

# White Paper

Smart City

Intel® Xeon®, Intel® Core™ Processor Series, Intel® Distribution of OpenVINO™ Toolkit



## Making Taipei City Safer Than Ever

### MiTAC and Intel® delivered an intelligent CCTV monitoring system for the Taipei City Police Department (TCPD), the largest urban safety system in Taiwan

**“MiTAC has been committing to the well-being of humanity and environmental sustainability by strategic development in digital transformation. ‘Smart cities’ should not be mere empty talk but should be down to earth to create value. ‘Smart cities’ should delve into the details of everyday life, caring for the convenience and happiness of human beings. The Taipei City Police Department project is just one aspect of our efforts. MiTAC will continue to innovate, create value, and work together with Intel® and various public sectors towards a better future.”**

**Liang, SU**  
Chairman,  
MiTAC Information  
Technology Corp.

#### Executive Summary

The intelligent CCTV monitoring system, developed by MiTAC Information Technology Corp. and Intel® is a groundbreaking solution designed to enhance public safety and improve work efficiency for the Taipei City Police Department (TCPD). This white paper presents an overview of the project, including its background, challenges addressed, solution description, unique features, and the role of Intel® technologies. By integrating advanced video analytics, license plate recognition, and centralized management systems, the solution has enhanced the TCPD’s efficiency, and serves as a psychological deterrent to illegal activities in Taiwan.

#### The Digitization of Public Safety: A Global Perspective

In an era marked by rapid advancements in technology, the digitization of public safety has emerged as a transformative force reshaping public planning and policy practices worldwide. Citizens’ safety and well-being have always been one of the key pillars of smart cities. A network of CCTV cameras monitored by human personnel can no longer provide the same level of safety owing to rapidly expanding cities with booming civilian populations. The convergence of digital tools, data analytics, and interconnected systems has revolutionized the way civic agencies operate, enabling them to respond more effectively to emerging challenges and enhance public safety on an unprecedented scale. Large metropolitan cities and remote corners of the globe are harnessing the power of digitization to streamline public safety, optimize resource allocation, and build stronger connections with the communities they serve.

This global shift towards digitization has fostered a dynamic environment where police departments can leverage cutting-edge technologies to deter illegal activities more effectively. Furthermore, integrating monitoring technologies with AI, ML, and video analytics, have bolstered the capabilities of police departments by enabling faster and more accurate data processing. Taipei City serves as one of the best examples of how a digitized police department can maintain law and order in a rapidly advancing metropolitan city that is currently ranked as the fourth safest city in the world, according to a global survey.<sup>1</sup>



## What Makes Taipei One of Asia's Safest Cities?

Several factors contribute to Taipei's exceptional safety record and the overall sense of safety experienced by its residents and visitors alike.

- Effective Public Safety:** Taipei has a well-organized and efficient police department that is highly regarded for its professionalism and dedication. The Taipei City Police Department implements proactive strategies, utilizing modern technology and data-driven approaches to public safety. Close cooperation between civic agencies and the community fosters a strong sense of partnership in maintaining public safety.
- Historically Low Incident Rates:** Taipei consistently reports low rates of adverse or illegal incidents across various categories. The city's commitment to public safety and swift response to incidents play a crucial role in deterring criminal activities. In conjunction with a thorough judicial system, this contributes to a safe environment for residents and visitors alike.
- Strong Community Engagement:** Taipei's residents actively participate in public safety efforts, creating a

strong bond between the police and the public. 'Neighborhood Watch' programs, citizen reporting platforms, and community-oriented initiatives foster a sense of collective responsibility for maintaining safety. This collaboration between the police department and the community builds trust, encourages timely reporting of suspicious activities, and facilitates the quick resolution of incidents.

- Comprehensive CCTV Monitoring:** Taipei has an extensive network of closed-circuit television (CCTV) cameras strategically placed throughout the city. MiCMS enhances the efficiency of monitoring the feeds from multiple CCTV cameras around the city, which in turn aids the TCPD in their investigations should any incidents occur.

MiTAC Information Technology Corp. and MiTAC Computing Technology (MCT) Corp., both integral components of the MiTAC-SYNNEX Group, stand as prominent providers of IoT solutions for cloud and terminal systems. With a focus on smart city innovations, MiTAC leveraged Intel® network architecture and hardware to address the challenges faced by the Taipei City Police Department (TCPD). The intelligent CCTV monitoring solution by MiTAC powered by Intel® technologies has improved public safety in Taipei City.

Year & Police Precinct	Crime Volume						Theft				
	Offenses Known to the Police (Cases)	Offenses Cleared (Cases)	Clearance Rate (%)	Offenders (Persons)	Offense Rate per 100,000 Pop.	Offender Rate per 100,000 Pop.	Offenses Known to the Police (Cases)	Offenses Cleared (Cases)	Clearance Rate (%)	Offenders (Persons)	Offense Rate per 100,000 Pop.
2007	53,921	44,312	82.18	31,291	2,049.64	1,189.43	20,212	15,419	76.29	2,854	768.30
2008	54,328	43,034	79.21	31,274	2,068.77	1,190.89	19,095	14,082	73.75	2,923	727.12
2009	52,544	39,710	75.57	32,001	2,009.20	1,223.67	15,583	10,899	69.94	2,748	595.87
2010	49,646	35,658	71.82	30,759	1,899.89	1,177.11	14,258	8,833	61.95	2,719	545.64
2011	46,690	33,281	71.28	30,728	1,772.00	1,166.21	10,852	7,559	69.66	3,210	411.86
2012	40,113	32,989	82.24	30,869	1,506.82	1,159.57	9,662	7,746	80.17	3,657	362.95
2013	41,255	34,919	84.64	34,828	1,539.44	1,299.61	8,052	6,120	76.01	3,639	300.46
2014	43,952	36,191	82.34	36,108	1,631.23	1,340.11	7,243	5,572	76.93	3,527	268.82
2015	42,212	40,057	94.89	39,951	1,561.35	1,477.72	6,250	5,645	90.32	3,660	231.18
2016	42,658	41,179	96.53	41,457	1,579.78	1,535.30	6,080	5,186	85.30	3,686	225.16
2017	41,071	39,782	96.86	40,980	1,527.10	1,523.71	6,062	5,064	83.54	3,873	225.40
2018	42,306	40,964	96.83	44,094	1,580.99	1,647.81	5,972	5,097	85.35	3,921	223.18
2019	40,098	38,741	96.62	42,412	1,509.26	1,596.35	5,645	5,012	88.79	4,151	212.47
2020	38,746	37,993	98.06	44,399	1,476.75	1,692.21	5,295	4,951	93.50	4,320	201.81
2021	34,480	34,753	100.79	40,040	1,345.09	1,561.98	4,633	4,570	98.64	3,906	180.74
<b>2022</b>	<b>36,210</b>	<b>36,673</b>	<b>101.28</b>	<b>41,871</b>	<b>1,446.93</b>	<b>1,673.14</b>	<b>4,767</b>	<b>4,807</b>	<b>100.84</b>	<b>4,115</b>	<b>190.49</b>
Datong Precinct	2,854	2,878	100.84	3,215	2,382.25	2,683.58	414	404	97.58	381	345.57
Wanhua Precinct	4,599	4,607	100.17	5,332	2,630.58	3,049.85	738	739	100.14	614	422.13
Zhongshan Precinct	4,575	4,460	97.49	5,073	2,136.67	2,369.25	472	455	96.40	420	220.44
Daan Precinct	4,504	4,437	98.51	5,012	1,563.98	1,740.38	459	455	99.13	412	159.38
Zhongzheng 1st Precinct	1,090	1,108	101.65	1,214	2,284.30	2,544.17	196	196	100.00	164	410.76
Zhongzheng 2nd Precinct	1,423	1,447	101.69	1,854	1,399.81	1,823.79	218	218	100.00	185	214.45
Songshan Precinct	1,423	1,444	101.48	1,548	742.45	807.67	295	305	103.39	271	153.92
Xinyi Precinct	3,294	3,208	97.39	3,392	1,601.83	1,649.48	449	426	94.88	340	218.34
Shilin Precinct	3,269	3,301	100.98	3,390	1,223.43	1,268.72	334	335	100.30	260	125.00
Beitou Precinct	2,485	2,486	100.04	2,377	1,023.74	979.25	375	377	100.53	274	154.49
Wenshan 1st Precinct	1,280	1,282	100.16	1,523	997.01	1,186.28	171	164	95.91	138	133.19
Wenshan 2nd Precinct	1,234	1,187	96.19	1,439	940.67	1,096.95	147	148	100.68	133	112.06
Nangang Precinct	1,559	1,565	100.38	1,788	1,358.14	1,557.64	175	175	100.00	160	152.45
Neihu Precinct	2,621	2,546	97.14	2,537	953.66	923.10	324	324	100.00	306	117.89
Others	-	717	-	2,177	-	-	-	86	-	57	-

Source: Criminal Investigation Division, Taipei City Police Department

Remark: The numbers in the Table indicate cases accepted(handled) by Police Station; the number of occurrence includes cases occurred in specific period and supplementary cases reported; the number of clearance includes accumulated cases cleared and cases in other jurisdictions.

Figure 1: A snapshot of incidents in Taipei City from 2007 to 2022 (Source: TCPD)

## Intelligent CCTV Monitoring: The Key to Taipei's Safety

The Taipei City Police Department (TCPD) operates across 14 sub-bureaus and 90 police stations, employing over 8,000 police personnel. Given Taipei's location, the level of public safety is considered a benchmark of the rest of the country. Therefore, up-to-date systems enhanced by state-of-the-art technology are paramount. The challenge lay in modernizing its existing CCTV infrastructure as well as implementing fully integrated, smart monitoring systems. The goal was not only to integrate multiple city-wide video feeds but also to enhance them with actionable insights that made workflows and decision-making easier for police personnel. MiTAC created a centralized, cloud-based intelligent CCTV

monitoring solution called MiCMS. Built on Intel® technologies and hardware, MiCMS collects and manages the videos from 18,000 cameras in Taipei City. It provides the critical functions of image query to TCPD personnel along with the integration of related administrative processes. By increasing computing speed, enabling parallel processing, and enhancing system stability MiCMS has improved the efficiency of monitoring and workflows at the TCPD. The increase in efficiency and speed brought about by the system has a direct correlation to the reduction in incident rates as well as an increase in positive case outcomes for the TCPD. Furthermore, the quality and reliability of Intel® components lead to cost savings on maintenance fees and labor.

### Enhancing TCPD's Effectiveness

Taipei's reputation as a smart city means it sets the benchmark for digital integration both nationally and globally. To keep its public monitoring system updated and help the TCPD protect and serve Taipei's residents better, the city needed to revamp its current CCTV monitoring capabilities.

By leveraging Intel® technologies, MiTAC deployed MiCMS in three phases. Phase I and II involved the installation of MiCMS, a central management system that integrated videos from 15,416 existing CCTV cameras, and the addition of 226 License Plate Recognition (LPR) CCTVs. Phase III is the latest iteration of the intelligent CCTV monitoring system.

It includes the following enhancements:

- Upgrading 13,699 cameras from 300,000 pixels to 2 million pixels for better clarity.

- Adding 2,216 new LPR CCTVs to create a real-time, electronic CCTV fence around 50,000 intersections in the city.
- Deploying real time vehicle recognition capabilities across 96 strategically important CCTV cameras to assist the police in handling cases.
- Providing on-ground personnel with IPCs designed by MCT and powered by 7th Generation Intel® Core™ processors. These individual units deliver enhanced efficiency and performance, even in demanding outdoor environments.
- Implementing an Intelligent Video Analysis System (IVS) that uses Video Synopsis® technology to compress hours of video footage into minutes making it easier for police personnel to study the footage from any incidents.

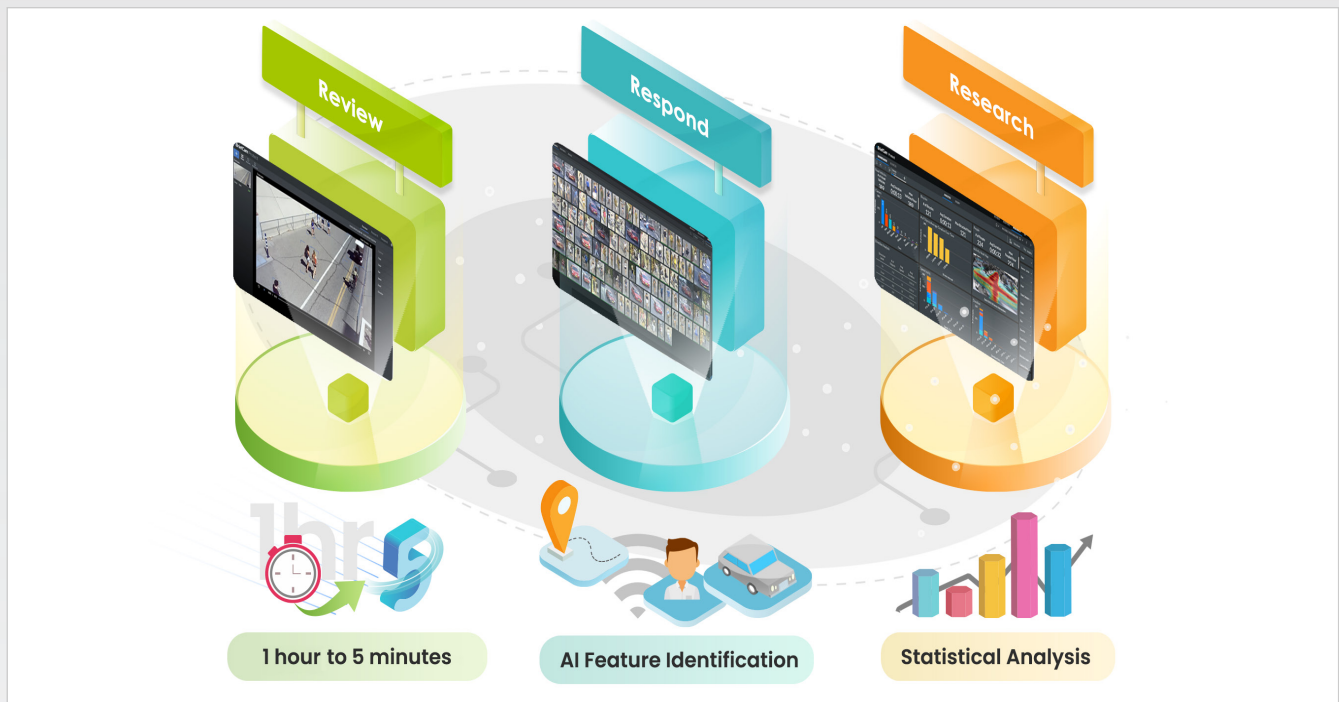


Figure 2: The IVS process of gaining valuable insights

## Adding to the Efficiency of City-wide CCTV Monitoring

MiCMS makes monitoring CCTV feeds from across the city more efficient and accurate by seamlessly integrating feeds from various monitoring systems into a single user interface. This integration includes the Video Management System (VMS), License Plate Recognition (LPR) System, and Intelligent Video monitoring (IVS) System, among others.

MiCMS analyzes images from the characteristics described by eyewitnesses to TCPD personnel and allows them to search for images of people or vehicles based on the characteristics described by eyewitnesses. This allows the movement path of a person or vehicle fitting the description to be estimated by MiCMS, thereby assisting the TCPD in handling cases more effectively.

At present MiCMS allows TCPD personnel to look up characteristics such as the color of clothing, the presence of bags or hats, and whether the subject wears long or short sleeves with a recognition accuracy rate of up to 80%. The vehicular characteristics can be looked up include the color of vehicle, types of vehicles (car, truck, motorcycle, or bicycle) and the license plate number.

Through the use of Geographic Information System (GIS) technology, MiCMS enables the TCPD to effectively monitor and manage video streams from thousands of monitoring cameras across the city. With this comprehensive solution, over 8,000 police officers are empowered with real-time access to review and analyze the data from multiple CCTV streams. This capability not only simplifies the monitoring process but also allows for swift and efficient responses to incidents as they

unfold.

The MiCMS solution leverages its advanced capabilities to streamline the workflows of TCPD personnel. Integrating diverse monitoring systems into a unified platform eliminates the need for officers to navigate multiple interfaces, saving valuable time and resources. The intuitive user interface of MiCMS ensures that officers can easily access and analyze data, making informed decisions in real time. This enhanced work efficiency translates into a more proactive and effective response to incidents, ultimately contributing to the overall safety of Taipei City.

Moreover, the MiCMS solution utilizes cutting-edge technologies, such as AI-based video analysis and license plate recognition, to extract valuable insights from monitoring footage. The integration of AI enables the system to automatically detect and notify officers with real time information, alerts and administrative announcements. Additionally, the license plate recognition feature aids in the identification and tracking of suspicious vehicles, enhancing the TCPD's investigative capabilities.

Through seamless integration and advanced technology, the system enhances work efficiency, and empowers officers with actionable insights. This comprehensive approach not only strengthens public safety but also enables the TCPD to respond swiftly and effectively to incidents, making Taipei City a safer place for its residents and visitors.

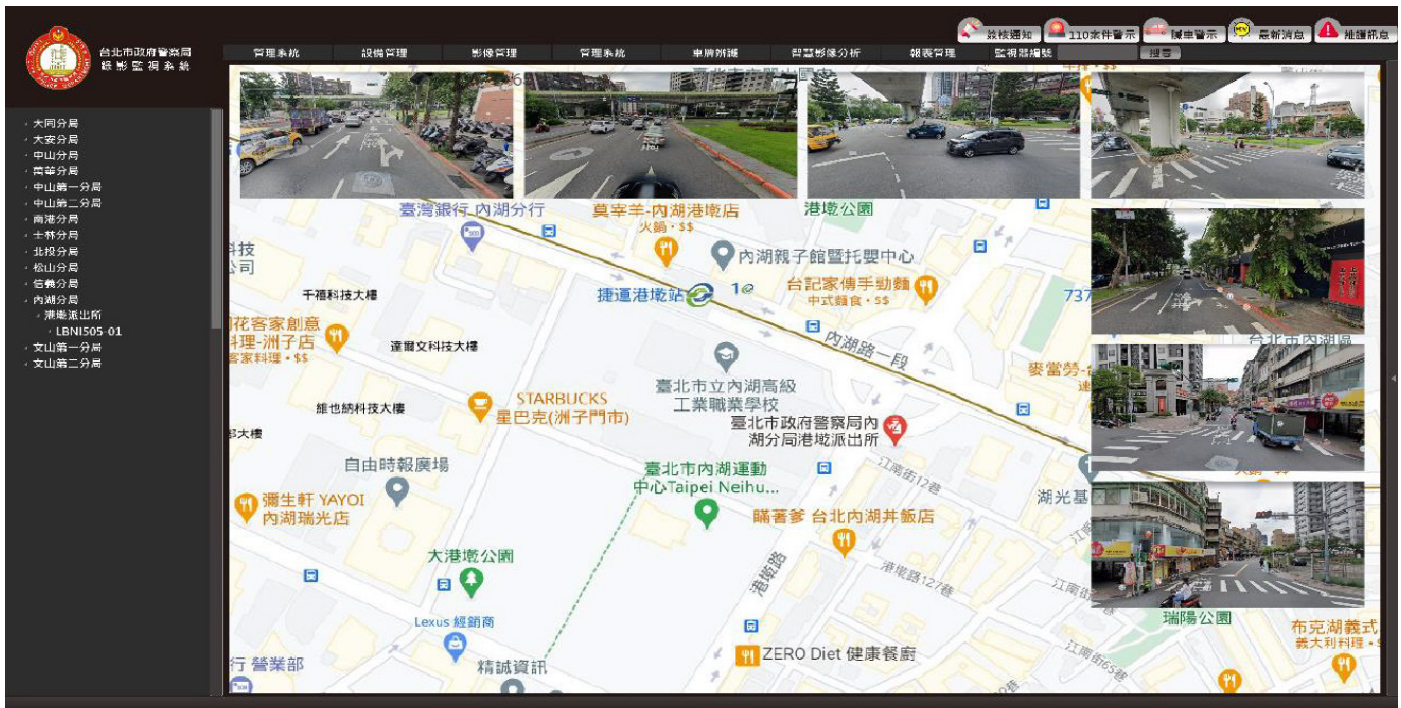


Figure 3: MiCMS provides a single integrated solution for all the systems deployed in the solution

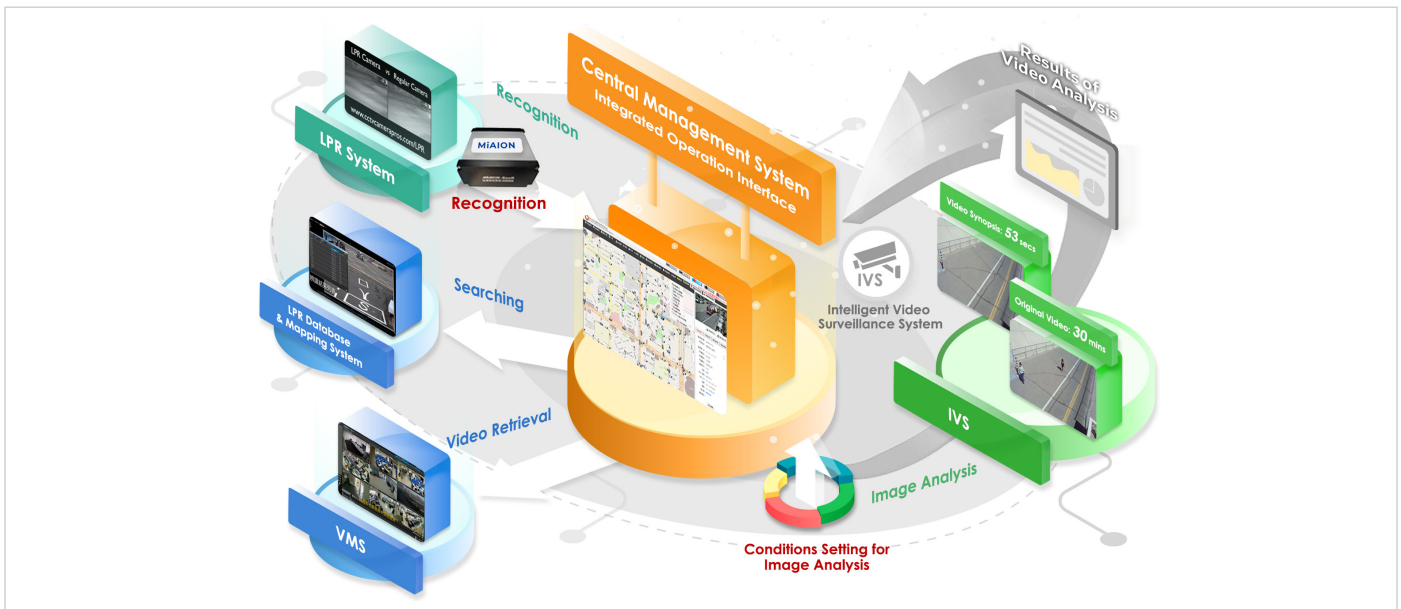
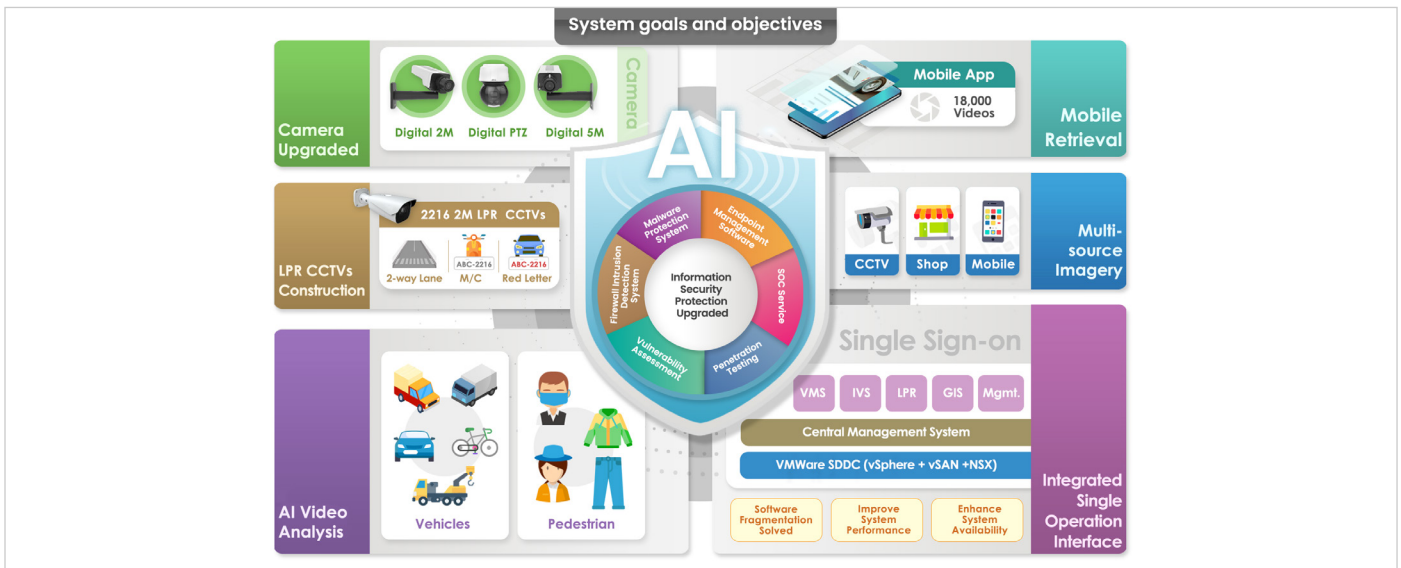


Figure 4: MiTAC's MICMS Integrated Single Operation Interface

## Collaborating to Improve Taipei's Overall Public Safety

Since the MiCMS system is accessible to multiple users across different civic authorities from the Fire Department, Transportation Department, and National Police Agency, parallel computing capabilities are vital to the system's success. Additionally, the database reaches 44 Petabytes, making it the single largest database in Taiwan that is operational round the clock.

Intel®'s partnership with MiTAC delivers the results that the TCPD needs and is driven by a high level of quality, stability, and trust. The intelligent CCTV monitoring system uses Intel® processors to manage over 20,000 devices.

To meet these performance needs, Intel® Xeon® Scalable processors have been deployed across the servers, workstations, and IPCs. In conjunction with Microsoft Windows series operating systems, Intel® processors

deliver the stability and speed required for the entire system to run efficiently. Intel® technologies help improve data safety and manageability while enabling local machine-to-machine automation. From predictive maintenance to data-based operations, Intel® architecture supports analytics capabilities to optimize processes, equipment, systems, and utilization.

The entire system is housed at the TCPD's Internet Data Centre (IDC) with 185 general servers, 18 16-core servers, and 427 workstations, all of which run on Intel® processors. The parallel computing power and multitasking capabilities of Intel® processors ensure that all 8,000 users of the intelligent CCTV monitoring system have access to potentially life-saving video data when they need it.

Additionally, the LPR IPC units utilized by field personnel for real-time monitoring are equipped with 7th Gen Intel® Core™ processors, enabling advanced video analysis at the individual level and facilitating simultaneous handling of multiple video channels.

EQUIPMENT	MODEL	QUANTITY	PROCESSOR
Video Management Server	Dell EMC Power Edge R740xd	6	Intel® Xeon® Gold 5218 (2.30 GHz)
Video Broadcast Server	Dell EMC Power Edge R640	156	Intel® Xeon® Gold 6240 (2.60 GHz)
IVS Management Server	Dell EMC Power Edge R740xd	2	Intel® Xeon® Gold 6240 (2.60 GHz)
IVS Analysis Server	Dell EMC Power Edge R740	16	Intel® Xeon® Gold 6240 (2.60 GHz)
CMS Server	Dell EMC Power Edge R740xd	16	Intel® Xeon® Gold 6252 (2.10 GHz)
M-Police Server	Dell EMC Power Edge R740xd	2	Intel® Xeon® Gold 6252 (2.10 GHz)
LPR Server	Dell EMC Power Edge R740	5	Intel® Xeon® Gold 5218 (2.30 GHz)
Workstation	Dell Precision 3640 Tower	427	Intel® Core™ i9-10900K (3.70 GHz)
Front-end LPR IPC (i3)	S310-11KS-7100U	2,000	7th Gen Intel® Core™ i3
Front-end LPR IPC (i5)	S310-11KS-7300U	108	7th Gen Intel® Core™ i5
RAID	IBM FlashSystem® 5100		Intel® Xeon® (8-core)

Figure 5: An overview of Intel® processors used in the solution

Intel®’s distribution of the OpenVINO™ toolkit is further enhancing MiTAC’s LPR system. OpenVINO™ provides the LPR system with artificial intelligence, giving it the ability to recognize multiple car and motorcycle license plates appearing simultaneously on both lanes of a road in real-time. It provides a set of tools for video inference and deep learning that helps the TCPD process more than 40 billion data points in the LPR database.

**It also allows the TCPD’s analysts and police personnel to:**

- Integrate video decode on multiple streams with video analytics
- Configure applications end-to-end with flexible AI capabilities and a Reference Video Analytics pipeline for fast development
- Connect stand-alone devices to cameras thereby enabling faster edge analytics in near-real-time
- Create discrete AI services on the network to run offline deep learning analytics on demand

Leveraging OpenVINO™ technology for real-time recognition of license plates is improving LPR accuracy by leveraging AI and deep learning algorithms.

“MiTAC is extremely honored to combine our 40 years of experience in information technology with the application of AI. Our cutting-edge hardware devices spearhead Taipei’s transformation into a smart city that seamlessly merges intelligent CCTV monitoring with AI algorithms. Our goal is to provide services and support to hardworking police officers through technology, thereby improving urban law enforcement efficiency, maintaining traffic order, and reducing urban crime. We also hope that this successful use case in Taipei City can serve as a role model and inspire more adoptions in other cities in Taiwan and globally, benefiting a larger community of police officers and the general public.”

**Steven Wen**  
 Vice President, MiTAC  
 Computing Technology Corp.

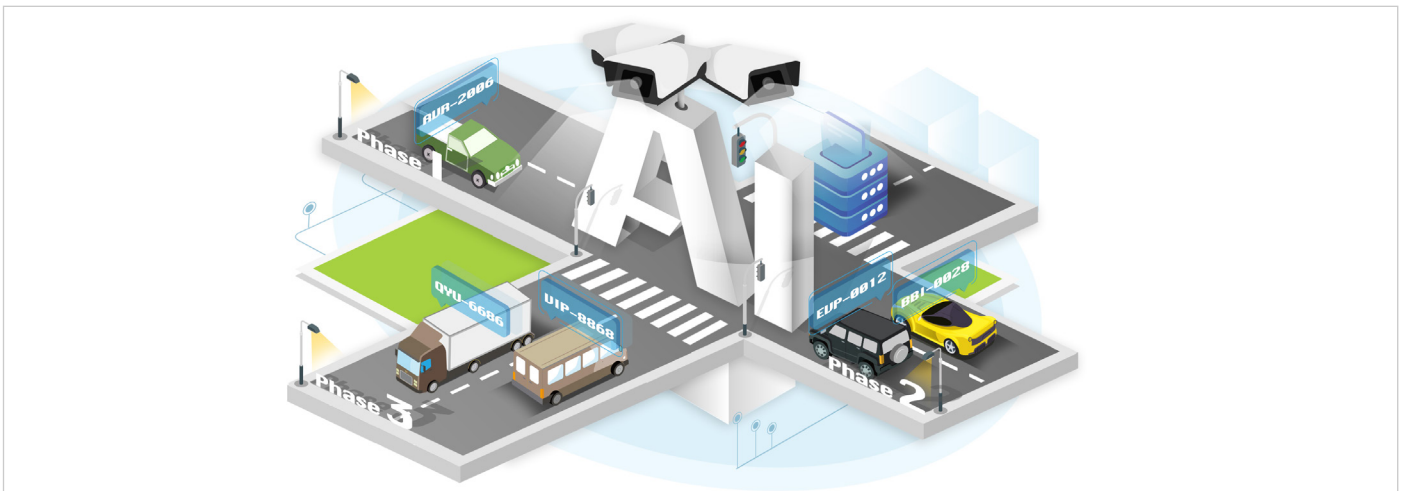


Figure 6: Phase-wise deployment of the LPR system

## Achieving High-impact Results

MiTAC's MiCMS solutions have played a pivotal role in transforming Taipei into the first location in Taiwan to implement an intelligent CCTV monitoring system, setting a new benchmark for public safety. The integrated system structure has been meticulously designed to align with the logical flow of police case handling, ensuring seamless integration and optimized efficiency.

One of the key advantages of MiTAC's MiCMS solution is its ability to automate the notifications of various alerts and updates directly to the M-Police phones of officers. This automation eliminates manual processes and significantly reduces response time, enabling officers to swiftly respond to any incidents. By receiving alerts and updates on their mobile devices, officers can proactively assess situations and initiate the necessary actions, resulting in improved situational awareness and enhanced operational effectiveness.

### With the intelligent CCTV monitoring system deployed in Taipei:

- The incident rate has been reduced by 11.83%.
- The detection rate has increased to 99%.
- Several major investigations have been successfully resolved.

Intel® technologies have been instrumental in streamlining operations and optimizing resource utilization, leading to significant time and manpower savings for the Taipei City Police Department. The robustness and reliability of Intel® processors ensure consistently high levels of system performance and availability, even under extreme workloads and heavy usage. This reliability is particularly crucial considering that the intelligent CCTV monitoring system is accessible to nearly 8,000 users across various departments, including the Fire Department, Transportation Department, and National Police Agency. The scalability and efficiency of Intel® technologies have enabled the system to handle the demands of a large user base, ensuring uninterrupted access and enabling faster data processing.

The impact of MiTAC's MiCMS solutions and Intel® technologies extends beyond the Taipei City Police Department. The intelligent CCTV system has facilitated interdepartmental collaboration and information sharing. This seamless integration has allowed different agencies and departments to work together, fostering a coordinated and unified approach to public safety and emergency response. The Fire Department, Transportation Department, and National Police Agency can leverage the system's capabilities to enhance their operations, improve incident management, and support effective decision-making processes.

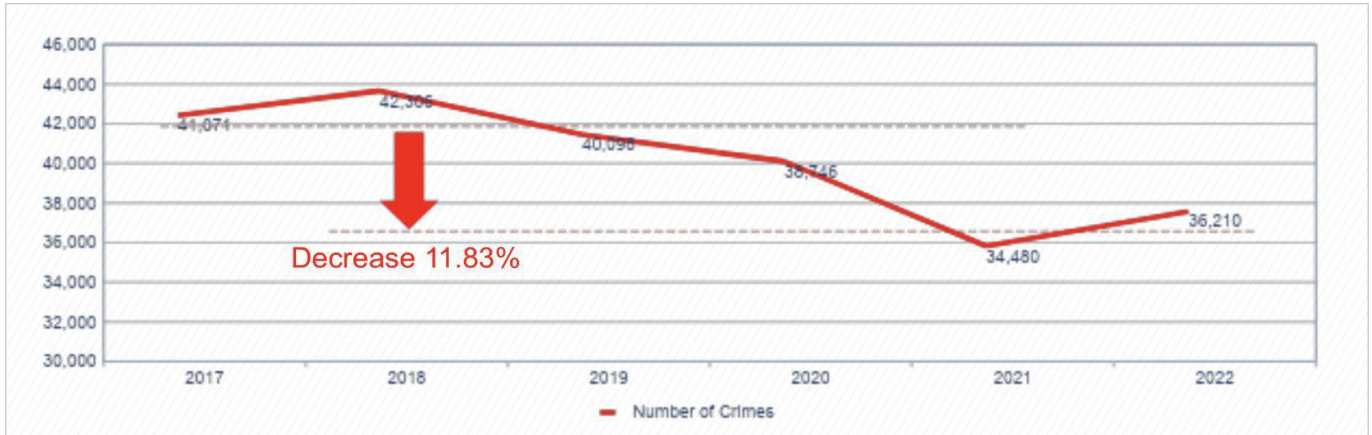


Figure 7.1: The reduced incident rate in Taipei City after the introduction of MiCMS

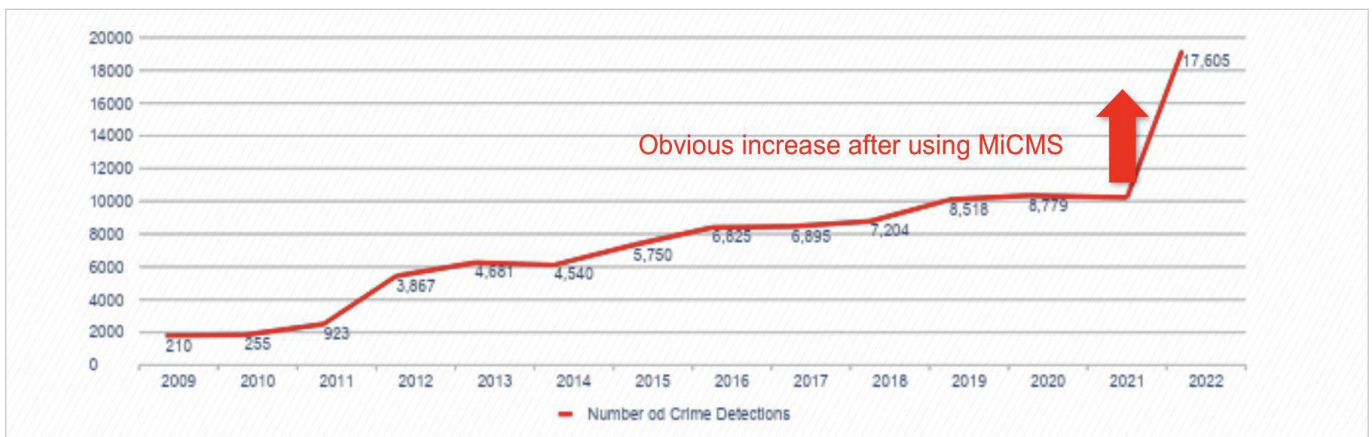


Figure 7.2: The increased rate of incident detection by the TCPD after the introduction of MiCMS

## Scaling Up the Future of Safety

The future plans for the intelligent CCTV monitoring system powered by Intel® include:

- **Expansion to other cities:** MiTAC plans to expand the system to other cities. By leveraging Intel's technology and expertise, they aim to create safer and smarter cities across Taiwan and around the world.
- **Integration with IoT devices:** MiTAC intends to integrate this intelligent system with IoT devices to create an integrated smart city ecosystem, enabling more efficient and proactive public safety measures.
- **Advanced analytics and predictive capabilities:** The collaboration between MiTAC and Intel® will focus on further enhancing the system's analytical capabilities. By leveraging Intel® advanced analytics platforms, the intelligent CCTV monitoring system will be able to analyze video footage more efficiently, detect anomalies, and predict potential safety incidents before they occur.
- **Cloud-based storage and analytics:** MiTAC plans to leverage Intel® cloud technologies to enable scalable storage and analysis of the massive amount of data generated by the system. Cloud-based solutions will provide flexibility, accessibility, and cost-effectiveness in managing and processing the data collected from the CCTV cameras.
- **Further optimization of LPR systems:** MiTAC and the TCPD plan to use the OpenVINO™ toolkit to optimize the core management of the LPR system to further improve its performance. They also plan to develop a single LPR host with the motherboard and peripheral devices powered by MiTAC peripherals and Intel® CPUs.

### References:

1: <https://rankingroyals.com/infographics/safest-cities-in-the-world-424-cities-ranked/>



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## Going Global with Intelligent CCTV Monitoring Systems

The successful implementation of MiTAC's intelligent CCTV monitoring system powered by Intel® in Taipei serves as a testament to its effectiveness in enhancing public safety.

The cutting-edge technology incorporated into the Intelligent CCTV Monitoring System has revolutionized work efficiency and detection capabilities within the Taipei City Police Department (TCPD). Through the seamless integration of AI-based video analysis, license plate recognition, and Geographic Information System (GIS), the system has significantly bolstered public safety in Taipei.

The utilization of Intel's powerful CPUs, along with innovative features like OpenVINO™ technology, has yielded remarkable results. Notably, the system has experienced a substantial increase in the detection rate of theft cases across Taipei City, enabling a swift response by the TCPD. Furthermore, the system has proven instrumental in assisting the TCPD with insights and data to augment ongoing investigations.

Cities around the world face similar challenges when it comes to public safety, and the implementation of advanced CCTV systems can play a pivotal role in addressing these issues. By adopting MiTAC's Intelligent CCTV Monitoring System powered by Intel® cities can benefit from cutting-edge technologies and solutions that have already proven their effectiveness in Taipei.