RADA)** software component provided detection capabilities throughout the ramp region, where aircraft were parked. This application used STANNO to monitor and characterize activity throughout the ramp area, and utilized that data to determine whether the event should be reported as an alarm or ignored altogether.

The **Curbside Anomaly Detection Application (CADA)** was the software component through which the curbside region at the front of the terminal could be monitored on a 24-hr basis for vehicle parking violations. This application used STANNO to determine [redacted]

The **Entrance Area Identification Application (EAIDA)** was the software component used to provide additional access control at two SIDA gates near the terminal. This application used

[3] *MSE-282 Final Report – Bert Mooney Airport Authority Perimeter Security System,* December 2010

STANNO to enroll and authenticate both personnel and vehicles so that they could pass through SIDA-access gates.

Because of personnel enrollment and authentication difficulties with the EAIDA, the APS project team supplemented this software with a commercial off-the-shelf system, **Verilook SDK**, until its issues could be resolved. Verilook was performing the personnel screening tasks of EAIDA at both SIDA gates at the time of the evaluation. However, because both systems were installed and functioning at the time of testing, the OT&E was modified to include data and observations for both EAIDA and Verilook.

Video monitoring equipment installed at each region transmitted surveillance data to either its corresponding STANNO node or directly to the main server room in the Fire Station. All information was eventually relayed to the HMI, the primary operator console.

3.3 Installation

Installation of the APS enhancement required only minor modifications to BTM's infrastructure, and no heavy construction. [redacted]

[redacted]

3.4 Interface

All camera nodes relayed video information back to the command center in the Fire Station. The video streams and processed data converged at the HMI, which served as the primary control console for the entire system. From the HMI, a controller could monitor and control various aspects of the enhancement. Figure 2 shows the primary user screen for the HMI console.

Figure 2. HMI Operator Screen

From this screen, an operator could determine the location of an alarm, retrieve live video, review history logs, adjust cameras, acknowledge alarms, and monitor the status of every subsystem.

Incoming alarms from all subsystems appeared on the HMI; both activity warnings and alarms were highlighted on the left side of the screen, on the map overview, and in the alarm queue at the top of the screen. Individual subsystems could be accessed via the tabs in the upper left portion of the screen.

All video associated with alarms was recorded and stored for 30 days, and was also easily accessible through the HMI.

4. METHODOLOGY

4.1 Site and Schedule

Safe Skies conducted OT&E onsite at BTM December 6 – 10, 2010. Tests were performed during both daytime (9:00 a.m. – 4:00 p.m.) and nighttime (6:00 p.m. – 2:00 a.m.)

4.2 Testing Personnel

All scenario-based testing was conducted by trained Safe Skies personnel. [redacted] Field testing and data collection duties rotated between team members.

BTM-assigned escorts were present for test procedures conducted within the secure areas.

4.3 Critical Operational Issues (COI)

The primary objective of the OT&E was to address the COIs and corresponding Missions and Tasks, and Measures of Effectiveness (MOE) and Performance (MOP) that were established in the project test plan.[4]

COI 1: What are the fundamental components supporting the BTM APS enhancement?			
Mission		**Task**	
1	Identify the fundamental components necessary to support, configure and integrate the APS enhancement	**A**	Document the physical infrastructure elements of the APS enhancement
		B	Document the methods of integration between all elements of the APS enhancement

COI 2: What are the detection capabilities and operational impact of the BTM APS enhancement?			
MOE		**MOP**	
1	Does the system provide continuous and reliable detection at its configured monitoring areas?	**A**	[redacted]
		B	
2	Does the system generate an operationally sustainable number of nuisance and false alarms?	**A**	Record, categorize, and analyze nuisance and false alarms that are produced throughout the OT&E period.
3	Determine the impact on security operations.	**A**	Conduct a series of interviews with BTM staff to ascertain their personal experiences and opinions on the enhancement

[4] The use of COIs, MOEs, and MOPs is the standard convention for all Safe Skies evaluation plans.

COI 3: What are the access control capabilities of the BTM APS enhancement?			
MOE		**MOP**	
1	Does the system successfully enroll personnel?	A	Process and record any enrollments that take place during the OT&E period. Document successes and failures.
2	Does the system successfully identify the enrolled personnel and allow access to protected gates?	A	[redacted]
		B	[redacted]

5. RESULTS

5.1 COI 1: Fundamental Components

The details and specifications of the APS enhancement were documented.

5.1.1 Mission 1A-1B: Infrastructure and Integration Elements

All information and specifications pertaining to infrastructure, technology components, and integration methodologies can be found in the MSE Final Report. Documentation was provided by MSE Technology Applications, Inc. and Industrial Automation Consulting, Inc.

5.2 COI 2: Detection Effectiveness and Operational Impact

The APS enhancement was designed to protect critical airport assets without encumbering existing security operations. The Safe Skies evaluation team documented quantitative performance data and observations to assess this criterion.

The resources available to test the performance of the system's facial and vehicle recognition capabilities were insufficient to generate reliable results. Results in the following sections show proof of concept only, and should not be assumed to apply to a larger population of test subjects.

5.2.1 MOE 1: Continuous Detection

The APS enhancement was designed to perform unmanned and continuous monitoring of critical airport assets. [redacted]

5.2.1.1 MOP 1A: Parked Commercial Aircraft Protection

BTM has very little commercial air traffic. Typical commercial volume ranged from 2-3 flights a day, with an estimated turnaround of 45-60 min. For the majority of the day, no aircraft were parked at the ramp. The last inbound flight of the day, however, remained parked within the ramp area between 10:00 p.m. and 5:00 a.m., during which time no security personnel were on site to monitor the aircraft.

The APS enhancement provided CCTV equipment along the BTM terminal building, which allowed security personnel to view the aircraft and nearly all of the ramp area. This application operated in two modes: “learn” and “alarm.” While in learning mode, the application used STANNO to monitor and characterize activity throughout the ramp area. The application then used that data to determine whether the event should be reported as an alarm or ignored altogether. The system would alarm on activity while in learning mode, but if the action recurred numerous times, the system would adapt and begin to ignore it. While in alarm mode, the system was designed to alarm on anything that approached a parked aircraft. [redacted]

[redacted]

Detection scenarios were then focused on the application while in alarm mode. Testing required the coordinated effort of the Safe Skies evaluation team, IAC technical support, and a BTM-appointed security escort. A fixed number of [redacted] scenarios, as defined in the project test plan[5], were randomized prior to the evaluation. Safe Skies field personnel, positioned at separate locations, approached the aircraft from various angles[6]. Table 1 summarizes the results from these scenarios.

Table 1. [redacted] Scenario Results [redacted]

Location	Scenario	Total Tests	Observed Alarm Rate
North Ramp	[redacted]	[redacted]	[redacted]
South Ramp	[redacted]	[redacted]	[redacted]

5.2.1.2 MOP 1B: Curbside Passenger Loading Zone Protection

The curbside passenger loading zone at the front of the BTM terminal was exposed to public traffic on a 24-hr basis. A fixed camera was installed and oriented near the passenger loading zone to provide adequate coverage of the entire area, as seen in Figure 4.

5 [redacted]

6 Approach angles were not documented. Aircraft orientation in reference to the camera views was not consistent between evaluation periods, and could not be measured or controlled.

[redacted]

[redacted]

Figure 4. Curbside Camera Location and Associated Field of View

CADA continuously monitored the camera feed, and alerted BTM security personnel to vehicles that violated parking restrictions. BTM implemented a strict time limit on parked vehicles; CADA was programmed to alarm when a vehicle was parked for more than 5 min. However, for testing purposes, Safe Skies requested that the time constraint be reduced temporarily to 2 min 30 sec, which would require less time to prove the same basic functionality.

The Safe Skies evaluation team performed scenarios, [redacted], within the passenger loading zone to determine whether CADA detected parking violations and reported the alarm events to the HMI. A Safe Skies team member drove a vehicle into the passenger loading zone and remained parked to exceed [redacted]. Personnel at the HMI recorded the system's output.

[redacted]

[7] Due to resource and time constraints, this portion of the evaluation deviated from the original test plan, which had listed 100 data points to be collected for this task.

[8] [redacted]

[redacted]

5.2.2 MOE 2: Nuisance and False Alarm Sustainability

To be operationally effective, the APS enhancement should provide sufficient protection of airport assets without generating an unacceptable number of nuisance and false alarms. RADA was equipped with additional capabilities to reduce nuisance and false alarms.

5.2.2.1 MOP 2A: Nuisance and False Alarms

While in learning mode, RADA would dynamically adapt to the environment that it was monitoring. The system continuously observed spatial activity and associated it with temporal reference points, which it then used as the basis for characterizing activities. Events that were consistently and repeatedly observed within the monitoring area were to be ignored as nuisance alarms.

[redacted]

5.2.2.2 MOP 3A: Impact on Security Operations

BTM staff had familiarized themselves with the operation of the equipment and subsystems, but had not begun to use the system on a daily basis as a primary monitoring tool. The surveys that were proposed in the test plan were not issued at the time of the evaluation as personnel had insufficient experience using the system to fairly assess its impact on security operations.

[9] See Section 6.7.

5.3 COI 3: Access Control Capability and Response

The APS enhancement was designed to provide additional vehicle and personnel screening capabilities at two SIDA locations.

EAIDA, the STANNO application that was originally installed for these tasks, was determined, prior to Safe Skies' testing, to be operationally ineffective. By the time of the evaluation, the project team had installed an additional commercial-off-the-shelf software application, Verilook, to perform the facial recognition tasks. [redacted]

Safe Skies collected quantitative performance data from both Verilook and EAIDA regarding vehicle and personnel authentication and their enrollment platforms.

5.3.1 MOE 1: Facial and Vehicle Enrollment

Both EAIDA and Verilook could be used to authenticate personnel. Personnel enrollment data was collected on the two systems.

Because only EAIDA had vehicle-recognition capabilities, vehicle enrollment data was not collected for the Verilook application.

5.3.1.1 MOP 1A: Recorded Enrollment Data

For facial recognition tasks, separate enrollments were required for the vehicle and pedestrian gates. To accommodate for different lighting conditions, team members provided image enrollments on both systems [redacted] Table 2 shows the enrollments that were performed for each system and at each location.

Table 2. Personnel Enrollments

System	[redacted]
EAIDA	[redacted]
Verilook	[redacted]

Verilook

Verilook personnel enrollment at the pedestrian site took 1-2 min per individual; personnel enrollment at the vehicle gate required only a few seconds. The difference was attributed to the different processing powers of the separate servers on which the vehicle and pedestrian systems were operating.

The three Safe Skies team members enrolled in the system multiple times to determine basic functionality of the enrollment process. Each evaluator enrolled 9 times into the system; of the 27 personnel enrollments performed with Verilook, all were successful. Safe Skies did not observe any additional enrollments from BTM personnel; however, four BTM personnel were already enrolled in the system.

No personnel enrollments were able to be performed at the vehicle gate under nighttime conditions. Lighting within this area was insufficient to capture good quality images. This issue was brought to the attention of the integration team, and plans to install additional lighting near the gate have been made.

EAIDA

Enrollment on the EAIDA required multiple exemplars[10] of each person under both night and day conditions. Six exemplars were taken of each of the Safe Skies evaluators, for a total of 18. Though exemplar images took approximately 1 min to acquire, enrollment time for each exemplar was approximately 1 hr, depending on the image quality. Each person required approximately 6 hr to enroll. Time constraints allowed Safe Skies to only perform one full enrollment for each team member. Three BTM personnel were already enrolled in the system in addition to the three Safe Skies evaluators.

Similar to the facial recognition enrollment, the EAIDA vehicle enrollment was a time-consuming process. Each enrolled vehicle required a multitude of exemplars under different illumination conditions throughout different times of the day, because lighting conditions and reflections affected the exemplar images. Due to time constraints and the difficulties associated with obtaining good quality vehicle exemplars, the evaluation team did not enroll any vehicles into EAIDA. However, a total of four vehicles were already enrolled in the system. See Section 6.4 for more details on the EAIDA enrollment issues.

MOE 2: Facial Recognition Functionality

Hardware and software were installed, integrated, and calibrated for additional access control screening [redacted] Personnel authentication data was collected for both the EAIDA and Verilook software applications[11].

5.3.1.2 MOP 2A: Pedestrian Gate Facial Recognition

To test the authentication capabilities of the EAIDA and Verilook applications, Safe Skies team members [redacted]

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[10] An exemplar is the template that is enrolled into the EAIDA database to be compared with live targets. A single image imported into the EAIDA constitutes one exemplar.

[11] Although EAIDA had been replaced by Verilook for facial recognition tasks, the EAIDA system was still active for this purpose. Because it required no additional resources, Safe Skies used the opportunity to test the system.

[redacted]

[redacted]

Figure 5. [redacted] and Associated Camera Location

Scenarios were conducted [redacted] for both software packages. Table 3 shows the results of the scenarios.

Table 3. Personnel Recognition Results

System	Day/Night	Test Subject	Total Tests	% Correct Matches	% False Positives	% with No Match
Verilook	[redacted]					
EAIDA						

[redacted]

5.3.1.3 MOP 2B: Vehicle Gate Facial and Vehicle Recognition

Access through the SIDA vehicle gate required both vehicle and personnel authentication. To meet this requirement, the integration team implemented EAIDA and Verilook to perform the vehicle and personnel authentication, respectively.

[redacted]

[12] The authorized BTM vehicle selected for the evaluation was a [redacted]. The unauthorized vehicle was a [redacted]

[redacted]

[redacted]

[redacted]

Test Subject	Total Tests	% with Correct Match
1	[redacted]	[redacted]
2	[redacted]	[redacted]
3	[redacted]	[redacted]

[redacted]

Table 5. Vehicle Gate: EAIDA Vehicle Recognition Results [redacted]

Vehicle	Enrolled	Total Tests	% Correct Matches	% False Positives	% with No Match
[redacted]					

[redacted]

Further testing would be required, [redacted], to obtain more definitive results.

[redacted]

6. SUMMARY & OBSERVATIONS

6.1 Installation and Integration

Installation of the system was reported to be relatively uncomplicated. Both integrators involved, MSE and IAC, were familiar with the climate at BTM, the requirements of the APS enhancement, and the importance in equipment selection and placement. Robust mounting hardware and environmental enclosures were selected to provide the most reliable performance under a wide range of weather conditions.

All nodes were networked back to the Fire Station and all data was successfully relayed back to the HMI. A KVM switch[13] was used at the HMI console to toggle between different computers. However, it was not necessary to use the KVM switch for normal monitoring and operation tasks.

[13] A KVM (Keyboard, Video, and Mouse) switch is a common computer component used to control multiple devices from a single keyboard, monitor, and mouse.

[redacted]

[redacted]

[redacted]

6.5 Verilook Facial Recognition

The Verilook SDK software was implemented by IAC to meet operational requirements of the APS enhancement while the EAIDA's issues were being resolved. Verilook proved to be both effective and simple to operate. Personnel could be enrolled in a matter of seconds, and authentication rates were [redacted]

[redacted]

6.6 HMI

The HMI was intuitive and easy to use. From this screen, an end user could control just about every aspect of the APS enhancement.

Incoming alarms from all subsystems appeared on the HMI; both Activity Warnings and Alarms were highlighted on the map overview, and listed in the alarm queue at the top of the screen. Individual subsystems could also be accessed via the tabs on the main screen.

All video associated with alarms was recorded and stored for 30 days, and was easily accessible using the HMI.

At the time of the evaluation, airport personnel had been trained in the operation of the system, but had not been actively using it at a level that would provide useful end user feedback. User surveys will be administered when personnel have enough experience to fairly assess the system.

6.7 Key Performance Parameter (KPP) Assessment

Table 6 shows the KPPs that were defined from the baseline assessment, and the disposition as to whether each was met.

Table 6. Key Performance Parameters

Requirement Group	Functional Requirements	Technical Requirements	Expectations Met
Sensor Performance	Must provide enhanced detection capabilities	The system must maintain a consistent probability of detection: [redacted]	[redacted]
	Must prove to have an efficient nuisance alarm rate		

[redacted]

Requirement Group	Functional Requirements	Technical Requirements	Expectations Met
GUI	Must be efficient, flexible, and reliable	- The system should be simple to learn and use.	[redacted]
		- The system should be capable of alerting the appropriate personnel for a given event.	
		- Alarm acknowledgements should not require any more [redacted]	
		- The alarm history should be easily accessible for reporting/auditing purposes.	
		- Security staff should be provided the necessary tools and training to operate the system with a high level of independence. Examples include: (1) Add/remove personnel from the database, perform routine updates and checks, and reboot basic components; (2) Use a detailed troubleshooting manual, to be issued at time of training	
		- Contact information for a designated customer service representative/team for advanced technical issues.	
		- The security staff should have the capability to easily and quickly shunt/disable the system if nuisance alarms persist or an unknown error is causing them.	

Requirement Group	Functional Requirements	Technical Requirements	Expectations Met
	Proof of Concept	- The GUI that will be used on a regular basis must be presented in a design format (diagram, prototype, beta, flowchart, etc.) showing the general layout of the screen, options, and commands. Sign-off from airport personnel should be required.	[redacted]
Integration	Proof of Concept	- The system should be able to integrate additional cameras.	
		- System information should show that it is scalable.	
General Operation	Power	- The system must be able to reliably initiate after complete power failure.	
		- The system must have a backup power supply.	
		- The system must indicate to managers, supervisors, or console operators that it was shut down for "X" period of time, but is now fully operational. If it is not operational, an error message should provide a reason.	

7. REFERENCES

MSE Technology Applications. (December 2010). *Final Report – Bert Mooney Airport Authority Perimeter Security System.* (MSE-282). Butte, MN: Cashell.

National Safe Skies Alliance. (February 2010). *Airport Perimeter Security (APS) Program – BTM Baseline Support Report.* (2600.02.01.10-018, Version 1.0). Alcoa, TN: Hunsucker.

National Safe Skies Alliance. (June 2010). *Airport Perimeter Security (APS) Program – BTM – Operational Test & Evaluation Plan.* (2600.02.01.10-068, Version 1.0). Alcoa, TN: Hunsucker.