

Edge-Based Security Use Cases with Accelerated Analytics and Storage

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Organizations of every kind have come to recognize that security, and particularly surveillance security, is critical to protect business assets, physical spaces, and personal safety. This has resulted in a surge in the surveillance market, and technology now plays a vital role in enhancing security and surveillance capabilities. Companies often deploy numerous technical solutions such as alarms, access control devices, and video surveillance. The global video surveillance market size was valued at USD 41.26 billion in 2019 and is anticipated to reach USD 86.53 billion by 2027 at a CAGR of 9.6%.¹

Traditional building and site security has greatly evolved in the past century, from humans guarding doors to closed circuit television (CCTV) to network video recording (NVR). With the advent of Artificial Intelligence (AI) and Machine Learning (ML), specifically Computer Vision (CV), and the consumerization of Internet of Things (IoT) devices such as networked thermostats, indoor cameras, and camera-doorbells, the capabilities exist today to shift the focus from video recording to situational awareness.

The demands for human intervention are in decline and surveillance systems are becoming smarter. One-to-one and even several-to-one (CCTV) monitoring relies on humans to watch "normal" while looking for "abnormal" activity. Leveraging technology to detect, interpret, and prioritize events in a coverage area reduces the labor costs from one person per area of interest to one person per thousand or more areas of interest.



The ability to process trillions of calculations per second is sparking an evolution in security. CV automates this process, allowing computer systems to learn what is "normal," and alert us when anomalies occur. They can also be instructed or trained to recognize specific objects, behavior, or activities, and recognize the situations that we would care to observe or investigate. Every environment is different and often time is precious. In many scenarios, the latency for streaming to the cloud and waiting for the response is not acceptable. Ideally, a hybrid edge- and cloud-based surveillance system can yield an optimized, flexible, and cost-effective solution.

¹<https://www.emergenresearch.com/industry-report/video-surveillance-market>

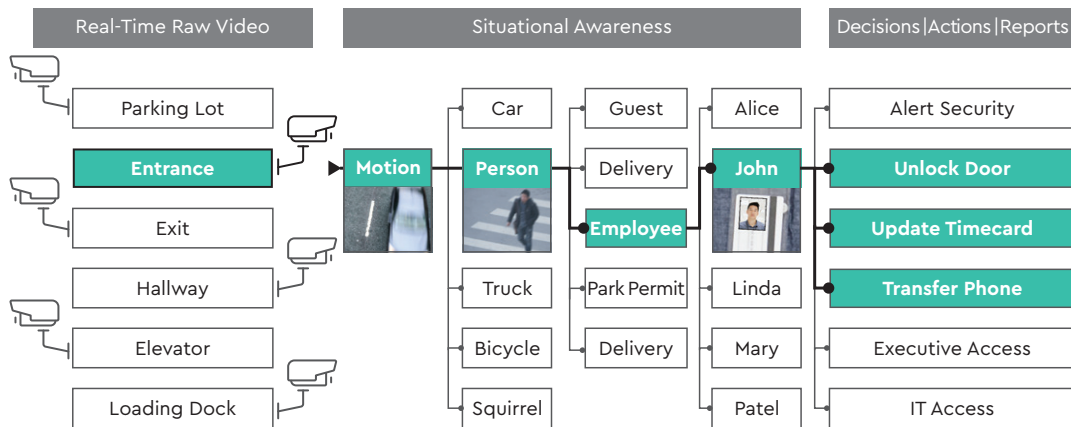
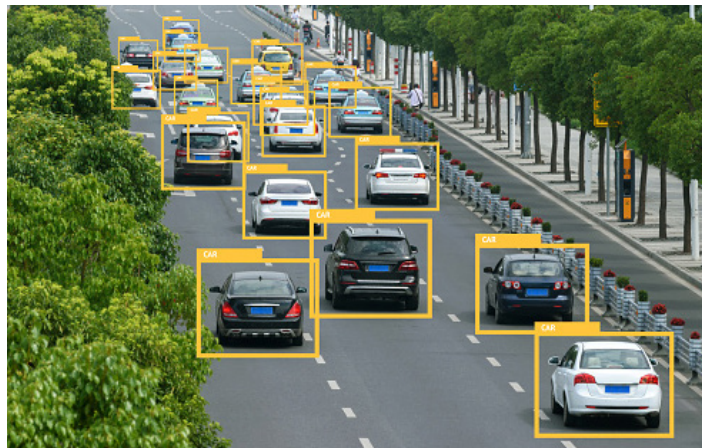


Figure 1: Example using analytics with a surveillance camera system

With the evolution of CV, the opportunity has arisen to leverage normal vs. abnormal comparisons to recognize crowds, match the number of customers in a store to the number of checkout lines open, see how effective marketing displays are at attracting customers, or even match defects in product packaging during manufacturing.

Modern CV-based video systems have the potential to change business processes, streamline multiple traditional industries, and increase overall efficiency. By leveraging common software and capabilities of matching inference knowledge databases, we can define the current status. For example, we can compare “what is normal,” or what things should be, according to the current state, time of day, historical data, and context of what has been seen versus what is being seen. All without human real-time attention and interpretation. An open object detection algorithm such as YOLO V3 (You Only Look Once, version 3) can be used to identify objects in video streams.



Numerous security solutions have been case-studied including:

- Machine Learning analysis and classification of malicious attacks assisting special operation command (SOC) teams, security researchers, and malware analysts to understand and remediate threats.
- Cyber Physical Infrastructure systems deploying AI not just for automated manufacturing optimization but for the introduction of employee-induced events, coordinating system, IoT, video and audio sources in the process.
- Vehicle Identification in buildings or parking lots or on the road. Identify vehicle type, color, license plate, and other characteristics.
- Matching in-store customer shopping behavior with known theft tendencies to help identify employee theft, shoplifting, and other potential threats to physical facilities.

The potential use of specialized processing on the edge and in the cloud offers a myriad of ever-growing solutions specific to many vertical industries. The key is a platform with the ability to adapt, test, and change. The hardware and software for situational awareness has become mainstream, with open source tools and cloud hosting capabilities and services becoming more and more common. While cloud-based and "as-a-service" offerings are growing, there is no "one-size-fits-all" solution in this area for many reasons.

In the first decade of the 21st century there began an enormous push to do everything in the cloud. The reasoning at the time was that centralized processing could be leveraged with ever-faster networking to numerous, varied edge points. As we moved into the 2010s and the cloud became a reality, multiple challenges were observed including expensive processing costs, high power consumption, bandwidth limitations, privacy, and more. Today, a hybrid cloud approach which leverages processing at the edge *and* using the cloud is growing in popularity and offers a flexible platform to address many surveillance solution architectures.

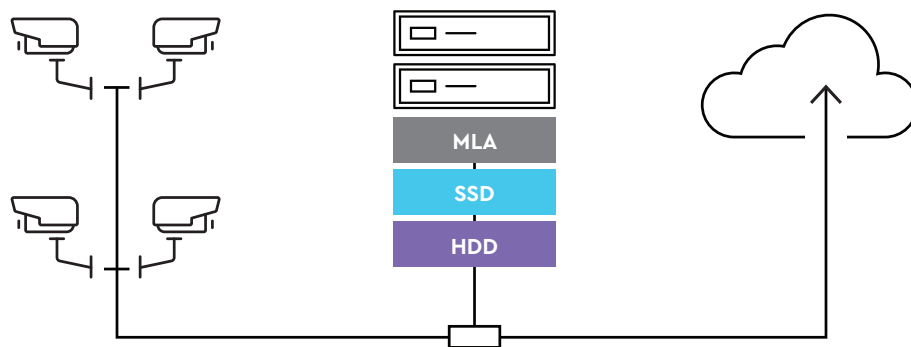


Figure 2: Hybrid cloud multi-camera surveillance system block diagram

Data, especially video-based data, is very privacy-sensitive and bandwidth-intensive, and carries implications for security and chain of custody if the events being observed are ever to be used in legal proceedings. In fact, many countries prohibit medical information from being stored in the cloud to protect user privacy. The hybrid cloud approach, leveraging site, edge server, and cloud capabilities, can be used in many combinations to optimize the performance, cost, regulatory compliance, and effectiveness of deployment.

By effectively processing the data where it has the most value, in the context of the local usage, the value of the data is maximized, and processing can match the needs of the local layer of audiences. A simple example could be: Who cares about the number of people leaving empty-handed from a store? The store management, so that they might redeploy their employees to provide better customer service or stock different products. This view creates actionable knowledge about the store's situation; therefore the data required to make these decisions and alerts should reside in the store.

These differing data access patterns and intensities at the points of interest also mean that we aren't just recording data 24/7 to cold storage. Rather than a gigabyte or more per camera per hour, we now have requirements with different resolutions, frame rates, and archival specifications.

A specific hybrid surveillance solution to detect people and enable further processing in the cloud for more detailed analytics is shown as an example. In this demonstration, the cameras start sending real-time data when any motion is detected. That data is automatically sent to a Supermicro® edge server which incorporates the Western Digital U.2 FPGA based card implementing a Machine Learning Accelerator (MLA), an SSD, and an HDD. The MLA card runs YOLO V3 on the incoming data and detects if the movement is a person. If it detects a person, that specific data set is sent to the cloud and also stored locally. The cloud can run further detailed analysis to ascertain whether the person is of interest or not.

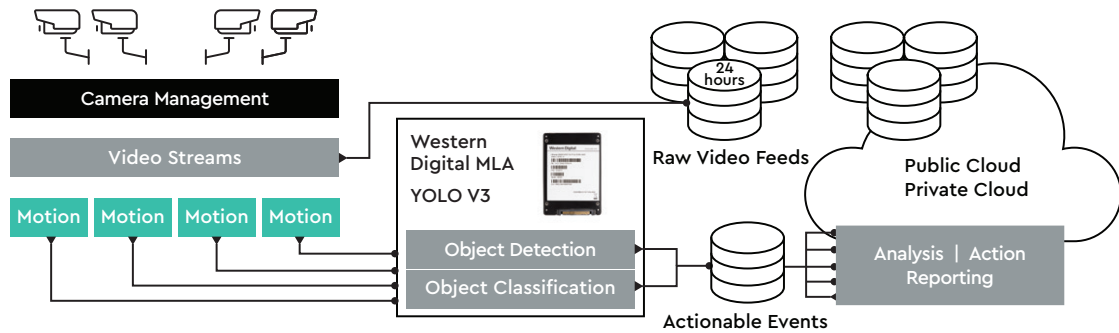


Figure 3: Detailed system block diagram of a multi-camera solution

Optimizing the storage for the intended usage patterns and minimizing the bandwidth and processing in the cloud will result in lower overall costs, higher performance and a better overall solution targeted to the generation, processing, and audience of each type of data. The implementation also allows a simpler expansion to the capabilities of the Computer Vision system over time as new use cases can be added or expanded, and new camera and processing technologies are introduced.



To learn more about this demonstration solution or the components that make it up, please visit <https://www.westerndigital.com/solutions/business/machine-learning>.

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