



VI DIMENSIONS

WHITE PAPER - December 2015 – The Challenge of the Unknown

The Rise of Unknown Threats

There has been an exponential increase in the number of surveillance cameras being used for city-wide deployment but many recent events have again brought our attention to the ineffectiveness of surveillance monitoring in pre-empting or preventing such security incidents.

While there has been fewer spectacular terrorist attacks like 9/11, we have definitely seen a shift in the tactics and kind of attacks recently. The 2015 Paris attacks were carried out on separate targets almost simultaneously, involved indiscriminate shooting, suicidal attackers and taking of hostages.

The rise in terrorist threats shows the vulnerability associated with public places. They are no longer confined to high value targets like power plants or nuclear facilities. Attacks can now take place anywhere, anytime making it difficult for any forewarning of danger even with this proliferation of CCTV.

All these point to the fact that there is now a greater need to discover unusual and suspicious behaviour as early as possible. Besides pre-empting threats, there is also a need for first responders to react more quickly and pro-actively. The longer the hostage takers are left in control, the higher the resulting death toll. It is of utmost priority to disperse crowds as quickly as possible or send a response team on the ground to free hostages and reduce casualties.

The Unknown Unknowns

It was once quoted by US former Secretary of Defence Donald Rumsfeld's in his now infamous remark to a US Department of Defence news briefing in 2002, "As we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also - unknown unknowns - the ones we don't know we don't know ... it is the latter category that tend to be the difficult ones." Question is: Can we find a trail or pattern that leads to these unknowns? The real challenge of the unknown unknown scenario is that you do not even know who or what to look for in the first place.

The Need for Better Analytics

The hard truth is that out of all the thousands of cameras deployed in a city, only a small fraction (less than 10%) are actually looking at perimeters, entrances or exits where an analytic rule can effectively be applied. If we look at this 10% of cameras, we can see that out of the all the possible behaviours or events that can be detected, perhaps another 10% of these events can be detected by applying simple

analytic rules. Putting it together means that we are only detecting 1% of all possible events, essentially missing out on the 99% of the events that could be of interest to us.

The inherent problem with rule-based analytics is that each rule specified is to detect a specific behaviour (e.g. loitering) and have to make good that claim with 90% accuracy. Much time and effort is then put into configuring this one rule and fine-tuning it to achieve the desired accuracy. If this particular event (i.e. loitering) does not occur, then the rule is basically sitting there doing nothing and produces no value. Worse, if it is inappropriately applied, it produces false alarms instead, adding to frustration of the users.

The questions we need to ask ourselves are:

- 1) Can we come up with a better way of automating the discovery of abnormal behaviour or deviant activity patterns?
- 2) Can we do it fast and autonomously applying it across thousands of cameras?

Big Video Data Analytics for Unknown Unknowns

This is where Big Video Data Analytics come in. The advantage is that you do not need to know beforehand what you are looking for. You are basically searching through vast amounts of constantly streaming or archived video data looking for abnormal patterns or activity which you had no idea was even happening. Ultimately it gives you a better and more efficient tool to unveil and discover the unknown unknowns.

Abnormal events can be contextual. For example an abnormal event occurring in a cluster of cameras could signify an event that spreads over a geographical location which leads to a higher level of alert. As in the case of the separate location attacks, it can be seen that people exiting buildings in different manners (e.g. rushing out of doors, climbing out of windows, descending on poles etc) signify many forms of the same crowd dispersal and escape event. To abnormality detection, this is commutative and unlike rule-based approach where it has to first recognize these different type of escape behaviours, we can simply show an increase in abnormal behaviours coming from multiple cameras and send an amplified alert to the operators.

A second order analytics can then be performed on the abnormality data to find patterns over different locations and possible correlations.

Big Data Analytics allow us to see more in the vast ocean of information. It brings our attention to alerts that need greater scrutiny. While it may be like searching for a needle in the haystack, even finding a significant abnormal event of high security threat in one camera will be worth the while.

Revolutionizing City Surveillance – Doing It Smarter

Our product is an unsupervised Machine Learning system that does not require human intervention to discover abnormal motion patterns. This also means it does not require a human to specify the rules for event detection. Our Abnormality Detection Algorithm is based on a unique and novel approach. We have adapted it for surveillance videos where multiple motion patterns are occurring simultaneously. Since the system is autonomous, it provides the means to automatically analyse hours of video easily. Currently, our proposed system consists of three main components, namely,

- a) The automatic abnormality detection (AAD) engine,
- b) The rules engine, and
- c) The AAD and rules fusion module.

AAD is a completely automatic, unsupervised algorithm to learn frequently occurring activity patterns in the scene. The functionality of AAD is the automatic detection of abnormal activities by looking for data out of the ordinary. With the set of frequently occurring activity patterns recovered by the unsupervised algorithm, the detection of abnormal activity will correspondingly be automatic. This detection is performed by matching the observed activity against the activity patterns recovered. In contrast to event or object centric methods described in the previous section, this method works automatically without requiring any human input.

The discovery of suspicious behaviours represent the best possible way for us to surface any abnormal activity for scrutiny. This increases the chances of us stopping an imminent threat to our safety and security.

About Vi Dimensions

Vi Dimensions was founded in 2015 with the simple idea that video analytics can be done in a much better and efficient way with the ultimate goal to revolutionize safe city surveillance harnessing thousands of cameras.

The company uses its patented algorithms and proprietary unsupervised Machine Learning techniques to derive meaningful information and actionable insights from live streaming video data. This translates to immediate value to the customer not only in terms of security and surveillance but also improves the organisation's safety, operational and maintenance aspects.

Our advanced and innovative system analyses vast amounts of real-time streaming (or archived) data autonomously for abnormal behavior and events. It does not require human intervention to automatically discover dominant motion patterns which means that unlike conventional systems, it does not require a human to specify rules necessary for detection.

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