CSIR C3
collaborate.create.commercialise.

A CSIR-developed camera can locate gunshots by detecting potassium emissions from the muzzle flash.

IMPROVED PUBLIC SECURITY IN CRIME HOTSPOTS

A camera to detect gunshots and gun-related crime

Addressing a problem and responding to market demand

Locating gunshots and criminals in real time to aid swift response and prosecution

Crime-ridden zones in South Africa feature frequent incidents of gun violence threatening public safety and tragic cases of collateral damage. In scenarios where the modus operandi is 'hit and run' and in bouts of gang member altercations, emergency response teams often arrive too late and identifying or accosting the offenders seems an impossibility. Globally, sound-based shot-detection systems have proven an effective means of locating shots and shooters in known crime hotspots, aiding improved prosecution – even deterrence. However, they have disadvantages, including low accuracy and precision in sound classification and positioning, and longer time taken to process the acoustic signal by a human in the loop.

While standard CCTV systems are in place in some such areas, they are not optimised to capture gunshots. A novel optronic intervention can assist in this as well as identifying the weapon used and capturing information about the shooter.

The technology on offer

Gunshot and shooter location detection in real time

A camera, roughly the size of that used for CCTV, can locate gunshots by detecting potassium emissions from the muzzle flash. Dubbed, 'The K-line camera' (K being the symbol for potassium on the periodic table), it can be integrated into a CCTV network in a hotspot area for gun-related crime. Gunshots and the location of the shooter are detected in real time, generating an early warning and recording for forensics investigation support, or reported to an operational command centre.

The camera is intended to be comparable in size, weight, power consumption and cost to commercial-off-the-shelf CCTV cameras.

A planned future version will be for dual use with both situational awareness and gunshot detection processing capabilities at the camera head.

Value proposition and competitive advantage

Small, simple to integrate and cost-effective

The system captures an image of both the signature of the weapon muzzle flash and the shooter instantaneously and generates a warning at the command centre.

Filtering for gunshot incidents in known crime hotspots not only means earlier warning for security and emergency services but also contributes forensics data that can be presented in the court of law during prosecution. Given an array of CCTV gunshot detection cameras looking at the same incident from various viewpoints, a 3D geometrical view of the scene can be generated and mapped for forensics analysis.

The system can be integrated seamlessly with existing CCTV infrastructure without the need for significant infrastructure changes. In addition, it can be built with available components without any custom development. It can operate in both indoor and outdoor environments and various conditions.

Existing commercial solutions make use of an acoustic array of microphones as auxiliary sensors for detecting the sound of the gunshot, and pointing a pan-tilt-zoom camera in the direction of the incident. Weapon shooting scenes are usually dynamic with the shooter and the target in constant motion. This could lead to inaccurate capture of the shooter, especially for a zoomed-in, narrow field of view.

Although there are already active players in the integrative security space, there is a market gap for cameras that perform gunshot detection without reliance on auxiliary sensors for primary detection, such as acoustic and radar sensors. This has the benefit of a small deployment footprint, low complexity in infrastructure management, and low cost of acquisition and maintenance.

Market opportunity

Instant detection, weapon identification and imaging of the shooter directly from the video feed with improved angular accuracy, precision and cost

Video surveillance and video-surveillance-as-a-service had a market size of USD41.4 billion in 2019 and are forecast to rise to USD76.1 billion by 2025. A relatively smaller market exists in South America, Africa and the Middle East at USD4.3 billion.

A near-similar system deployed as part of a pilot project in the Western Cape uses acoustic sensors to detect a potential gunshot and rotate cameras in the direction of the shot. The system works with human operators in the background to confirm the gunshot and log it as such. The end-users pay a subscription fee for the service.

Competitors for the K-line gunshot detection systems are infrared, acoustic and radar-based sensors. These sensors have their limitations in performance, such as clutter for infrared-based sensors; sound clutter from various sources in dense areas, and building obscuration for acoustic sensors. Radar-based sensors can be bulky and costly and are limited in performance in urban areas due to reflections and obscuration from tall buildings. However, all these sensors work as auxiliary sensors to generate primary detections for CCTV.

The K-line system has a lower deployment footprint and maintenance costs through the use of a single camera technology.

Market opportunity

Licensing of the gunshot detection camera technology

The gunshot detection camera technology is available for licensing to an industry partner with CSIR C^3 deriving royalties and licence fees from sales. Local and global industry players who are system integrators and service providers have created a market for subscription-based services where end-users are not burdened with infrastructure ownership and the associated maintenance costs. They provide a turnkey solution and service at a fee.

The target market is thus video surveillance and video-surveillance-as-a-service. The key trend in this market is CCTV cameras with artificial intelligence enhancement for computer vision, with the latest innovation being the on-camera processing of video images to minimise server infrastructure costs.

A smart camera with gunshot detection capabilities will be an attractive prospect for this market.

Investment and return on investment

Investing to become the most advanced gunshot detection camera on the market

Funding in the order of R30 million is required over three years. The system is at technology readiness level 4 to 5. Technology risk reduction related to the real-time processing of gunshot signatures at distances in the range of 50 m to 100 m will be undertaken. Testing with a wider range of firearms has to be carried out so that the capability of identifying different muzzle flash signatures over distances of 50 m to 100 m becomes another feature to set the technology apart from the competition.

During the three years, a preproduction model will be finalised and – ideally with a partner from industry – testing, evaluation and licensing will be undertaken.

A team of experts in optronics, image processing and machine learning

The CSIR's optronics team has expertise in designing, building, optical testing and evaluation, image processing and machine learning applied to optronics systems. Various optical systems designed and developed by the CSIR are in operation, such as the K-line camera onboard the ZACUBE-2 satellite, a long-range camera used in the Kruger National Park and other systems for international clients.

ENQUIRIES:
>> Innocent Siziba
isiziba@csir.co.za