



Spynel:

A SURVEILLANCE
SOLUTION FOR PRISONS

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1. INTRODUCTION: PRISONS IN THE US

The United States has the most prisoners of any developed country in the world, with the largest total prison population of any nation. This is proven by the raw numbers of inmates and the percentage of inmates relative to the entire population. With this increased inmate population comes the need for a heightened standard of security for prisons across the United States. Today, prisons attempt to improve their security practice each using different methods depending on the location and layout of the facility itself. Despite these changes, there are still vulnerabilities within prison security systems, and as technology advances, threats become progressively more perilous. Such threats, as seen in recent months: inmates escaping; contraband being thrown over perimeter fencing or drones being used to smuggle in illicit items create dangerous opportunities for incarcerated criminals to continue breaking the law and posing domestic and international security risks.

2. NEW THREATS FOR PRISON SECURITY

Traditionally, prisons are designed to keep people in but recently, it has become increasingly difficult for prisons to be able to keep contraband out from over the fence line. A dangerous trend in the past few years has seen the rise of UAVs being used to smuggle contraband (drugs, cell phones, weapons, etc.) over a prison's perimeter fences. Additionally, criminals are using more primitive ways to get contraband over prison walls by discretely packaging drugs and contraband in items like tennis balls and duct tape to throw onto the property. These two methods are extremely successful to help facilitate criminal enterprises from within prison walls.

In just the last two years alone, authorities have detected four attempts at correction facilities in the US and at least four more attempts of UAVs being used as a means for getting contraband into a correctional facility were also reported abroad during this same time period in Ireland, Britain, Australia and Canada.

For example, in 2013 four people were accused of trying to fly a DJI Spektrum DX6i hexocopter carrying tobacco and cell phones in Calhoun State Prison in Morgan, Georgia. In January 2015, criminals outside of Lee Correctional Institution in Bishopville, South Carolina accidentally crashed their drone carrying synthetic marijuana and cell phones, this drone was fortunately found and secured by prison guards in the bushes just outside the fence line. Cell phones are prized possessions in prison, some convicts and their families or friends are willing to pay upwards of \$1,000 for an iPhone smuggled to an inmate. Prisoners are only allowed to use the monitored public pay phones within the correctional facility, thus, private cellphones become an extremely desirable tool for coordinating criminal activities while behind bars. Cell phones are used to coordinate times and locations of contraband drops, or threats that are to be executed on other inmates or rival gang members while inside prison walls. Organized criminal gangs still operate when leaders or members are behind bars and cell phones assist these organizations to continue to be powerful, even after the United States Justice system has put them in prison. Another incident at Lee Correctional, a maximum security institution, saw another security breach highlighting the dangers of inmates obtaining cell phones. A group of inmates gained control of some parts of the prison after stabbing two correctional officers and assaulting three others; additionally they took other inmates as hostages and called a local news stations sending pictures of the destruction inside.

The soaring number of cellphones inside cellblocks has facilitated violence and criminal enterprise that can jeopardize the safety of communities and public safety officials both inside and outside the prison. These security breaches illustrate a shift in using modern technology to penetrate a prison's security measures and with the current wide-spread accessibility of drones, pose new and unknown challenges to prison security.

Drones, however, are just one of the many security challenges presented to correctional officers. In terms of surveillance equipment, typically, the following requirements should be considered;

- Wide area surveillance of an entire prison facility and its surroundings on a reduced budget;
- Simultaneously and automatically detect and track all types of air, land or maritime targets: vehicles, crawling men, etc. in real-time;
- Be able to withstand harsh outside conditions (rain, wind, snow, ice, heat, fog and other extreme environments);
- Complete zone protection, detect intruders/objects before they reach critical areas;
- True day and night vision even in total darkness to stay vigilant 24/7;
- Easy to integrate with existing security systems to allow for a slew to cue operation;
- Capability for stored video and forensic analysis with bookmarked times, dates and location of events;
- Quick and easy deployment even with limited infrastructure;
- Reduce operator fatigue and cut down on need and frequency of mobile patrols on foot;
- Identify and deter illegal contraband (drugs, cellphones, etc.) from being hurled over the perimeter fencing;
- Adapt to site specific operational conditions and varying security level requirements with a focus on areas of interest: monitoring critical areas with continuous and reliable protection while also able to exclude possible normal traffic during parts of the day.

3. PANORAMIC SURVEILLANCE: THE SPYNEL INNOVATION

3. CONVENTIONAL SOLUTIONS

Conventional security solutions that have been a hallmark of prison security have not been able to tackle the new challenges of the 21st century presented by small drones, neither by terms of detection range nor reaction time. Surveillance solutions traditionally used for purposes of wide area surveillance surrounding correctional facilities or other critical infrastructures generally requires installing dozens of fixed cameras to a network to attempt to cover the complete 360° perimeter. This solution results in an overinflated cost of system acquisition, training and maintenance.

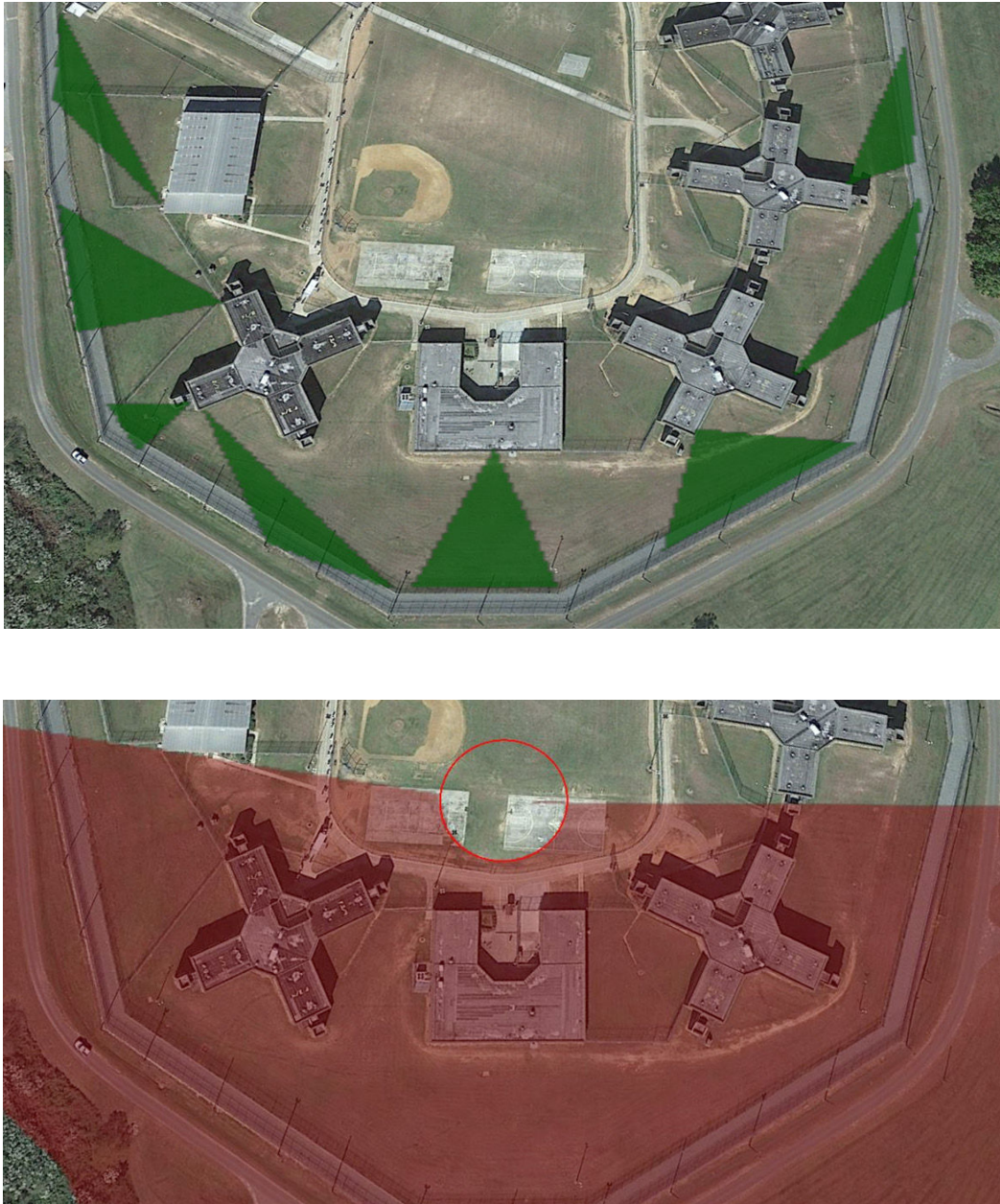


Figure 1 - TOP: A rendering of a prison yard with the conventional approach of CCTVs/PTZ cameras. With limited fields of view, fixed cameras require multiple units to be able to cover a full wide area. BOTTOM: A rendering of a prison yard with the Spynel-M; only one camera is needed to provide unprecedented surveillance for the same area. **Note:** some areas may not be completely visible due to blind spots caused by the outer buildings.

3.2. THE SPYNEL INNOVATION

The SPYNEL systems are composed of two essential elements, developed by HGH:

- The high resolution panoramic thermal camera, Spynel, allows for the high speed acquisition of data.
- Cyclope software: for data processing, visualization, detection and automatic tracking of multiple targets over 360°.

The Spynel / Cyclope tandem is more than a thermal camera: it is a single long-range automatic detection system that SIMULTANEOUSLY:

- Visualizes multiple targets over 360°
- Conducts detection and tracking of an unlimited amount of targets 360° (terrestrial, maritime or airborne threats).

3.2.1 SPYNEL SENSORS

Spynel's infrared camera continuously rotates at a high speed (up to 2 Hz = 2 revolutions per second). HGH's thermal camera is capable of rotating at a high speed while providing outstanding image quality with very high spatial resolution.

The continuous rotation makes it possible to generate a thermal panoramic image after each camera turn. The successive panoramic images make a video.

Thermal imaging allows for day and night surveillance, but also guarantees the ability to view any object, even deemed as stealth.

Spynel can therefore produce a high resolution thermal panoramic image at a rate equal to the rotation frequency. Additionally, the Spynel M has the capability to perform a 90 degree and 180 degree sector scan rate, which in turn speeds up the refresh rate of the panoramic image.



Figure 2 - Rendering of the Spynel-M's capabilities and customizable options: sector scan rates at both 90° 2.5 Hz for 2.5 scan/second (left) and 180° 1.5 Hz for 1.5 scan/second (right) and the potential ranges over a prison site.

3.2.2. Cyclope software

The Cyclope software is the brains of the system. For 15 years, HGH's software development teams have developed advanced algorithms for detecting and tracking of all types of conventional and asymmetric threats to include: humans, vehicles, helicopters, aircraft, drones, etc.

Without the Cyclope software, the sensor is simply used to provide images for observation purposes with no detection. The distinction between «observation» and «detection» is crucial.

The Cyclope software can generate automatic detections of intrusions that an operator could not pick up by himself through simple observation. It also relieves the operator from scanning the image permanently and missing a target during lapses of attention.

The Cyclope software can be installed on industry standard PCs and includes a user-friendly, intuitive interface.

4. SPYNEL-M FOR PRISON SECURITY

CONCEPT OF OPERATIONS:

A typical security requirement for prisons is the ability to detect persons who hide near tree lines and attempt to throw contraband over the walls. Other essential prerequisites for a prison's surveillance equipment include:

1. An infrared camera to monitor up to 600 meters of open area up to the tree line;
2. Detect and track humans/unauthorized vehicles both day and night through all types of inclement weather;
3. Perform alerts to notify security staff of possible intruders or attempted contraband drops;
4. Integrate with pan tilt zoom cameras to identify targets;
5. Exclude detections from certain zones so the image is not cluttered with prison staff entering and exiting the prison grounds;
6. Have the ability to record and playback events that happened over a 12 hour shift.

REQUIREMENT 1: Monitor up to 600 meters of open area up to the tree line in real-time

SPYNEL SOLUTION:

HGH Infrared Systems' Spynel-M has several different options for prison security, depending on the desired detection range of targets (from 250m up to 700m for detection of humans to 600m up to 1500m for the detection of vehicles).

The Spynel system is easy to set up and integrate with Common Operating Pictures software as well as other systems already in place. Information can be sent either via wireless or fiber in real-time, stored digitally in a database for further, future analysis and displayed in a central command room; the hypervisor option managing several Spynel systems from one single operator station, greatly reducing operator fatigue.

REQUIREMENT 2: Detect and track humans/unauthorized vehicles both day and night through all types of inclement weather

SPYNEL SOLUTION:

Spynel's infrared thermal imaging technology is a significant advantage over all visible imaging systems that are only effective with the presence of illumination (either artificial or natural). Spynel, with the Cyclope proprietary software, detects the change in heat and movement of the targets, never losing their tracks.

REQUIREMENT 3: Perform alerts to notify security staff of possible intruders or attempted contraband drops

SPYNEL SOLUTION:

With Cyclope, advanced intrusion detection and tracking software, image processing analysis is automatic and is performed in real-time for an unlimited number of mobile targets within the panoramic picture: ground, maritime or airborne. Upon detection, the software automatically tracks multiple and simultaneous intrusions and zoom windows aim and display newly detected targets without operator action. Distance, GPS position, display of azimuth/elevation coordinates of detected targets can be achieved while bookmarks allow for a manual classification of threats for future forensic analysis.

REQUIREMENT 4: Identify intruders

SPYNEL SOLUTION:

Cyclope offers the ability to automatically control a PTZ camera with a slew-to-cue application for intruder identification. The detected threat is instantly identified (no click from the operator). This feature is extremely important when identification is necessary.

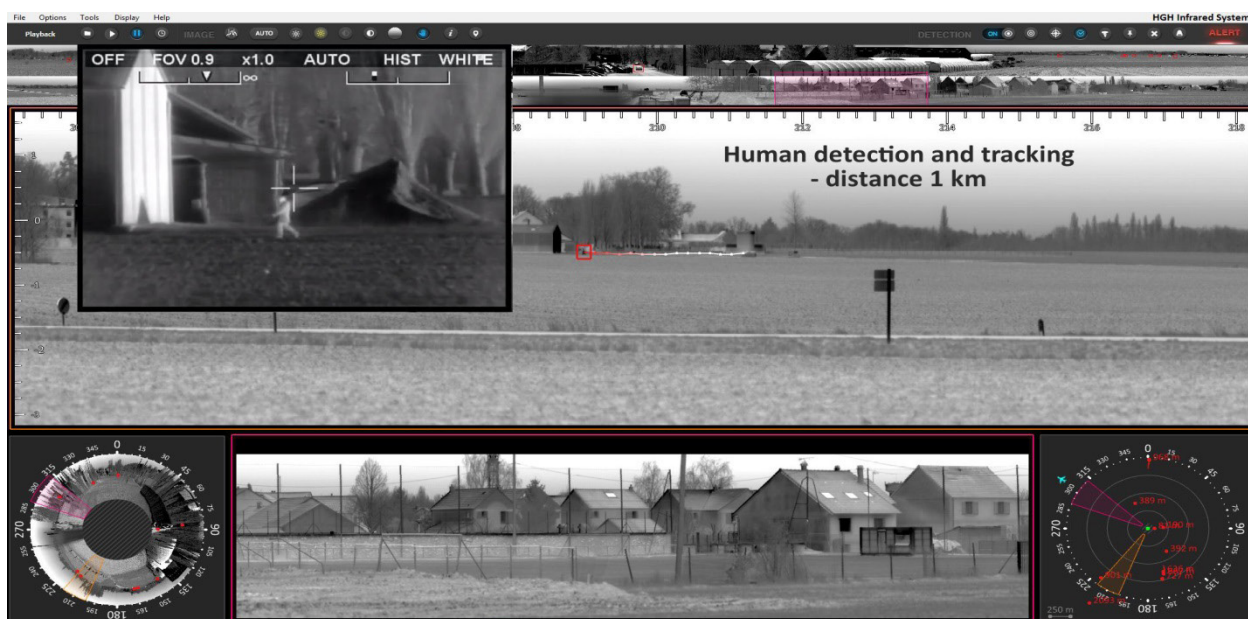


Figure 3 - This Cyclope screenshot shows a standard PTZ plugin tracking a human through a field identified by Spynel for up-close identification. The red box at the top alerts the operator that a target is detected and automatically tracks.

REQUIREMENT 5: Exclude detections from certain zones so the image is not cluttered with prison staff entering and exiting the prison grounds or other necessary traffic on the prison grounds.

SPYNEL SOLUTION:

The operator has the ability to program and customize automatic inclusion and exclusion zones around a property within Cyclope.

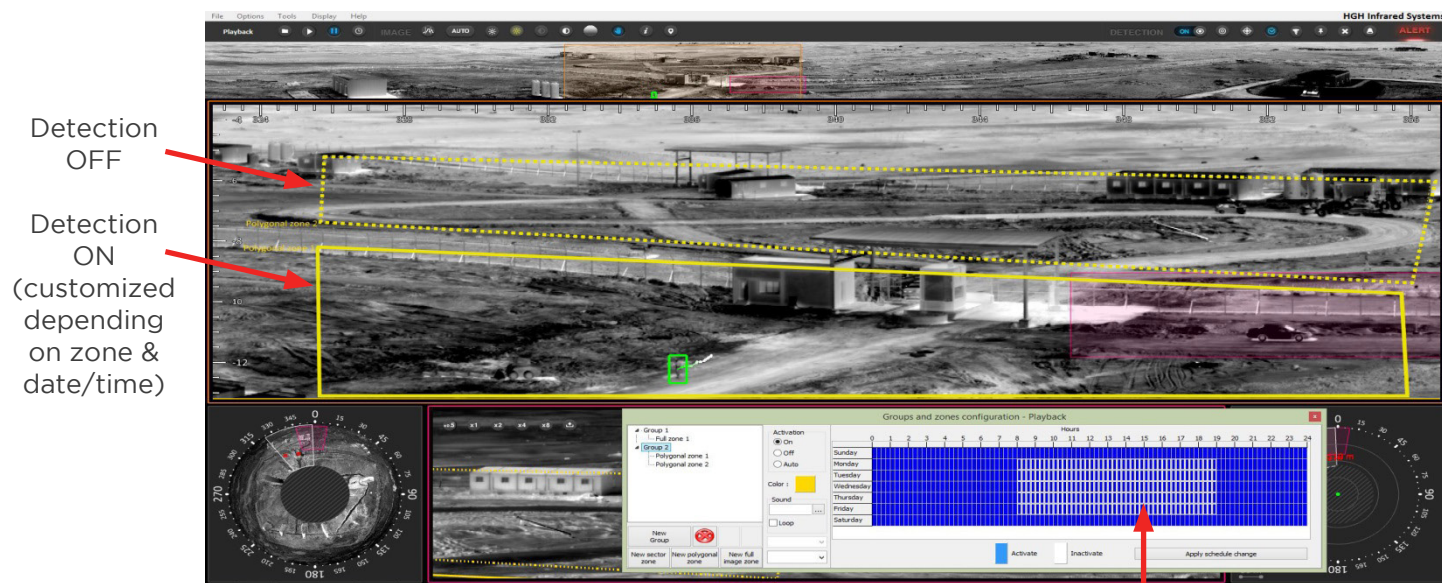


Figure 4 - This Cyclope screenshot shows a completely customized interface as per an operator's preferences: 360° strip window shows full surrounding at the top of the screen; alarm activation set to trigger according to specific date/time; sound and visual alarms output; list of possible target classifications; and two different detection zones based on date and times-one activated, the other turned off.

Alarm activation
according to date/time

REQUIREMENT 6: Have the ability to record and playback events that happened over a 12 hour shift.

SPYNEL SOLUTION:

Cyclope's advanced forensic capabilities allow the operator to replay a sequence as if it were live. All original settings (color palettes, zoom resolution, contrast, detection sensitivity, etc.) can be changed, to allow the user to pinpoint events in a report. Additionally, smart tags provide an easy way for the operator to mark and describe an event or a particular component from the scene. When looking back at the timeline, the analyst has a quick overview of all alarms and bookmarks.

The footage is time-stamped and can be used as evidence in court. Cyclope's zoom windows' footage can be saved on a CD ROM in a standard MSFT media format, and replayed without the Cyclope software.

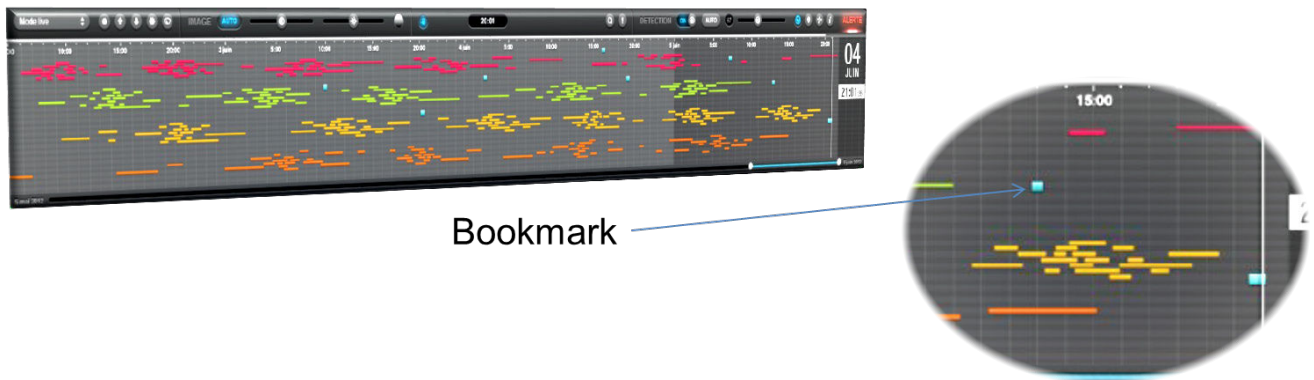


Figure 5 - An example of a Cyclope timeline with color coded smart bookmarks

REQUIREMENT 7: System should notify and direct guards patrolling the prison yard of any intrusion.

SPYNEL SOLUTION:

A Spynel deployed in a prison setting would allow fewer guards having to patrol the prison yard and monitors inside since it's all automated and merged onto one screen. Furthermore, with Cyclope's customizable and user-friendly interface, an operator can choose one of several ways to view the area being covered based on their preference: panoramic, annular and radar. By incorporating a radar view in the screen, the operator is able to gage the distance of potential targets as well as localize them. All threats detected always appear in all views in red, assuring a quick response for immediate action on the part of the guards.

5. CONCLUSION

The Spynel series of infrared surveillance sensors were initially commercialized in 2006 after many years of research and development. Since then, Spynel has been deployed in the harshest of environments, including: Afghanistan for the US Army, the Middle East to protect critical infrastructures and forward operating bases and the ocean in a hot, humid and corrosive environment on a French Navy frigate. These diverse and extreme conditions have tested the Spynel to its most vulnerable points and succeeded in every type of environment.

Spynel is often described as “infrared radar”: as it provides the benefits of an infrared camera, displaying threats day or night in total darkness as well as the benefits of radar, automatically detecting and tracking an unlimited number of threats in all directions at once.

Spynel is the only reliable, proven 360° “infrared radar” with more than 100 units deployed to date and advanced detection algorithms developed over the course of 10 years. HGH Infrared Systems is dedicated to provide the best solutions in perimeter security for commercial clients or federal, state and local agencies and welcome the opportunity to answer and further questions or requests for information.

About HGH Infrared Systems: Founded in 1982, HGH designs, develops, assembles and sells high end optronics systems for security, industrial and civil applications. HGH's team of highly qualified engineering team is comprised of experts in optics, software, mechanics and electronics and operates in France, at Igny (near Paris). HGH strives to provide advanced and innovative infrared equipment to protect their clients all around the world, while keeping the agility and dedication of a small and passionate team. Speed, flexibility, technical excellence and innovation constitute their core values. HGH has established itself as an international reference for infrared technology innovation through the development of multiple advanced thermal sensors, among which its award-winning real-time 360-degree thermal camera, the SpynelC 2008 Product of the Year from Photonics Tech Briefs, 2010 Innovation Prize from the EuroNaval Committee, 2011 Kummerman Award from the French Academy of Marine, 2012 GovSec Platinum Award.