Whitepaper

Radically Faster Video Intelligence

# Case Study: Serious Assault Case

# Table of Contents

# Mass of Video Evidence Potentially Available

The availability of video evidence has soared in the last ten years. There are more than 6 million CCTV cameras in use in the UK and its growing at the rate of 10% each year. People in urban areas of the UK are likely to be captured by about 30 surveillance camera systems every day. And that is not counting body worn videos used by police and private mobile phone cameras.

Recorded video provides a tremendous opportunity as a source of information and evidence. And help police and security agencies detect, investigate and prosecute criminals – if they can be accessed and analysed effectively and efficiently.

But there are practical barriers. Firstly, there are more than 1000 different video formats in use, which makes it difficult to get at the contents for analysis. In most investigations, some video sources are ignored because they are not readable by the investigation team.

Secondly, the current practice for reviewing CCTV and other video data involves outdated systems and manual processes. The methods have not changed significantly in the last 20 years and still rely heavily on experienced analysts watching videos and writing notes. On average, one hour of video review time is currently required for each hour of video footage. (Source: Head of Metropolitan Police CCTV Unit.) There is no way to quickly search a video for people or objects of interest. Further, full user attention span is short: typically just 15-20 minutes, and there is scope for human error.

These problems make the task of extracting valuable evidence from a large number of cameras, in major events and serious crime, a big challenge.

In the aftermath of the London riots in August 2011 police gathered more than 200,000 hours of CCTV to identify suspects. Around 5,000 offenders were found by trawling through the footage, after a process that took more than five months. Finding missing people is similarly arduous work -- when teenager Alice Gross went missing in September 2014, 30 officers were tasked with combing through CCTV from 30 cameras, covering a six-mile radius.

The statistics are worse for more minor offences. In London, across criminal cases where CCTV was available, it was collected in just 16% of these cases. Meaning in 84% of cases, CCTV is available but not used due to a lack of resources (source: The Evening Standard, 11/12/13).

## The Technical Challenge

Current video analysis tools are poor.  There have been some software developments of relevance in this area but they rely on expensive, specially-installed cameras to make these techniques possible. They are presented more as technical research tools rather than as practical support for routine forensic analysis.  For example, facial recognition techniques can perform at a certain level in highly controlled environments with high quality images However, with “wild footage” gathered from real investigations with varying image quality, facial recognition technology is described by leading CCTV Analysts as “Fantasyland”. The reality is there are 6 million legacy cameras out there in the UK alone, and they are going to stay. Video analysis techniques that perform on both existing and future camera infrastructure, is needed.

The prize from creating a new technical solution for analysing video evidence is compelling for forces and agencies that face increasing workloads, increased security risks and reduced budgets.  Improving productivity - getting answers with less manual effort - will enable forces to investigate more crimes or reduce their costs. Providing answers faster, in high profile cases where time is critical, will help protect the community. Increasing conviction rates, through extracting maximum value from the available video evidence, will avoid wasted police effort.

# Gorilla Technology Group

Gorilla has researched and developed a new toolkit that enables analysts to find people in any quantity of video, regardless of camera source or quality of footage. It is intended to help analysts work most effectively and to focus their time on the critical "value added" activities. The technology, using a web based platform and workbench, provides:

## Video Importer Application

This separate application allows the user to quickly view camera footage and also converts it, using decoders and analysers, to a standard MP4 H.264 format from which metadata can be extracted and used with video analytics.

## Dynamic Map

Online maps showing the location of cameras help the analyst manage analysis, facilitating logical search the different video sources.

## Motion Detection

This video analysis tool enables analysts to quickly filter away areas of the video where there is no motion, and to focus on the video with "high probability" of action involved.

## Face Extraction

This tool extracts and displays from the video a set of facial images to support the identification process (particularly helpful when the analyst is searching for particular individuals in a hive of activity).

## Person Detection

A third tool pulls out full body images and posts these on a “Full Body-Shot” wall and creates a starting point for matching those body images.

## Video Search (Re-Identification)

The computer finds matches of a “Full Body-Shot”, replacing much of the manual searching activity. The technology can search through body profiles on the original video or on any other videos. It uses more than 1000 factors or “appearance descriptors” created from the image including height, colour, texture, pattern and shape in different locations, from different cameras, under different lighting conditions and with different angles of view and directions of movement. The system ranks the likelihood of matches being real to assist the analyst in sorting them.

## Video Editing

Video material often needs to be presented in Court or relied on by third parties such as the Prosecution or Defence. Public requests for video are increasing as well. Gorilla offers a comprehensive video editing suite to optimize video for these demands.

## Case Management

As well as the analytics tools, Gorilla provides workflow, file management and information reporting facilities, to remove the administrative load on the analyst.

The full suite of analytics and case management tools are hosted in a single user web based platform that makes operations easy for the analyst and enables them to concentrate on the real skilled analysis needed to find and record answers quickly. Further, the platform will allow multi-tasking, showing maps and synchronized video tracks on a single screen, in order to help the analyst deal with the complexity of many sources of video information, and to join up the different parts of the story.

## The Challenge from a UK Police Force

Gorilla claims that their system can greatly improve police efficiency by exploiting research and development of leading edge video technology. They believe their system will make police and security teams more productive, so they solve more crimes faster.

When one UK Police Force (*County Constabulary*), heard these claims it was apprehensive - many technical products have been brought to the market in the past that have failed to deliver promised benefits.

County Constabulary decided – with support from the Home Office - to test Gorilla for itself as part of the preparation for a business case to justify any new investment. They gave Gorilla an exercise based on a real crime that they had investigated and had achieved a conviction using conventional methods for video interrogation. They were keen to find out how much effort could be saved using Gorilla and how effective it was at identifying the critical evidence for prosecution.

They structured the test on a serious assault case:

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| 1 | A female victim alleges an assault by a male close to a town centre, committed in the early hours of the morning. There is a suspect, but he denies the assault. |
| 2 | There is no video evidence of the crime being committed, but the police gather 185 hours of video data from 15 camera locations, that might have captured evidence about the suspect and the victim in the time before and after the crime. Sources include council cameras on the main streets; cameras outside retail shops and medical centres; cameras at entrance to bars and cafes; cameras behind serving counters in fast food restaurants. |

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| 3 | Gorilla is challenged to provide the following evidence from this data:<br>▪ the whereabouts of the suspect and victim prior to and after the assault;<br>▪ any other incidents that the suspect or victim were involved in;<br>▪ any activity that would support or discredit the accusation of assault by the suspect on the alleged victim. |

County Constabulary provided the Gorilla team with 146 video files on discs, together with the locations of the cameras and the time adjustment needed for each camera to correct and synchronise recorded timings.

## The Gorilla Technology Response

Gorilla brought in an experienced criminal video analyst borrowed from London's Metropolitan Police. He had not worked with Gorilla solutions before. He was given a total of 6 hours training in the toolset, before he was given access to the video files.

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| 1 | The 146 video files supplied by County, in a variety of video formats, were converted using the Video Importer Application and "ingested" into a secure data store for access and analysis by the web based Gorilla toolset. This process took 4 hours and created an important first base for the analysis. |
| 2 | The video analyst used the Dynamic Mapping on screen to manage the camera locations and to compile a priority search order for the video files. |
| 3 | He started to work through the videos, using the Motion Detection facility to eliminate time spent on irrelevant video content and identify the main areas of interest. |
| 4 | Next he ran a Face Extraction for the suspect, but in this case the facial images were not clear enough to positively identify the suspect. |
| 5 | He ran the Person Detection module on one of the Council videos in the primary area of interest. This provided a set of full body images for people in the video. The analyst quickly scanned those images and found the suspect. |

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| 6 | He then opened up other videos using the multi-tasking facilities, on the single screen. By simply clicking and dragging the body image result from the Person Detection module into those other videos, he initiated the person matching process using the Video Search (Re-Identification) tool. The tool brought up sets of possible matches ranked in order of probability from each video. The analyst examined the results, identified the likely true hits, and then confirmed them by playing the relevant clip of the video where the matching image had been taken from. |
| 7 | The analyst repeatedly used the Dynamic Map on screen and multi-tasking windows to follow through the analysis, to manage a portfolio of concurrent search activities, to trace the timings of suspect appearing on and going off a particular camera and to identify the next videos to look for the suspect, using the re-identification module with those videos. |
| 8 | Next the analyst traced the movements and activities of the victim. This time the face extraction tool provided results that established where and when the victim had appeared in various locations. The Face Extraction was particularly useful where the victim was in crowded locations such as the fast food outlet and only the head was visible. |
| 9 | In this process the analyst filled in the complete storyline for the suspect and the victim. He also linked the adjacent bits of video from different cameras, providing a comprehensive profile of the events and the evidence. |
| 10 | Finally, the analyst prepared a report for the investigating officer. The report was assembled, using the Case Management element of the toolset, with the constructed timeline, the video clip files, and notes annotated by the analyst as he had gone through the process of analysing and capturing relevant content, from the 185 hours of video. |

The total time taken by the Met Police analyst to find and extract the relevant information and evidence and to prepare a report was 11 hours.

## Findings - Time Savings

Using the Gorilla video analytics toolset saves time and effort. Forces typically allow at least one hour of analyst effort for every one hour of video to review. On that basis, doing the video analysis using conventional methods would have taken County Constabulary over 185 hours of analyst viewing time (and considerably longer to convert formats; organise the video so it

can be viewed & produce outputs based on the material viewed). Even with the data upload time involved, using the Gorilla tools and approach only took a total of 15 hours – less than 10% of the time taken by the conventional route.

The time savings were attributed to:

- Creating an online source of video files for analysis with the Video Importer Application, reducing time taken by the analyst physically dealing with different discs in different file formats. Further, pictures and selected video footage are stored traditionally on the analyst's local computer hard drive, causing performance problems.
- Effective use of the motion detection tool to eliminate irrelevant video time. This cut out a significant amount of non-productive effort by the analyst.
- Use of the Person Detection and Re-identification tools to complete a 1st scan of people and return matches at various levels of probability. This still requires an experienced analyst to review the hits and select from those hits – but this is a fraction of the time taken to scan the original video itself, and this facility again has a major impact on the total time taken.
- Use of an integrated single software platform – all the systems support is provided through the single Gorilla desk top application. So for example, in a conventional approach, the process of capturing a selected video clip from the main video file and storing it would require at least two other applications. Switching from one application to another takes up user time as well as creating opportunity for error.
- Similarly, the multi-tasking facility – the ability to run different videos on the single screen, and different searches running in parallel – increases productivity and reduces the search time by up to a factor of 4, as well as pointing to the right lines of investigation faster.
- Time taken capturing, storing and presenting the results, using the Case Management facilities, is significantly reduced. The conventional approach typically involves use of paper to log findings, and subsequent management of paper documents. The toolset is designed and operates specifically to facilitate the process and really help the analyst – using one application, and removing unnecessary administration tasks.

These time savings would translate into cost savings for the Police Force as well as freeing up officer and staff effort for other investigations. A conservative estimate is that a process that might have cost £6,000 in Analyst time and lasted over 26 days using conventional methods (without overtime) was reduced to a cost of £360 of Analyst time and could have been completed in just over two days (including video ingestion onto Gorilla). There is then also the meaningful, if less tangible benefit, of running a more efficient investigation, as crucial evidence is gleaned much faster using Gorilla than conventional means. Leading to improved outcomes, in shorter time.

# Findings - Quality of the Results

Nowadays, digital transformation is far more accessible than ever before. New Edge AI and Big Data solutions can help overcome barriers to adopting new systems.[6]

### Full Access to Video Files

One of the 15 videos could not be viewed – it was in an unusable state. This problem typically happens with about one in twenty videos collected for analysis using the conventional approach. The Gorilla video conversion package was able to open all the files and include the contents in the video analysis.

### Quality of the Results

The test with the Gorilla system and an experienced video analyst found all the relevant critical evidence parts that the conventional approach had found.

In very high level investigations such as terrorist incidents, the investigators will often duplicate the manual video analysis process to make sure that nothing has been missed i.e. acknowledging that the human process can make mistakes.

By avoiding time spent looking at a blank screen, and shifting from a purely passive process to an active search process, with routine repeated search elements performed by the machine rather than people, the risk of missed evidence can be significantly reduced.

> One of the videos showed a scene close to the location of the assault, after it had happened. For two hours, there was no movement on the scene. Unfortunately, the camera was looking into the rising sun. It was hard for anyone watching that video to concentrate on the blank screen for a long period of time. The Gorilla motion detection tool, picked up one incident of movement towards the end of the video and flagged this up – so it could not

be missed. The analyst looked at this incident in slow motion and identified the suspect – who had been claiming that he was not in the area at that time. In this instance, the manual process had also identified that (though in considerably longer time), but there may be cases where it could have been missed.

The assembled evidence and the storyline generated by the Gorilla process provide clear concise information for the investigating officer. Also, it is easy to engage the investigating officer in the output, to revisit elements of the storyline and evidence, and to repeat parts of the analysis.

## Usability

The video analyst was pleased with the toolset and felt it significantly improved his productivity as well as giving him more job satisfaction.

"I found the Gorilla toolset very easy to use, it was easy to learn and less stressful than working with conventional tools. It cut down the time spent doing non-productive work and it meant I didn't have to worry about setting up file paths, saving the right video clips in the right place, and keeping notes in paper form. I could do the video analysis in the way I wanted to work. I did not need to call in technical help to deal with different software applications and I felt I was 100% doing real analysis and investigation work. It was good to get the results a lot faster than I am used to working."

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