

Handheld Thermal Imaging Combined With Microwave Radar



WHITE PAPERS

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CYCLOPS ID OVERVIEW

EXECUTIVE SUMMARY

Strengthening a first responders ability to deploy and perform during a critical incident expeditiously, effectively and safely is an ongoing challenge. Augmenting a humans ability to detect beyond human capacity is possible. This technology must be light, maneuverable and simple to use. It must not only detect victims and suspects but differentiate victims and suspects from first responders. However, this technology must have a fair amount of symmetry with a first responder. It must coexist physically while working along side of policies, procedures or exceeding the scope of a first responders overall training. This technology must not slow down, jeopardize safety or expedience while responding to a critical incident.

Data bottle necks created by multiple technologies must be avoided. Receiving, disseminating and funneling information to the right people at the right time is paramount. Development was accomplished by direct input from first responders who expressed a desire for a light and simple life sign detector. A device that allows continued focus on safety and mission objectives.

After two years of development a low power radar that uses artificial intelligence to detect and report movement of living things through mass has been created. This pocket sized radar weights in at 155 grams (5.5 oz) in its current state. It's powered by an off the shelf nine volt battery that is dropped in to place without concern of polarity. This device is ready for duty when switched to the on position. Simple to read LED RGB (red green blue) indicators allow the operator to have eyes up at all times and still notice a detection. A bank of six LED's simply flash red when a detection is made and green when the system is operating nominal with no detections. Scanning is near instantaneous with a 1.4 second delay which can be advance to almost instantaneous results with further development.

This device emits a signal on an azimuth of 80° and elevation of 35°. Detection distance is up to 15 meters (50 ft) in open air. Penetration of mass composed of slab type poured concrete is up to 10 centimeters (4 in). Other common construction material will yield greater penetration. Using a microwave transceiver the size of a large postage stamp, enables detection of gross organic movement of targets. But wait! Theres one more thing; This system also detects respiration. By holding this ultra light device on a target area for 3 to 4 seconds detection of respiration is accomplished using the same LED's located to the rear of the device. Green LED's pulse in sync with the targets respiration thus visualizing that targets respiration.

This hand held device was developed by our engineering and field operations team. We listened to first responders and military requests and needs clearly for a short range simple to use device. The result is the creation of a hand held mini radar. Searches can now be conducted in a way that are quicker and safer augmenting current methods. The intent is not to eliminate existing tactics, techniques or procedures (TTP) nor is the intent to create a data or task overload to the user. The intent is to create symmetry with the first responder while simplifying data in a visual format.

As we move forward with this technology we have identified where innovation and improvements can be implemented. Techniques and procedures are developed to improve this technology. The most important aspect of further development is *continuously infusing engineers with civil and federal entities guided by seasoned instructors*. A better understanding of the environment and unique challenges that might cause false positives is developed at a much quicker pace. More testing and exposure to live critical incidents increase the expedience and accuracy of this system.

THE DILEMMA

A critical incident can be anything from a natural disaster to an active shooter scenario or the search for incapacitated victims. In each scenario the need to detect victims and suspects is paramount. Visualizing where unseen targets are would change the dynamic of critical incident response and execution. Targets which can be heard or seen do not require this technology to a degree. However targets that cannot communicate because of injury or circumstance do require a greater level of investigation. Conversely those targets that refuse to make themselves seen or heard as in the case of a suspect hiding creates an even greater safety challenge.

What are the potential challenges and safety concerns detecting a victim or suspect?

Safety

Above all safety is the primary concern when searching for a victim or a suspect. Standards such as first responder safety and officer safety are woven into every action. Having the ability to detect victims or suspects from a distance creates a new level of stand off safety. Deploying a hand held mini radar on its own changes the approach to a critical incident. However using our hand held pocket size mini radar along with Canines, robotics, LIDAR, advanced imaging and listening devices increased safety standards and mission success. Being able to differentiate the victims and suspects from those who search for them further creates a new layer of safety and view into a critical incident. This same ability would detect first responders in distress in places that GPS and the line of sight technology cannot reach.

Hazards

Hazards are those which would cause harm to the first responder while searching for a victim or suspect. Hazards can also be in the form of an armed suspect during an active shooter scenario or during a warrant search. For fire rescue and urban search and rescue (USAR) hazards are specific to their duties. These hazards can range from chemical spills to unsafe structures where victims may be trapped. Law enforcement officers (LEO) and soldiers have different hazards to which this system acts as a warning system. The ability to curtail an action or gain an advantage over a particular critical incident introduces the ability to change the dynamic of that critical incident. This ability would swing the advantage over a critical incident in favor of the first responders.

Manpower Management

Manpower and efficiently in using that manpower poses constant challenges to leadership. The constant need to make fluid changes to match each critical incident creates these challenges. In search and rescue operation we will look at a Void Search Team (VST). A typical VST is made up of six individuals. A void is simply an opening whether in a collapsed building or an intact building. These VST's put their lives at risk physically searching by hand. Using this mini radar that six man team can become three two man teams that can search voids and thresholds in minutes. The same TTP's would apply to law enforcement. This expands manpower capability or frees up manpower to be used by the leadership in other ways.

BACKGROUND

Today's first responders, both civilian, federal and military are highly skilled and trained. Being ready at a moment's notice is more than ever prevalent. Yet without observing first responder safety TTP's skills and training become less effective. Running into a fire is not always the best practice. Breaching a room to neutralize an active shooter without situational awareness also poses safety concerns. The approach of slow is smooth and smooth is safe and fast creates a higher margin of success. This is all accomplished by deploying light weight flashlight sized mini radar.

As time progresses technology, knowledge and skills are updated to reflect the latest best practices. This implies that civilian, federal and military elements are in a perpetual state of learning and improvement. It's important to note that these human beings are still very human. They cannot be expected to know everything or perform the impossible. This being said, it would be reasonable to also say that any tool which can improve the safety, quality and speed of information should be considered as a potential instrument for deployment on the field.

OTHER TECHNICAL SEARCH MEANS

The Following is just a few of the many common instruments used for the purpose of detecting victims and suspects. These are some implements often used by civilian, federal and military elements today.

Canines (dogs)

Highly trained canines have a powerful sense of smell. We exploit this sense of smell to help identify where buried and trapped victims or hiding suspects are likely to be. Dogs have strengths and weaknesses. For our purposes we will focus on weaknesses. Dogs are limited by their availability. In most cases their operation time is short. Dogs can become distracted and also grow weary or possibly bored with time. Finally, they must rest, eat and sleep.

Sensitive Listening Devices

Sensitive listening devices might be deployed in the attempt to identify locations of victims. This is a great tool if you are conscience and able to yell for help or tap on something to make a sound. But what if a victim is unconscious. Unless the victim is making auditable noises while

unconscious that victim can be missed. Another problem with this method is *natural interference*. Sound from wind, rain, water and structures can hinder the results of such devices. Additionally, ambient noise may make this method impossible to use effectively. Even under ideal circumstances, the use of sensitive listening devices requires multi-man teams to attempt to triangulate the position of victims.

Specialized Cameras

Use of specialized cameras such as infrared, thermal or conventional are common. Some of these cameras come fitted with sensitive microphones. The biggest single weakness is whether cameras are visible light type, thermal or low-light, cameras. They also require line-of-sight. This limits detection considerably.

Robotics

More often robotics is being used to augment the abilities of man. When searching for victims and suspects, robots are limited by their design. However, robots are the most promising advancement in the search for victims or suspects. Their ability to transmit data remotely from great distances is its most prolific contribution. Yet they too fall victim to the other above mentioned technical search means.

Common Problems

While each of the above methods provide capability not inherent in humans alone, you'll note that three out of four search means share a common problem: humans must be close enough to the critical incident to employ existing technical search methods with the exception of robotics. A first responders presence may also harm a victim by possibly standing on the very same debris atop a victim or in dangerous proximity to a suspect.

Potential Benefits of Addressing the Above Problems

By developing a solution that quickly identifies victims or suspects conscious or not and from a safe distance consistently, will change search techniques for victims and suspects. It will greatly reduce the time spent searching for targets who have expired. This is due to the system looking for live targets. It can also serve as an early warning system when searching for suspects. Such a solution will potentially save first responder lives by reducing exposure to safety concerns in areas where no living victim is present. Even if you cannot quickly extract all victims or suspects, just detecting them is critical. The ability to know where victims and suspects are changes the dynamics of reaction to critical incident profoundly. More over the ability to differentiate victims, suspects and first responders becomes possible. Slow is smooth and smooth is safe and fast. You have effectively enhanced time management and manpower management providing a greater level of safety for all by having remote search abilities.

SOLUTION

Humans move 24 Hours a day. Even when standing perfectly still your body is moving, swaying slightly from the blood rushing throughout your veins with each heartbeat. Even if you lay down, the blood from your heart causes the surface of your skin to plump. You must also breathe. Because of actions of your heart and lungs, your body inflates and relaxes with your biorhythm of respiration and heart beats. This “necessity of movement” can be exploited within the arena of searching for human life.

SpecOps has refined a technology showcased in the MK4 Finder Life Sign Detection System. By refining this technology, new technology was discovered and created. This discovery yielded a low power microwave hand held device.

This feat of engineering is performed through up to 10 inches of concrete whether the individual is conscience or not. The time to perform a search scan is approximately less then 40 seconds. Because the scans is short, large areas can be searched from a distance and expeditiously. Additionally, the detection layout grid functionality visually charts out the detections greatly reducing the time lost searching through areas where no one is present.

The technology is not bulletproof however, no technology is. This microwave frequency cannot scan through metal or water. Enough signal must make it to the target and back to the unit to make detection possible. Tactics, techniques and procedures have been developed in the field to address these weaknesses. By conducting three overlapping scans from three positions, it is possible to detect individuals who might be occluded from detection from one vantage point. It is therefore recommended that no less than three (3) scans from differing angles be taken to establish the lowest possible error from a scan. On a per-victim basis, it has been determined that a single series of scan yields an 89% confidence level typically. This number is plus or minus 1%. This is much higher than what may be possible with other methods of search including mistakes made by human perception. Additionally, the algorithms used for detection are in a perpetual state of improvement as more data is acquired for examination and analysis. With further funding and development a mid 90% detection rate would be expected.

CONCLUSION

Critical incidents whether natural or caused by man are a part of today's civilization. Finding new ways to approach these incidents in a safe and proficient manner is the challenge. New technologies are needed as populations continue to rise and become more dense. It is the intent of the SpecOps Group Team to be at the forefront of developing solutions to today's problems as well as future problems.

It is our hope that this white paper has...

- ✓ Stressed the need for new technology for detecting victims and suspects.
- ✓ Clearly visited some of the challenges faced by civilian first responders, federal agencies and military.
- ✓ Explained how our technology can provide solutions in the areas of safety, negotiating hazards and manpower management with efficiency, accuracy and speed.
- ✓ Displayed how we can continue to improve abilities for civilian first responders, federal agencies and military using this technology where it is needed most rapidly.

PHOTOS



ADDITIONAL RESOURCES

- Centers of Disease Control and Prevention “Nonfatal Injuries among Law Enforcement Officers” February 12, 2018.
- U.S. Bureau of Labor Statistics “Police Injuries, Illnesses and fatalities”
- World Health Organization (WHO) Natural Disaster Profiles
- Federal Emergency Management Agency (FEMA) Data Visualization: Declaration for states and Countries since 1953.
- Department of Homeland Security “Operation Shaken Fury” June 2019.
- U.S. Army Robotics Enhancement Program 19.1 (REP 19.1) October 2019.
- National Fire Protection Association ‘Firefighter Injuries in the United States” 2018.

FOR MORE INFORMATION

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