US, Israel and India developing new technologies to detect and neutralize terror tunnels used for drug and weapon smuggling, human trafficking, and cross border terorrism

In recent Israel-Palestine Conflict, Israel had carried out massive ground offensive to wipe out a vast network of tunnels built by Hamas. Israel sees these being built for infiltrating its territory, smuggle large amounts of firearms and other sabotage materials into the Gaza Strip. Many bemoan the fact, that such a large number of tunnels dug by Hamas from Gaza into Israel have gone undetected for so long.

The tunnel threat is a serious and growing concern to U.S and Mexico, as they enable human trafficking and smuggling of drugs and weapons across the border. It seems tunnel warfare is becoming a global concern as it is also common in other parts of the world such as Iraq, Afghanistan and Syria where rebels use them in combating Assad's military forces.

Recently a drug smuggling tunnel was discovered along the California-Mexico border that set the record for the longest cross-border tunnel ever discovered in Southern California. Around 170 tunnels have been discovered since 1990, Sixty percent of them discovered in just the last three years. According to the Department of Justice's accounting, the tunnel was estimated to span 800 yards, and likely a lot longer due to its "zig-zagging" route, as Assistant U.S.

Attorney Timothy Salel put it. “It is equipped with rail and ventilation systems, lights and a sophisticated large elevator leading from the tunnel into a closet inside the Tijuana residence,” he added. “It is one of the narrowest tunnels found to date, with a diameter of just three feet for most of the length of the passageway.”

In between 2001 and 2016, India has discovered at least eight tunnels originating from across the border along Pakistan, at an average of one every two years. And, only one of these is suspected to have been dug for drug running, while the others are linked to possible or successful infiltrations.

Many defense companies including Lockheed Martin and Raytheon, are developing technologies for detecting tunnels. U.S. government is earmarking $120 million over the next three years and partnering with Israel to help develop a new tunnel detector. The goal, U.S. Defense Department spokesman Christopher Sherwood told Foreign Policy, “is to establish anti-tunnel capabilities to detect, map, and neutralize underground tunnels that threaten the U.S. or Israel…”

The Israeli government, has been developing such a system for at least the past five years. Codenamed project “Hourglass,” Israel has already invested the U.S. dollar equivalent of more than $60 million in the system, involving help from more than 100 technologies, defense, and engineering companies. Remote controlled robots help agents explore tunnels that are too risky for humans to enter.

Tata on Indo-Pak border: Using tech to detect tunnels, check infiltration

The 3,323-km India-Pakistan border consists of the international border guarded by the BSF and the Line of

Control guarded by the Indian Army. The border is porous which makes infiltration by terrorists possible. In the 1990s, the government had erected a fence along the entire length of the India-Pakistan border. But infiltration was still taking place. Over the years, the BSF has found several tunnels starting from Pakistan reaching into India.

In March 2016, the BSF floated a Request for Proposal for a pilot project of the CIBMS in two five-km patches along the border in Jammu. Tata Power SED and Dat Con have won a pilot project of the Ministry of Home Affairs to install an integrated border-guarding system to test technology for preventing infiltration, especially by detecting cross-border tunnels as well as possible entries through aerial and underwater routes. Called the Comprehensive Integrated Border Management System (CIBMS), it is a major counter-infiltration measure to prevent cross-border terror attacks.

The CIBMS will integrate sensors, communication, infrastructure, response, and command and control. It will be a force multiplier for the BSF. “Manpower along the border is irreplaceable, but human endurance has its limitations. With the CIBMS we can detect threats in advance and ensure a counter attack. This would lead to reduction in casualties,” said an official.

An important component of the CIBMS is satellite imagery. The BSF is already using satellite imagery. It helps the security forces in learning about the terrain and military fortifications across the border. It also helps in better planning of operations and border defences on the Indian side. However, not being real-time, they are not always useful.

The BSF has also planned to use UAVs as part of the CIBMS to launch them when required to gain real-time data.
Sensors such as those placed underground will also form part of the CIBMS. These sensors sound an alarm when a person steps near them, alerting the troops. “The firms will also be

setting up equipment to detect cross-border tunnels and possible infiltration through aerial and underwater means. The pilot project will be the first to test such technology," said an official. The RFP had stated the requirement of tracking low-level flying threats from 500 m up to 1 km. Sonars will also be used to track underwater movement.

In a statement issued yesterday, Tata Power said, "CIBMS will establish a seamless multi-tier security ring at the border using a variety of sensors, to identify any infiltration attempts and will be operational 24x7x365. Sensors (viz. Thermal Imager, Radar, Aerostat with EO Payload, Optical Fibre Intrusion Detection System, Unattended Ground Sensor and Underwater Sensor) can detect threats not just on the surface but also underground and underwater." Dat Con refused to divulge details of the pi ..

Challenge of detecting terror tunnels

Part of the problem in detecting tunnels, say experts like Paul Bauman, a Canadian geophysicist, is the ground itself. Finding what is under the surface is not as simple as shooting radar or electromagnetic waves into the ground, he said. With underground cracks, water tables, tree roots and caves, it is hard to tell what is and is not a tunnel, he said. Mr. Bauman, who has worked with the Israel Defense Forces in their efforts to find tunnels, said most of the devices used for tunnel detection were developed for industries to find oil or mineral deposits, not drug tunnels.

Carey M. Rappaport, a professor of electrical and computer engineering at Northeastern University in Boston, said the depth of many tunnels also posed a technological challenge. Some can be as deep as 90 feet, beyond the reach of most ground radar devices and sensors. "Soil is very good at

keeping secrets," said Mr. Rappaport, who has also worked with the United States and Israeli governments on tunnel detection methods.

Recently, the Science and Technology Directorate of the Department of Homeland Security concluded that none of the current methods used to detect underground tunnels were "necessarily suited to Border Patrol agents' operational needs."

Tunnel detection technologies

Most of the existing tunnel detecting capabilities are modifications of existing equipment originally used to detect land mines or natural gas and oil deposits. More sensitive, sophisticated techniques are needed to find tunnels, which exist between those two extremes of size and depth.

An Israeli company, Magna, has proposed digging a 70-km tunnel along the Israel-Gaza border, equipped with a sensitive alert system. The system shall be able to localize attack tunnel, estimate how many people are in it, and can monitor the progress of digging. Now, Israel Hayom reports, Israel has built its own network of defense tunnels along the Gaza border, with the cooperation of the United States.

Some of the technology solutions that have been found useful for tunnel detection are

The effectiveness of tunnel detection devices is directly related to the geophysical characteristics of local soil. DHS&T is in the process of collecting and compiling a database of existing derived and new geological and geophysical survey

data along the border where the tunneling is most probable.

Ground penetrating Radar

Special radar mounted on a vehicle that uses pulses of appropriate frequency and ultra wideband waveforms to form an underground image. Its promising technology widely used in quality-testing roads, and to find unmarked graves, locate utility lines, trace subsurface geology, sweep for mines and search archaeological sites.

However, some of its limitations of this method is that it does not work well in most mediums like clay and rarely penetrates deeper than 40 ft and produces lots of false alarms even at shallow depths leading to waste of time and money. The developers are concentrating their efforts on using much lower frequencies that can penetrate the ground much deeper, and a sophisticated new imaging technology that can display clear pictures of deep tunnels.

The R2TD system developed by the U.S. Army Engineer Research and Development Center is a ground-penetrating radar capable of detecting tunnels deep within the ground. It employs sensors to detect acoustic and seismic energy. The R2TD system can be mounted in a vehicle or carried by a soldier to an area of interest, and is capable of transmitting data to a remote post for data analysis.

Surprise attacks by enemy troops hiding in tunnels are difficult to predict, although radar technology can help by finding the tunnels. The Rapid Reaction Tunnel Detection (R2TD) system can detect the underground void created by a tunnel, as well as electrical cables or devices within the tunnels, using ground-penetrating-radar (GPR) technology.

Because adversaries are continually adapting—using different tunnel depths and more complex maze configurations—the

analysis software for the R2TD system must be continually refined, with increased transmit power for greater ground penetration.

The National Centre for Excellence in Technology for Internal Security (NCETIS) at IIT-B, which also has people working with other IITs, has developed a Ground Penetrating Radar (GPR) at 920MHz, which can not only detect tunnels but also landmines buried in soil. “Right now, we testing the equipment for ruggedness. We have a mandate that it needs to work in all terrains and conditions and once the ruggedness test is complete, we will begin the field trials in February,” Seema Periwal, project manager, NCETIS told TOI from Mumbai.

Seismic Sensor Network

The underground activity like digging, drilling, scraping, jack-hammering, can create the ground disturbances or vibrations that travel through the ground in the form of seismic waves and can be detected by seismic sensors like geophones buried under the ground.

Signal processing is the critical technology for extraction of data and intelligence from the signals generated by seismic sensors, identifying the type of activity like digging, walking, vehicle etc. and also the localization of activity. The intelligent algorithms can also filter out non-threatening vibrations, from construction equipment, traffic on nearby roads and underground subways, in order to minimize false alarms.

Other technologies

A combination of Airborne SAR (Synthetic Aperture Radar) and GPR has also been proposed for underground tunnel detection.

Some of the other proposals include measuring electrical resistivity through metal electrodes, microgravity sensors and detecting muons underground brought by cosmic rays hitting the earth.

Robots in anti-tunnel campaign

IDF‘s military robot Talon 4 has been used in dangerous tunnels on the Gaza Strip border instead of soldiers to reduce risks to troops.

Manportable tunnel mapping robot

Another are lightweight, portable Carrier Robots, that would be carried by soldiers on their backs. They shall be capable of scanning areas underground for many hours, mapping entire buildings and terror tunnels. It is equipped with cameras, sensors, and a communications system capable of transmitting signals from underground. The groundbreaking technology will allow soldiers to understand the exact appearance of any structure, helping them avoid the dangers of underground or urban combat as explained by Major Lior Trablisi, the head of the IDF’s robot and technology unit.

“Robotic-laptop soldier,” will assist soldiers from the Combat Engineering Corps and infantry soldiers in underground combat. The idea of this small-scope robot is to take on dangerous missions, including patrolling and collecting information for the fighters on the ground. This will solve many of the problems soldiers are forced to face when operating underground, such as collapsing walls and lack of oxygen and lighting.

Underground Iron Dome i.a. Against Hamas' Terror Tunnels

Western sources reported on 11th March 2016, that the new weapon, dubbed the "Underground Iron Dome," can detect a tunnel, then send in a moving missile ton blow it up. The new weapon is not counter measure only against threat from Gaza and Lebanon but against Iran nukes too.

US intelligence sources disclosed only that new weapon is equipped with seismic sensors to detect underground vibrations and map their location before destroying them. Western experts haven been talking for years about a secret Israeli weapon capable of destroying Iran's Fordo nuclear facility, which is buried deep inside a mountain not farn from the Shiite shrine city of Qom.

They suggested that this hypothetical weapon could be slipped through the Fordo facility's vents, thread its way through the underground chambers and take down the illicit enrichment facility. It was discussed again three years ago, when the Israeli Air Force on 23rd Aug. 2013 blew up the Popular Palestinian Front-General Command underground facility at Al-Naama on the South Lebanese coast, 15 km south of Beirut.

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