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TECHNOLOGY

AI in video analytics: Improving safety, security, and operations

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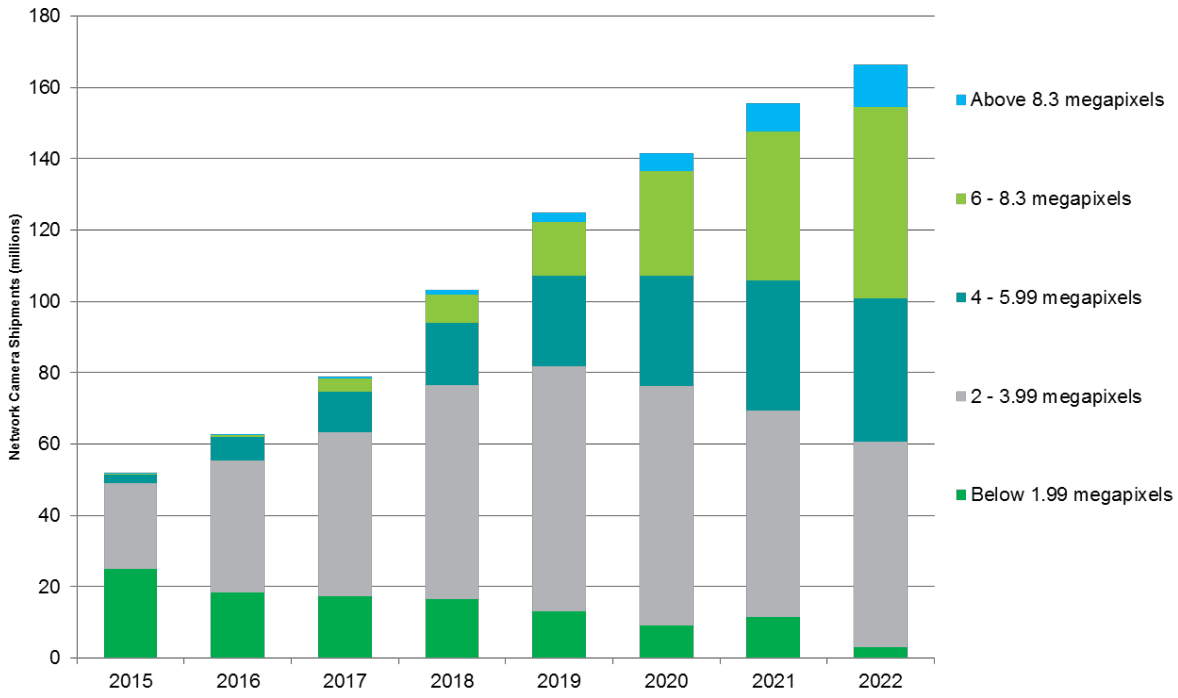
Introduction

For years, the reliability of video analytics had been extremely variable, with vendors struggling to develop algorithms that could function in complex scenes. The industry has come a long way in recent years, and more traditional video analytics have seen steady increases in their capabilities. However, traditional analytics have never been able to constantly provide the appropriate level of reliability, accuracy, and insight. Deep learning analytics are poised to facilitate a significant leap in the capabilities of video analytics. The last couple of years has seen a large increase in research and development in deep learning neural networks, proving their capabilities, generating considerable excitement, and putting them within reach of a much wider user group.

An increasing number of surveillance cameras

As the number of cameras being installed increases substantially year on year, so too has the amount of video that is being generated. IHS Markit estimates that in 2018 108 million network cameras will be shipped. Of those network cameras, 84% will be 2 megapixel or above.

Exhibit 1: Global network camera shipments



Source: IHS Markit Video Surveillance Intelligence Service, June 2018

As the number of camera shipments increases, a better way of analyzing and assessing the captured video is needed, as current conventional methods of computer vision analytics or manual analysis is not able to provide the insights needed.

This need has led to the development of deep learning analytics.

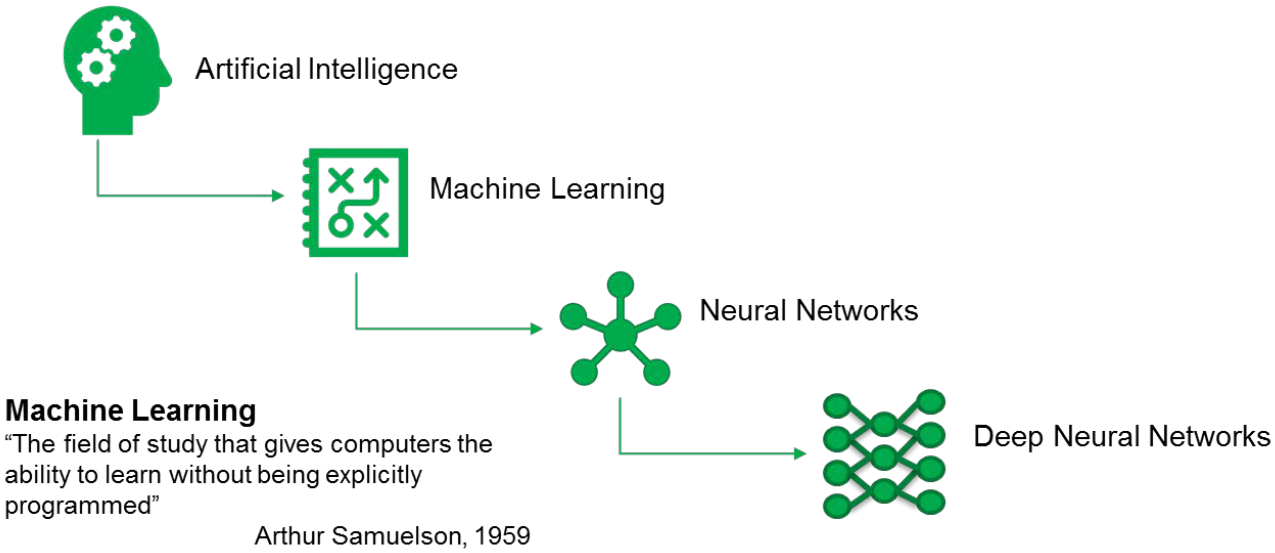
What are deep learning video analytics?

Deep learning is a technique for the implementation of machine learning that has existed since the 1980s that mimics cognitive functions that humans associate with brain functions, such as learning and problem solving.

Deep learning computers are able to learn from experience and are able to understand the world in terms of a hierarchy of concepts. This hierarchy is built from the ground up without predefined rules; it is similar to the way a child learns to classify objects in accordance with a series of sub-characteristics which when added together form the larger concept.

Deep learning is a form of artificial intelligence (AI). IHS Markit views these technologies as consensual sub-sets of each other.

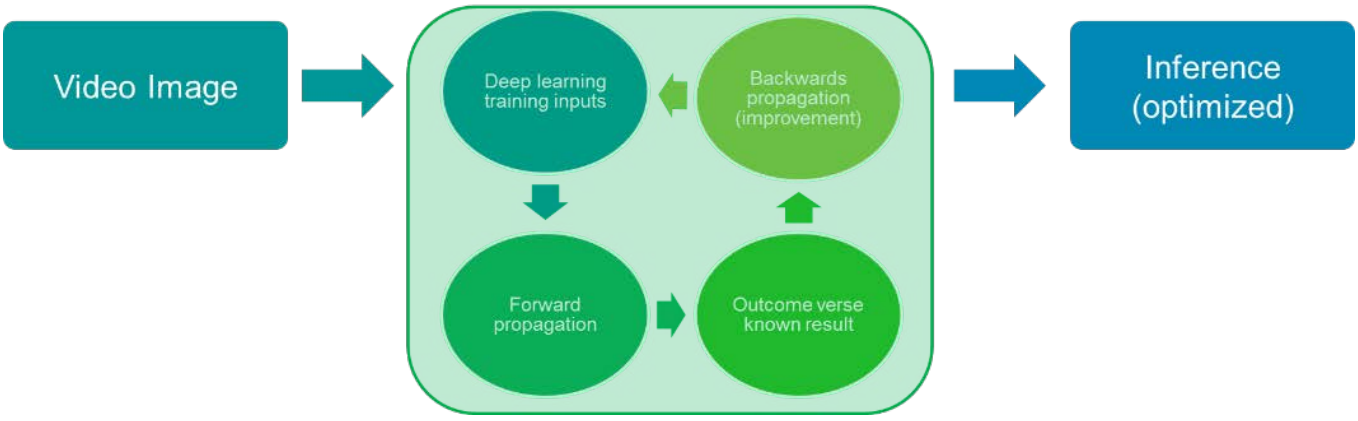
Exhibit 2: AI sub-sets of deep neural networks



Source: IHS Markit, "Video Analytics in Security and Business Intelligence Report," 2018

A key element that distinguishes a deep learning analytic from traditional computer vision technologies is that it employs artificial neural networks in order to mimic the human brain. Its algorithms are able to learn from example and then apply that knowledge in interpreting new data, all the while continuing to refine its ability to interpret and infer.

Exhibit 3: The training process



Source: IHS Markit, "Video Analytics in Security and Business Intelligence Report," 2018

Large amounts of data relating to a specific problem are collected to create a training model. This model can then be used by the algorithm to process new information accurately and make inferences.

In this process, sound, images, and other inputs fed into the system are broken down into several layers of higher abstraction, each representing a feature or identifier, such as edges, colors, shapes, and tones.

What benefit to deep learning analytics provide

Deep learning is able to offer a level of accuracy and reliability in object and behavior detection and classification significantly greater compared to traditional rules-based analytics. Broadly speaking, there are two main areas in which deep learning analytics offer great benefits over the technology that has preceded it. Those areas are as follows:

Accuracy

A long-held complaint levied against traditional rules-based analytics products was that their algorithms were unable to distinguish between objects and behaviors that a human being would have no problem classifying. This inability is due to the algorithms being based on geometrics rules. This deficiency in computer vision algorithms results either in missed security breaches or false alarms. The ability of deep learning algorithms to view a scene intuitively, as a human viewer would, means that detection accuracy increases dramatically while false alarm rates fall. Neural networks allow a computer to apply a series of assessments to a given situation. This is an important development for the video analytics industry. Although some end-users may not need an analytics solution that is 100% accurate 100% of the time, many use cases require that their security system be as close to infallible as possible. Users in the critical infrastructure sector, for instance, cannot afford to miss a breach in their security and can spend a large amount of money investigating false alarms. Deep learning algorithms have shown they can learn to achieve extremely high levels of accuracy in certain tasks, where conventional systems would struggle to achieve anywhere near this. In many security use cases, a few percentage points make all the difference.

Power

Not only has deep learning demonstrated its capacity to radically increase the effectiveness of a computer to reliably classify objects and behavior, it is also making possible the processing and analysis of increasing volumes of video footage in a fraction of the time of earlier analytics. Companies are marketing analytics that leverage deep learning to quickly turn vast amounts of video footage into usable information. Video processing software that allows users to interact with their surveillance footage using a Google-like interface and natural language search terms drastically reduces the time it takes to find relevant video footage in an archive that might store video from thousands of feeds.

In addition to this the ability to detect multiple objects and classify them, this technology allows for much greater insight to be gained from the video. Insights extend beyond simply recognizing, for example, cars—or even red cars—to the recognition of car types, makes, and models. Additionally, that data can be analyzed to include which directions these vehicles were moving and at what speed, then drawing patterns, insights, and conclusions based on the data.

The aim of deep learning video analytics is to take unstructured video, autonomously classify it, then provide searchable actionable and quantifiable data and insight.

Making video searchable

One of the most important aspects of deep learning analytics is the ability to rapidly search through large amounts of stored video. The vast majority of video surveillance footage is not monitored. A typical surveillance camera records between 8-15 frames per second. A town or city with thousands of cameras can therefore generate a huge amount of data in a single day. A crucial piece of information may be

contained in only a few frames captured by a single camera. Identification and retrieval of relevant information from the massive amounts of irrelevant noise has been one of the most challenging tasks.

In the same way that search engines created mass appeal for the internet, searchable analytics are changing the way stored video is searched, making it quicker, easier, and more cost-effective to find the correct frames.

Searchable analytics is a prominent and important trend, with more and more providers of analytics providing searchable video with an aim to make a collection of forensic evidence much more efficient.

Searchable analytics works by creating a meta-data stream in parallel with the video stream. This meta-data stream acts like an index or list of content. When there is an event, key information such as size, color, object type, speed, event time, and duration is stored in the meta-data stream. This can be searched independently of the video. Therefore, it is possible to search for a red car travelling at over 50 MPH without watching hours of video images. In a police investigation, this has the potential to save hundreds of hours of officers' time. Searchable analytics are therefore penetrating markets such as city surveillance, which historically searched video manually.

As with video analytics in general, searchable video works best in scenes with limited activity. However, deep learning algorithms that increase the reliability of object and behavior classification are constantly increasing the capability of such analytics to operate in high-traffic scenes.

Deep learning algorithms allow predetermined events that are not of interest to be filtered out of this summary without the need for end users to do so manually. For example, a user could specify that they did not want to see events featuring their car pulling into their driveway; these events would be filtered out of the summary footage.

Considerations

Deep learning analytics are expected to advance the analytics market capabilities. However, as with all new technologies, there are issues that need to be considered. The main issues are processing power, cost, and application. Advancements in GPUs for parallel processing are able to provide the necessary processing power, especially when running higher frame rate algorithms for live analytics. Of course there are trade-offs with purchasing the required compute power. Additionally, not all applications require deep learning analytics. While facial recognition and object recognition algorithms have seen considerable increases in capability, object tracking or people counting will see little improvements versus the increased compute power and cost that would be required.

Bottom line

As video surveillance becomes increasingly common, the need to better analyze the captured video is becoming more important. The ability to gain insight from video that is already being recorded will become progressively more important.

For a retailer to know not just how many people entered the store, but also their age, sex, the route around the store the customer walked, how long they spent in the store, and what items they looked at, even if they do not purchase anything, is incredibly valuable information. It is also valuable for police departments, highway agencies, and local governments to gain the ability to search entire cities for a particular person, to analyze traffic patterns, and search for a vehicle based on only a few criteria. This functionality will save numerous man hours and offer abilities far beyond what has been available in the past.

Realistically, deep learning analytics are currently the only viable way to produce this insight. Not only do these types of analytics allow for more powerful and advanced analytics, but they also provide more accurate and reliable results with lower false alarms compared to traditional analytics.

Deep learning analytics are expected to advance the analytics market capabilities and will become the main processing method in the future. However, processing power, cost, and application need to be taken into consideration.

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