# Firearm Identification Technology

Safe Zone sends accurate and reliable gunshot alerts quickly. Safe Zone is the first gunfire detection system (GFD) with a patent-pending tri-mode data capture system. Safe Zone's technology responds to acoustic, infrared, and concussion signatures instantly. The detectors send that data to a machine-learning system in the cloud for rapid assessment, then push a detailed report to authorities that includes the shooter's location, the firearm type, and the number of shots fired. Law enforcement and EMTs are provided the best possible advantages in an active shooter situation.

CONCUSSION SENSOR

ACOUSTIC SENSOR

SPECTRAL SENSOR

State of the Art Technology

Safe Zone's tri-mode technology provides a more detailed picture of the gunshot signature compared to older single and dual sensor designs. When the detector captures the acoustic, infrared, and concussion information from a firearm's muzzle blast, it sends that information to Safe Zone's patent-pending machine-learning system (ML/AI) for real-time analysis of thousands of signature features. Within seconds, users are sent a notification that includes a map showing the location (address and room) of the shots fired, the number of shots, and the type of firearm (i.e., handgun vs. rifle).
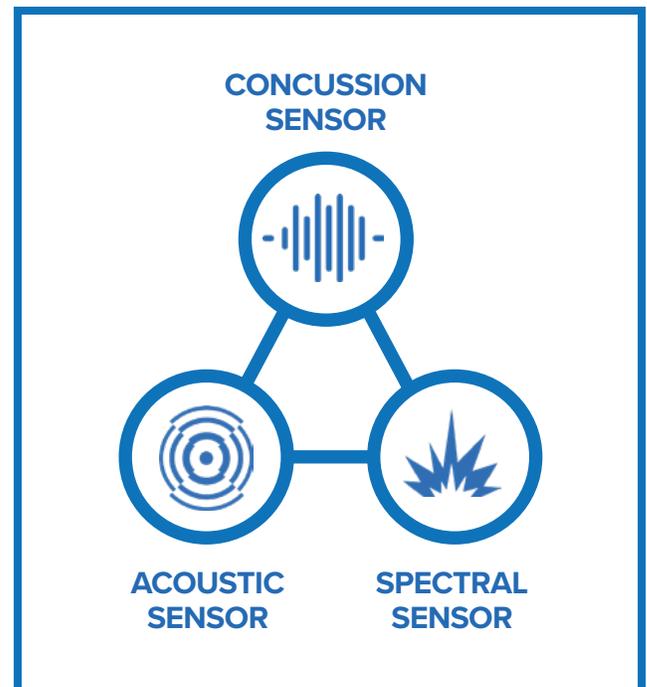
Capturing the Acoustic Signature

Each Safe Zone detector contains a micro electromechanical (MEMS) microphone equipped with a specially designed mechanical attenuator. This proprietary configuration allows the microphone to accurately capture the extremely high sound pressure levels contained in a firearm muzzle blast. The carefully engineered microphone system also captures unique sound features such as the slide action of the firearm and ejecting brass. All of these sounds contribute to the acoustic signature and make Safe Zone the most intelligent gunfire detector on the market.

Anaylzing the Muzzle Flash

The muzzle flash is the visible component of a muzzle blast. Safe Zone utilizes a sophisticated pyroelectric spectral analyzer that is exclusive to Safe Zone. The spectral signature of the muzzle flash is captured, and over 3,000 specific features are analyzed. It's important to note that Passive InfraRed sensors used by most gunfire detectors are not sensitive to some of the most important non-visible light wave frequencies that are the most critical to identifying specific firearm types. Safe Zone captures non-visible light from five distinct components of the muzzle flash: muzzle glow, primary flash, intermediate flash, secondary flash, and incandescent particles. Together, this data comprises the muzzle flash signature.

Capturing the Firearm Concussion

The third applied component of the muzzle blast is a percussive wave that is more felt than heard. Safe Zone engineers developed a patents-pending technology for the Safe Zone detector that detects localized impulsive pressure changes on three separate sensing axes. This technology provides the ability to construct three distinct images of the concussion generated by the firearm discharge. The concussion signature is another key component in determining the firearm type.

Ability to Identify Type of Firearm Used

These five distinct pieces of data (acoustic, spectral, and three concussion axes) make up a signature of each firearm and ammunition combination that is as unique as a fingerprint. The machine-learning system compares this signature to a library of known gunshot signatures and known non-gunshot signatures. This is how the system identifies specific firearm types. It's important to note that any machine-learning system's effectiveness is determined by the size and accuracy of its library. Safe Zone's library contains thousands of signatures of known gunshots including every firearm and ammunition combination used in a mass shooting in the last 30 years. Safe Zone's library also contains equally as many known non-gunshots. Further, the Safe Zone library continuously receives new data from every installed gunfire detector in real time, growing the library.

Reporting the Shooter's Location

The location of the shooter is determined by analyzing the signature from every detector in range of the firearm discharge. The detector closest to the firearm is determined and that device location is reported as the shooter's location. Safe Zone has two unique characteristics that make this possible: greater spatial density (i.e. more detectors deployed in a given space for higher location resolution) and the analysis of multiple detector signatures for every gunshot, which is a Safe Zone patent-pending technology.

Safe Zone will also update the shooter's location as he moves through a building firing multiple shots and even report multiple shooter locations and firearm types in events with more than one aggressor.