



BORDER VIDEO SURVEILLANCE SOLUTION



ZOOM AREA

BORDER VIDEO SURVEILLANCE

Contemporary global issues call for a need for more protected borders. A superior defense technology can support high risk border areas on varied terrain. This is the reason why we have created the Logipix Border Video Surveillance Solution.

Our solution is an intelligent video surveillance-based system that provides various surveillance sensors, and this way it ensures the most comprehensive coverage

and monitoring of border areas. Leveraging high-resolution visible light and thermal sensors, advanced Computer Vision Technologies, 3D surveillance radars, the solution is able to realize a complex system that minimizes monitoring gaps and produces the lowest false alarm rate possible.

The structure of the solution is flexible and adapts to different open-air sites. Potential threats can be detected automatically within an immense area. The solution operates with high efficiency under all lighting and environmental conditions as alarm verification happens involving several types of sensors. The system components are able to withstand even severe weather conditions on the field.





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YOU NEED OUR SYSTEM, IF YOU WOULD LIKE TO...

- Effectively monitor vast areas day and night, whether they are lands or water with only a few Panorama cameras and automatically detect potential threats like smuggling, terrorism and illegal immigration
- have a sensor cluster from a single company, comprising of visible and thermal image sensors and a 3D radar
- have accurate, automatic object detection and classification even 3 kilometers away based on Video Content Analysis (VCA)
- minimize false alarm rate and have Real-time Decision Making Support to highlight potential threats only
- automatically track even the slowest moving targets on panoramic images through kilometers in any direction
- have high-resolution visual feedback on targets, and on their surrounding area
- monitor the area with visible and thermal sensors and get visual extension for all lighting conditions
- merge external sensor data with VCA detected objects and visualize information on 200-960 MP panoramic images
- know the real-time geoposition of targets
- have a comprehensive system that is able to operate with full functionality over a low-bandwidth network
- guide patrol units or squads as fast as possible to target location
- have high-resolution footage of patrol unit or squad actions



SECURITY BENEFITS

- **Maximized system uptime**

Logipix provides uninterrupted system availability as all their components are developed to operate with high MTBF.

- **Adaptable system structure**

Logipix always consider the specific purpose of monitoring and also the characteristics of the border area in order to choose the most appropriate technologies and coverage structure on the field.

- **Extended vision**

Logipix provides dual vision Panorama cameras that covers vast areas with high-resolution panoramic images in the spectrum of visible light and thermal radiation. 960 MP visible and 6.6 MP

thermal image resolutions create a solid base for Video Content Analysis. Humans can be detected and classified automatically at a range of 3 km.

- **Increased surveillance efficiency**

Logipix fuses and visualizes the information of several sensors in order to highlight potential threats and guide the attention of operators, who get early alerts automatically.

- **Undoubted visual evidence**

The 200-960 MP panoramic video footage contains high-resolution details of all squad and patrol unit actions. These images can serve as evidence during investigation on demand.





ZOOM AREA

FINANCIAL BENEFITS

- **No need for frequent maintenance using human resources**

Logipix hardware components are capable of self-maintenance, thanks to their built-in self-cleaning and deicing systems.

- **No need to deploy costly fiber optic network between cameras and Command and Control Centers**

The Logipix Border Video Surveillance Solution ensures on-site recording with weather and vandal-proof, outdoor Data Processing Units.

- **Designed to overcome severe environmental conditions**

Logipix hardware components are full metal constructions with built-in heating and cooling systems, and they are also available made of marine

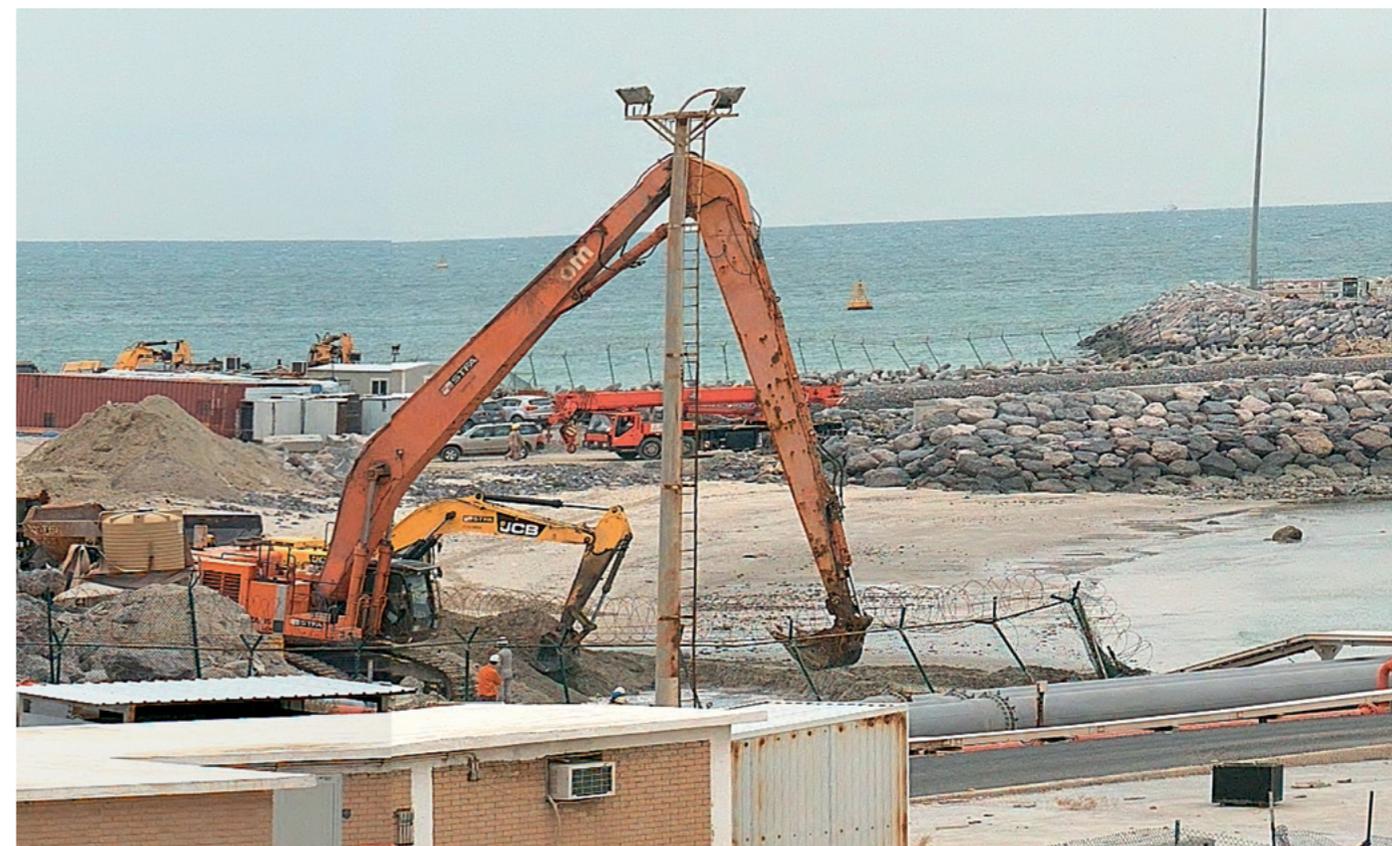
grade materials. They can withstand intense weather conditions.

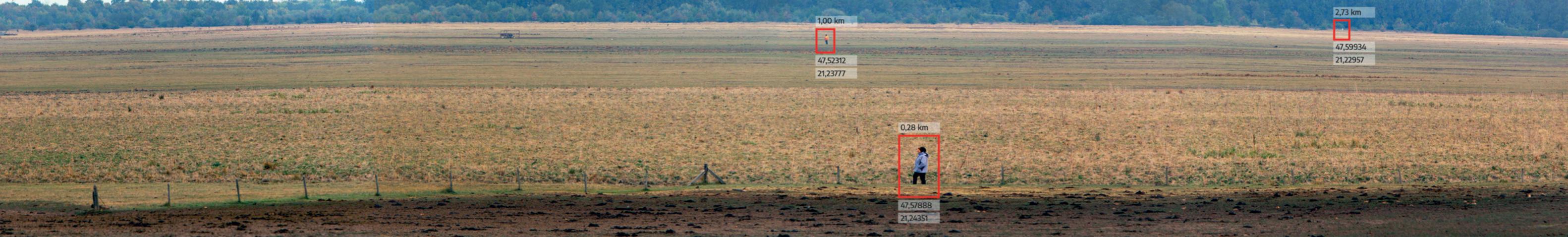
- **Designed for long-term**

Our engineers developed leading-edge technologies that ensure the system avoids both physical and technological obsolescence for a long time.

- **Interoperating with external surveillance sensors**

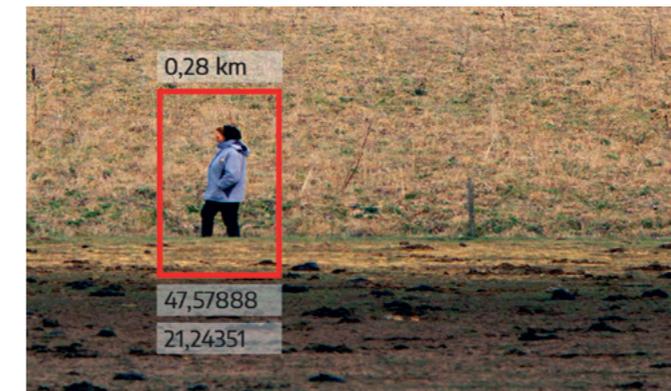
Each border surveillance technology has its own bottleneck. Logipix solution is designed to strengthen these technologies and leverage them. It provides AI-assisted video surveillance with unparalleled quality, moreover it brings all third-party sensor information together and eliminates monitoring gaps.





WHAT DIFFERS US FROM OTHERS

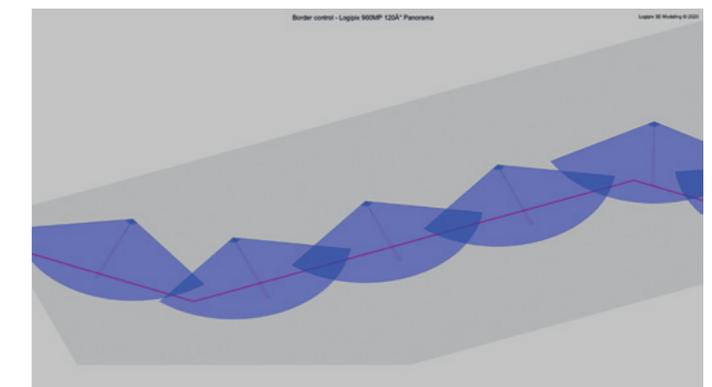
- Developing and manufacturing the full component group and technologies of a complex surveillance system that minimizes monitoring gaps. This system includes a high-end sensor cluster, an intelligent video and data processing unit with embedded AI and Computer Vision, and the Command and Control Center.
- 200-960 MP panoramic images ensure better spatial awareness for operators, as large areas are displayed simultaneously and the relative positions of landscape formations help visual orientation
- Large area coverage by Dual Vision Panorama Cameras with thermal panorama module for more efficient monitoring in pitch darkness and degraded visibility conditions
- Sensor Fusion Technology that realizes aggregated raw data analysis where data sources are different types of surveillance sensors
- Cross-mapping visible and thermal images and also radar data and visualizing the outcome on a single platform
- Providing Computer Vision Technologies specially developed to detect, classify and track targets automatically even kilometers away
- Logipix Panorama and VCA makes it possible to track multiple targets at the same time in numerous individual zoom windows
- Logipix can automatically control specifically developed Laser PTZ illuminators and third-party long-range and thermal PTZ cameras to track targets
- 20 fps panoramic video stream with hundreds of megapixels
- Intelligent Video Content Analysis on full resolution JPEG2000 image streams

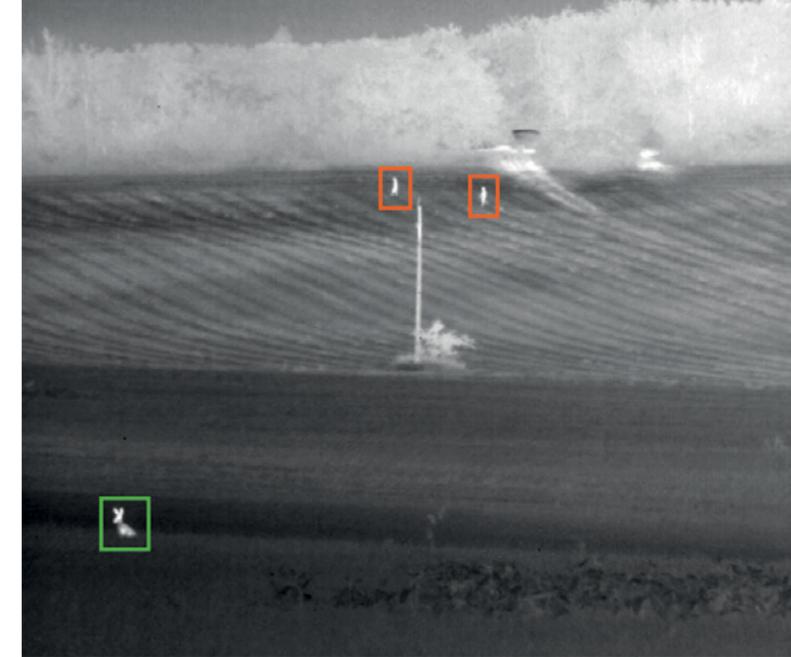


- Specially developed technology to handle large visual data and utilize the full resolution during monitoring
- Long storage periods, thanks to intelligent frame reducing technology
- Beside providing intelligent video surveillance, Logipix gathers several sensor data and merges them together, making the most out of different surveillance technologies

3D MODEL OF VISUAL COVERAGE

An accurate design of camera arrangement is essential in every border area to achieve the required resolution that is necessary for the desired Logipix functions. Logipix therefore creates 3D models that precisely visualize final installation points, field of view (FOV), and exact resolution and distance values.





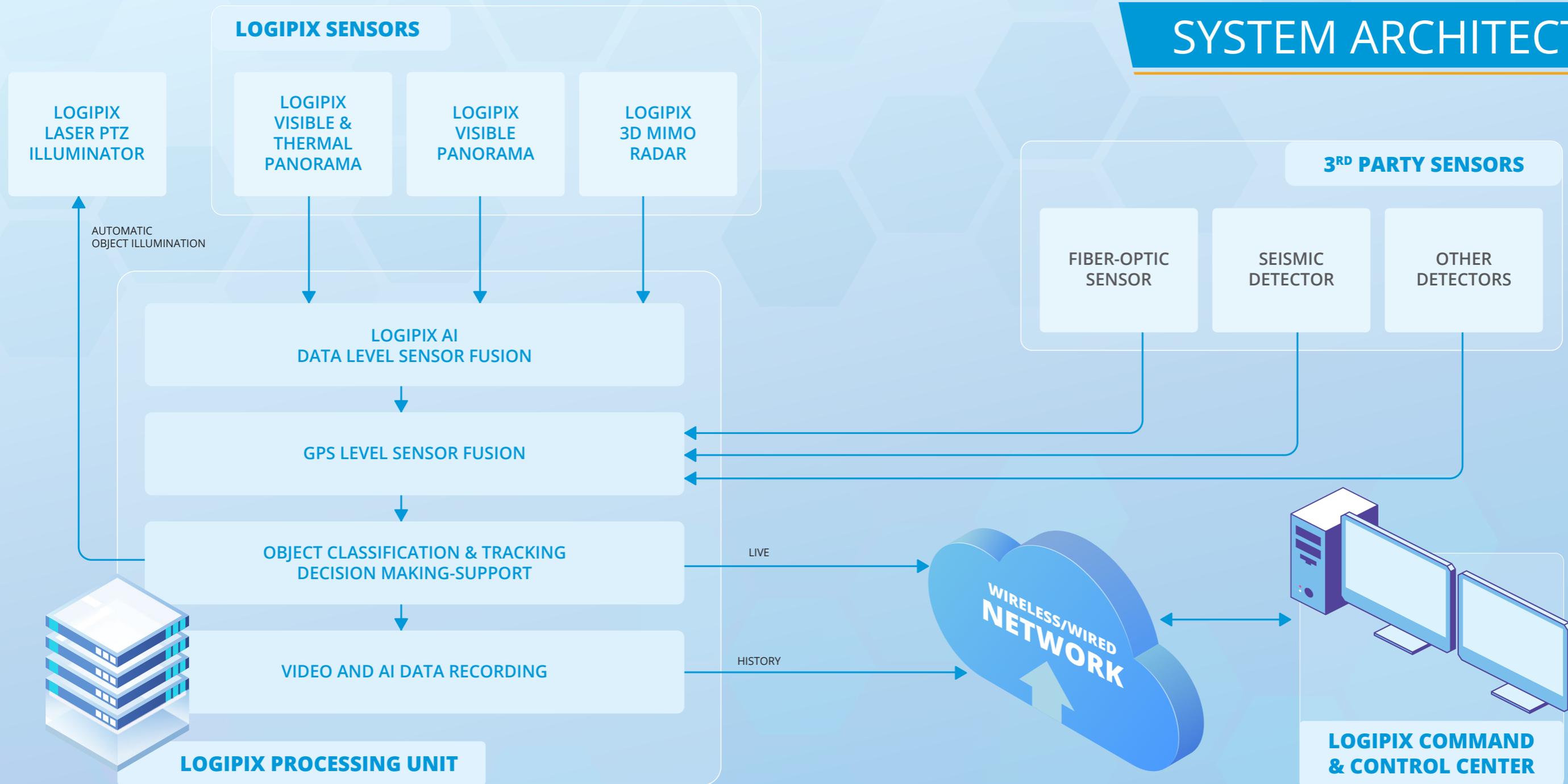
FROM THE OPERATORS' POINT OF VIEW

The Logipix Command and Control Center allows operators to successfully surveil immense areas utilizing various surveillance sensors. The solution displays panoramic images, both visible light and thermal ones, an interactive map with moving object icons and an object list with detailed object information. The entire monitored area is displayed continuously in high-resolution panoramic images and both radar and VCA detection results are visualized on the video stream. When objects are clear, the Logipix VCA classifies them automatically. Potential threats are highlighted on the front end interface. Real-time Decision Making Support and high-resolution visual verification help decide between non-threatening objects and alerts that require fast respond.

Operators can easily observe multiple targets simultaneously in individual zoom windows. The Video Content Analysis tracks targets on the panoramic images and also controls the Laser PTZ Illuminators to keep targets lit even in pitch darkness. The interactive map also provides reference for better orientation as targets are displayed on it as moving icons. The Command and Control Center displays real-time GPS coordinates of each targets, which allows operators to effectively guide patrol units or squads to the exact spot, where they can take efficient actions to stop illegal activities.

Time	GPS	Speed (k m/h)	Distance (m)	Object ID	Area	Type	State
10/22/2020 09:38:06 pm	38.456980 12.122028	4	673	30234	Area 02	Human	Alert
10/22/2020 09:34:45 pm	38.456760 12.117220	11	340	30208	Area 02	Animal	Goose
10/22/2020 09:32:11 pm	38.456370 12.123770	13	1200	30215	Area 02	Animal	Goose
10/22/2020 09:31:05 pm	38.454530 12.122850	13	1450	30205	Area 02	Animal	Goose
10/22/2020 09:31:43 pm	38.456760 12.115060	10	1250	30290	Area 02	Animal	Goose
10/22/2020 09:29:13 pm	38.456370 12.124270	12	1700	30289	Area 02	Animal	Goose
10/22/2020 09:12:22 pm	38.454230 12.122820	27	530	30351	Area 02	Animal	Goose
10/22/2020 08:12:05 pm	38.488380 12.128340	35	1890	30350	Area 02	Vehicle	Goose
10/22/2020 08:10:10 pm	38.485347 12.117421	18	340	30345	Area 02	Animal	Goose
10/22/2020 08:08:49 pm	38.493411 12.113773	21	210	30343	Area 02	Animal	Goose
10/22/2020 08:02:28 pm	38.498271 12.128600	20	1360	30342	Area 02	Animal	Goose
10/22/2020 04:34:21 pm	38.498131 12.129621	16	1360	30341	Area 02	Animal	Goose
10/22/2020 04:34:19 pm	38.498211 12.129511	8	1260	30332	Area 02	Animal	Goose
10/22/2020 04:22:10 pm	38.494196 12.122560	5	1210	30326	Area 02	Animal	Goose
10/22/2020 04:21:45 pm	38.497340 12.111420	21	410	30324	Area 02	Animal	Goose
10/22/2020 04:12:18 pm	38.497530 12.122400	35	730	30315	Area 02	Vehicle	Goose
10/22/2020 04:12:13 pm	38.486760 12.125060	31	730	30312	Area 02	Vehicle	Goose
10/22/2020 04:12:11 pm	38.498370 12.123770	31	730	30311	Area 02	Vehicle	Goose
10/22/2020 04:12:01 pm	38.492526 12.122203	5	960	30304	Area 02	Animal	Goose
10/22/2020 04:02:56 pm	38.492072 12.112270	11	110	30305	Area 02	Animal	Goose
10/22/2020 03:49:57 pm	38.498131 12.118810	12	200	30309	Area 02	Animal	Goose

SYSTEM ARCHITECTURE



TECHNOLOGICAL DESCRIPTION

COMPLEX MONITORING SOLUTION

Logipix Border Video Surveillance Solution realizes a complex system that leverages different surveillance technologies in order to overcome monitoring gaps. Basically the solution provides intelligent video surveillance with extreme high-resolution visible light panorama that is supplemented with a thermal panorama camera module. The solution also provides a 3D MIMO Radar, Sensor Fusion and Computer Vision Technologies for automatic functions, on-site recorders for storage and data transmission and Command and Control Center software for monitoring.

In order to detect motions that are obscured to Logipix sensors, the system is able to integrate third-party surveillance sensors, for instance fiber-optic sensors and seismic detectors.

Covering vast areas

Logipix solution was designed to fully cover immense border areas even on challenging terrains using high-end surveillance sensors.

The main line of visual coverage consists of Logipix Dual Vision Panorama Cameras. A single Panorama provides 320 MP resolution for visible-light surveillance and 6 MP for thermal vision. The Panorama provides 40° FOV and effectively monitors an area of 3.2 km² from a single viewpoint. Its resolution allows to detect humans within a range of up to 3 km. Three of these cameras can be installed at a single spot, providing 120° FOV and 9.6 km² area coverage. The effective human detection range of the Logipix 3D MIMO Radar is 5 km.

In case a narrower area should be monitored near a defense line, Logipix single sensor cameras can be used in a desired structure.



Logipix cameras at night

Logipix Panoramas have excellent low-light performance. When it is getting darker, thanks to the high-sensitivity image sensors, the camera's visible light module still delivers images wherein humans can be detected kilometers away.

In case of night observation or in low-visibility conditions the multi-sensor thermal camera module ensures efficient monitoring and delivers useful visual information, specially when the monitored area is not illuminated by artificial lighting.



Automatic object detection

Logipix developed a specific Sensor Fusion technology, which realizes exceptionally accurate object detection in the surveillance area. The Video Content Analysis and the Radar Data Analysis are combined together. The algorithm recognizes any suspicious moving object in the distance that could be a potential threat. Geofencing function allows specific detection configurations within the covered area. Zones can be virtually designated which for various detection rules can be assigned.



<input type="checkbox"/>	Time	GPS	Speed (km/h)	Distance (m)	Object ID	Area	Type	State
<input checked="" type="checkbox"/>	9/22/2020 05:38:23 pm	39.456955 12.122375	4	653	30234	Area 02	Human	Alert
<input type="checkbox"/>	9/22/2020 05:34:45 pm	39.456760 12.117220	11	340	30208	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:32:11 pm	39.458370 12.123770	13	1200	30215	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:31:55 pm	39.454530 12.123850	13	1450	30205	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:31:43 pm	39.456760 12.115060	10	1250	30190	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:24:13 pm	39.458370 12.124270	12	1700	30189	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:12:22 pm	39.454210 12.122810	27	520	30151	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:12:20 pm	39.458160 12.126540	30	1840	30150	Area 02	Vehicle	Gone
<input type="checkbox"/>	9/22/2020 05:10:10 pm	39.455347 12.117421	18	340	30145	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:05:49 pm	39.453411 12.113773	21	210	30143	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 05:02:28 pm	39.458271 12.120650	20	1360	30142	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 04:34:21 pm	39.458131 12.120621	16	1360	30141	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 04:34:50 pm	39.458211 12.120511	8	1360	30132	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 04:22:10 pm	39.454196 12.122560	5	1210	30126	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 04:21:45 pm	39.457340 12.111420	21	410	30124	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 04:12:16 pm	39.457530 12.123850	28	720	30113	Area 02	Vehicle	Gone
<input type="checkbox"/>	9/22/2020 04:12:13 pm	39.456760 12.125060	31	720	30112	Area 02	Vehicle	Gone
<input type="checkbox"/>	9/22/2020 04:12:11 pm	39.458370 12.123770	31	720	30111	Area 02	Vehicle	Gone
<input type="checkbox"/>	9/22/2020 04:12:01 pm	39.452526 12.122253	5	980	30104	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 04:02:56 pm	39.459372 12.112270	11	110	30095	Area 02	Animal	Gone
<input type="checkbox"/>	9/22/2020 03:49:57 pm	39.458131 12.116810	12	260	30089	Area 02	Animal	Gone

Automatic target tracking

The system automatically tracks the motion of all detected objects. Even if they move between panorama camera images, the VCA and the RDA accurately follow and record their paths in the images. The algorithm is able to track 2500 targets at the same time and operators are able to lock the selected ones for automatic tracking in individual zoom windows.

Based on GPS coordinates that are delivered by the radars and also calculated by interpolation on the panoramic images, the system automatically controls PTZ and thermal PTZ cameras.

During night monitoring or in low-bandwidth network environments an aligned reference image and mov-

ing position indicators help operators to find targets' real-time spatial positions in the images.

Target localization

In order to respond threats effectively, the exact positions of targets must be known beside tracking them. Logipix delivers the precise GPS coordinates, speed and heading information of all detected objects from the moment of detection. The system uses both radar information and VCA calculated coordinates for localization. It is able to match radar data with the VCA-detected objects and display the information together with the targets.

Interactive map

Logipix also provides an interactive map that visualizes objects as moving icons. It shows camera FOVs and real-time GPS coordinates of targets as well. Operators can select targets on the map to show immediate zoom images of them.

Maximized detection accuracy

Accurately detecting an object within the defense area is just the first step. Fast decision between real threats and non-threatening objects is essential. Logipix AI-powered object classification ensures to filter animals and other hazardous objects out to avoid numerous false alarms. Logipix Real-time Decision Making Support boosts operators' efficiency, as using this embedded intelligence, the system highlights only potential threats.

Visual target verification is fast and effective as Logipix provides automatic zoom functions on detected objects. Complementing each other, visible light, thermal and radar sensors deliver informative details even under degraded visibility conditions.



Integration

One of the solution's great advantages is, that it is able to integrate third-party surveillance components in order to fill remaining monitoring gaps. In addition to the Logipix sensors the system can integrate third-party seismic detectors, fiber-optic sensors, long-range and thermal PTZ cameras and PIDS.

Logipix ensures the full manual and automatic control of the integrated PTZ cameras. Although, in contrast

with the Panoramas, a single PTZ can not track multiple targets at the same time, but installing them on strategic spots they can perform as effective surveillance sensors.

In case seismic detectors, fiber-optic sensors or an other Perimeter Intrusion Detection System operates on the field, Logipix can receive their signals and use them to trigger automatic zoom functions on cameras.

TECHNOLOGIES BEHIND LOGIPIX FUNCTIONS

Logipix Panoramic Technology

Logipix panoramic technology makes it possible to geometrically stitch together images of individual Logipix sensors. The images are taken in a synchronized fashion which precludes the possibility of duplicated or hidden objects at the stitching borders. White balance and tone corrections smoothen the gradient between images.

PTZ control

A special Logipix function allows the Panoramas and PTZ cameras to be assigned by registering common spatial points that are visible to both cameras. This function allows operators to control the PTZ cameras by selecting the area of interest in the panoramic image.



Sensor Fusion Technology

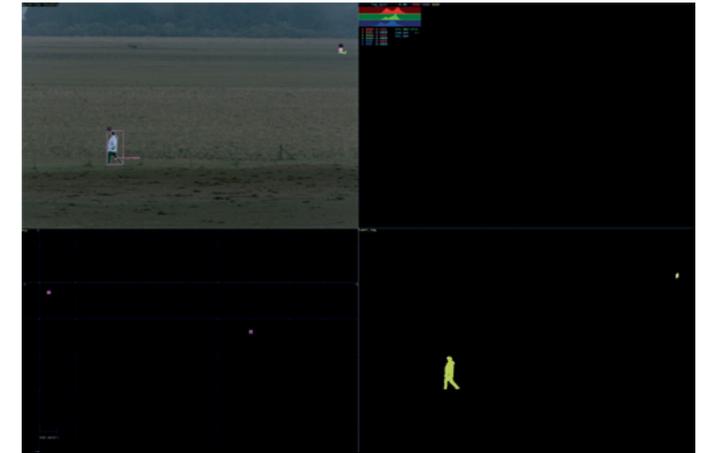
Logipix developed a specific data level sensor fusion technology, whereby it provides raw data analysis involving different types of surveillance sensors. Raw data analysis means, the algorithms work with uncompressed data. This technique provides data fusion at the lowest level of abstraction, therefore it provides the highest level of accuracy.

Logipix Video Content Analysis

The Logipix VCA relies on several advanced methods. One of them is the Multidimensional Gaussian Background Model that always adapts to the background and differentiates every moving object from the learnt environment. The VCA also applies Object Feature Extraction, Motion Behavior Analysis and Motion Path Estimation algorithms in order to realize an intelligent, self-learning virtual environment.

PTZ Auto-tracking

Logipix is able to automatically control PTZ cameras based on Video Content Analysis that runs on panoramic images. As Panorama cameras and PTZ cameras are measured together, once the VCA detects and tracks an object, the system can transmit its real-time coordinates towards the PTZ. This way PTZ cameras can automatically track the desired targets.



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Monitoring in Full Resolution

Displaying 200-960 MP panoramic images during live monitoring or archive playback is not an easy task. This amount of data can impose excessive burdens on the network infrastructure and also on client computers.

Logipix developed a special technology to overcome this issue. The system stores the panoramic images in full resolution on the NVR, but always transmits and displays only relevant pixels. When a panoramic overview is on screen, its horizontal resolution is equal to the screen resolution. When an operator zooms in, the system sends the cropped image in higher resolution. As the zoom value increases, so does the transmitted image resolution.



Logipix Ageing Technology

The system continuously records the images. Thanks to the Logipix Ageing Technology, storage period of video streams can be greatly prolonged. The system intelligently drops frames from the video stream according to a configured period. As the JPEG2000 stream consists only intra-frame images, the footage will be still available after video stream ageing, but with reduced fps.

MAIN FEATURES AND FUNCTIONS (SUMMARY)

Video Monitoring functions

- 200-960 MP visible light panoramic video stream with 20 fps
- 6-18 MP thermal panoramic video stream
- Real-time monitoring in full resolution
- PTZ control on panoramic images
- Automatic zoom tour
- Archive video

Integration

- Long-range PTZ cameras (2000 mm or higher focal length)
- Thermal PTZ cameras
- Long-range IR Laser Illuminators
- Seismic detectors
- Fiber-optic sensors
- Perimeter Intrusion Detection System

AI-powered Video and Data Analysis

- Object detection
- Object classification (animal, human, heavy and light vehicle, boat, vessel)
- Multiple target tracking through multiple camera images
- Automatic zoom and tracking function
- PTZ control for automatic target tracking
- Geofencing

TECHNOLOGIES FOR AN OPEN-AIR SOLUTION

Resistant hardware design

All Logipix cameras and NVRs are ruggedized, full metal constructions and are designed for long-term use. They can be equipped with passive and also active thermal constructions. This makes them resistant even to extreme weather and environmental conditions. Heat pipes, heat sinks with fans and Thermoelectric Peltier modules ensure the appropriate operating temperature within the devices.

On-site recording

4th generation Logipix Data Processing Units are available with a special, outdoor design. They are weather- and vandal-proof constructions with integrated thermal management to operate on-site. This feature significantly reduces installation costs, as there is no need to deploy fiber optic infrastructure over hundreds of kilometers between the cameras and the Command and Control Centers.



KEY SYSTEM COMPONENTS

- **Logipix 960 MP + 19.8 MP Dual Vision Panorama Camera**
- **Logipix 320 MP + 6.6 MP Dual Vision Panorama Camera**
- **Logipix 320 MP Panorama Camera**
- **Logipix 300 MP Panorama Camera**
- **Logipix 200 MP Panorama Camera**
- **Logipix Multi-sensor Thermal Camera**
- **Logipix 3D MIMO Radar**
- **Logipix Outdoor Data Processing Unit**
- **Logipix Command & Control Center**





TECHNOLOGICAL STRENGTHS OF THE SOLUTION

- Logipix uses a specifically developed data level sensor fusion technology, involving multiple surveillance sensors for the most accurate object detection and tracking possible.
- AI-powered Video Content and Radar Data Analysis provides accurate object detection and classification at long range. The system can differentiate animals, humans, heavy and light vehicles, vessels and boats. Humans can be classified automatically at a range of up to 3 km.
- Logipix automatically filters false alarms out based on intelligent data analysis, which works with fused image and radar data.
- Logipix provides automatic multiple target tracking based on VCA and RDA. Targets are highlighted on the interactive map and also on the panoramic images.
- Target tracking function makes it possible to display multiple targets in individual, automatically tracking zoom windows.
- Logipix provides immense area coverage with visible-light and thermal imagery sensors. A single 960 + 18 MP Panorama construction can monitor an area up to 9.6 km².
- The solution uses the scalable JPEG2000 image compression, which is the only standard that allows for real-time monitoring with hundreds of megapixels in a bandwidth effective manner.
- Logipix Video Content Analysis is embedded in the Logipix cameras and in the Data Processing Units. It works with full resolution JPEG2000 images.
- Logipix Border Video Surveillance Solution provides real-time GPS coordinates on moving targets.
- Logipix enables to integrate third-party border surveillance sensors into the Logipix Border Video Surveillance Solution.
- The system is able to intelligently process all received third-party sensor data and merges them with the automatically detected objects.
- The system can automatically control integrated PTZ cameras to zoom in on targets and track their motion based on VCA and radar information.

CONCLUSION



Logipix brings a new era in border video surveillance. The most secure walls are not built from concrete and steel, but from thousands of megapixels, advanced computer vision technologies and intelligent data processing. Logipix created an intelligent surveillance solution with which illegal activities can be detected automatically with the highest accuracy possible. The end result is safer borders and, ultimately, more secured nations.



ABOUT LOGIPIX

Logipix Technical Development Ltd. is a privately held company established in 1996 in Budapest, Hungary. Since then, Logipix has grown into the international company that it is today – one of the most innovative, end-to-end video surveillance solution developers and manufacturers. Today the main profile of the company is to provide specially designed, high-end video surveillance solutions considering the various characteristics of different application areas.

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