Electronic Sensor Technology
1077 Business Center Circle
Newbury Park, California 91320
Phone: (805) 480-1994
FAX: (805) 480-1984
http://www.estcal.com

Uniqueness of EST's zNose® for Security Applications

About The Company

Electronic Sensor Technology, Inc. ("EST" or "the company") manufactures and sells a product line of fast and highly sensitive screening devices under the brand name zNose®, which are able to analyze and identify volatile organic compounds (VOC) in less than 10 seconds, with parts-per-billion sensitivity. The technology is patented and employs a proprietary Surface Acoustic Wave (SAW) sensor and ultra-fast Gas Chromatography (GC) technology to separate vapor samples according to their chemical and physical properties. Unlike conventional security devices such as "bomb-sniffing" explosive detectors (Ion Mobility Spectrometer), the zNose® is not restricted in sensitivity or target-specific; it is able to access, evaluate, and identify any sample by converting output signals into precise chromatograms or visual images – trademarked as VaporPrints® - which enable trained personnel to instantly recognize and react to any dangerous, illegal, or toxic compound present. Evidence of its versatility and utility, the zNose® has received validation from the United States Environmental Protection Agency (EPA) and the White House Office of National Drug Control Policy.

The zNose® was developed by Electronic Sensor Technology in 1995 and, globally, has hundreds of installations and is employed in applications for Homeland Security as well as for consumer products and the life sciences. The company is located at 1077 Business Center Circle, Newbury Park, CA, 91320. Our phone number is 805-480-1994, our FAX number is 805.480.1984. Information on the company's technology and products can be obtained from our web site at www.estcal.com.

The Technology

Unlike trace detectors, electronic noses recognize odors and fragrances based upon their full chemical signature. An electronic nose is able to detect all compounds within an odor and provide a complete chemical profile. Software includes an expandable library of over 700 chemicals and odor signatures allowing the zNose® to recognize virtually any target odor. Using ultra-high speed chromatography to separate chemicals within an odor in near real time, pattern recognition and trace detection using virtual chemical sensors can be performed at the same time. Trace detection combined with odor profiling can be an effective method for recognizing the presence of contraband material of

all kinds. Electronic odor profiles are instrument independent allowing security users to distribute and share odor signatures.

Based on Surface Acoustic Wave sensors and Ultra-fast Chromatography, the patented zNose® can analyze chemical vapors in less than 10 seconds by separating vapors according to their chemical and physical properties. Instead of using physical sensors, the zNose® creates hundreds of user-defined, virtual chemical sensors for multiple applications. Once a vapor has been detected, the Company's VaporPrint™ software technology provides users with visual representations of the vapor, allowing for easy interpretation and pattern recognition. Unlike conventional detection systems, the zNose® can adapt and learn to recognize the chemical signature of virtually any threat. In effect the zNose is an electronic dog, which can be trained to recognize chemical vapor signatures. Unlike a dog however, it never needs to rest and electronic chemical signatures can be shared within a network of sensors.

Electronic Sensor Technology's zNose® provides comprehensive, real time analysis of any chemical vapor with part-per-trillion sensitivity. The company has sold over 400 systems worldwide and they are listed as commercial-off-the-shelf (COTS) by the US government. The zNose® technology is protected by four U.S. patents and is the only electronic nose technology to receive validation from both the U.S. EPA and the White House Office of National Drug Control Policy. The zNose® technology is considered mature and ready for deployment.

The Features and Capabilities of the zNose®

EST's electronic nose, the zNose®, can be used for the detection and identification of explosives, narcotics, and other contraband at maritime ports, the screening for a variety of explosive compounds and chemical agents at vehicle check points (VCP), on departing passengers and luggage at airports, the screening of vehicles and shipments at entry and exit points. It can also be used to detect hazardous volatile organic compounds in the HVAC system or ambient air of an airport terminal.

Figure 1- Using the zNose at a VCP.

The company produces several different models of zNose covering fixed site sensor networking as well as wireless and completely portable or mobile systems. The ability to detect all chemical compounds is unique and enables the system to quickly adapt and learn to recognize any threat including such explosives as TATP as well as conventional nitro-based compounds. The complete monitoring of ambient air within or around secure facilities by a network of sensors would provide comprehensive protection against all threats as well as identification of suspicious or unusual chemical emissions.

Current Security Applications

The zNose has been used by the military in Iraq for the detection and defeat of improvised explosives devices (IED) and at the Abugrab prison in Iraq. It is being used with chemical weapons at military facilities such as Aberdeen and Dugway Proving Ground. It is also in use as a screening sensor at embassies as well as sheriff and police departments. Figure 1 shows a soldier scanning the trunk of a automobile. The scanner on the zNose can also be inserted into the passenger compartment of any vehicle to sample and analyze the chemical compounds in this compartment. The same approach can be used to sample the bed of a truck or to scan a suitcase for contraband vapors. The zNose instruments can also be used to sample the air in a building or an airport terminal to look for a change in an established background profile. All these different applications can be operated from a central operation location through connectivity by RF link or telephone modem. See the attached power point which shows schematically how the network will operate.

Networking the zNose®

The zNose can operate within a wireless network using either Wi-fi, or bluetooth, or RF modems with ranges up to 1 mile. It can also be remotely linked using an Internet connection. Currently the most recent model is completely mobile using a built in connection. The company provides online support for all its products using an internet network connection. This capability could be used within an airport security system to provide over site by a central monitoring station as well as updating of new threat signatures to every zNose within the facility.

Figure 2- Linking zNoses within a wireless network.

Improvements in Situational Awareness

Unlike conventional security sensor systems, zNose® technology would provide a comprehensive analysis capability enabling monitoring of the complete chemistry of the environment within the airport both in space and time. This would lead to greatly enhanced situational awareness for these facilities as well. As an example, the ability to detect changes within the environment could be used to detect odors or chemical emissions which were not normal and lead in turn to early warning of a dangerous or suspect chemical emission. The ability to detect changes in the environment in the airport would be important issues for an airport Security Operations Center (SOC)

Integration into Geographic Information Systems (GIS)

GIS is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. With a geographic information system (GIS), you can link information (attributes) to location data, such as people to addresses, buildings to parcels, or streets within a network. You can then layer that information to give you a better understanding of how it all works together. You choose what layers to combine based on what questions you need to answer

The zNose is well suited to GIS systems because it operates wirelessly and because it incorporates GPS information into its chemical analysis database. When operating and analyzing the chemical content of vapors the GPS coordinates of each analysis are linked to the chemicals and their reported concentrations. This ability would enable mobile and fixed chemical sensors to provide a situational awareness by measuring the chemical content of ambient air throughout the airport facility. Practical uses might be for early detection and tracking the progression of hazardous materials, toxic chemicals, or smoke within the facility from a fire.

Comparison IMS vs. zNose®

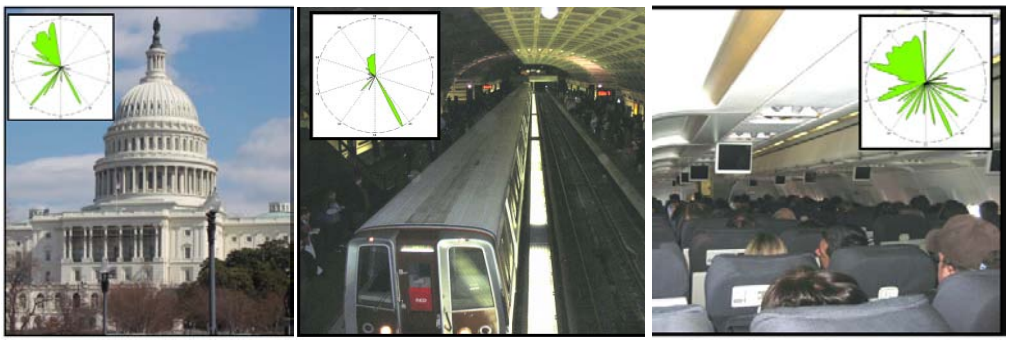

Figure 3- Situational awareness in public buildings, subways, and aircraft.

		Ion Mobility Spectrometer (IMS)		zNose®
Manufacturer		GE Security/Smith Detection		Electronic Sensor Technology
Technology		Ion Mobility Spectrometer		Surface Acoustic Wave/Gas Chromatography
Configuration		Drugs/Ex[plosives (ONLY Nitrates)/		Drugs/Explosives/Chemical Agents/
		Liquid Bomb (difficult)		Liquid Bomb (Easy)
		Chemical Agents		Yes (very sensitive)
		Money in Package	No	Yes
	Tobacco/Gasoline/Non-Nitrate Explosives		No	Yes
Detection Capability		**Limited**		**Unlimited**
Separation Capability		Yes		Yes
Radioactive Material		Yes, Nickel 63		No, Solid State
Ionization Gas		Needed		None
Warm Up		~10 minutes		~10 minutes
False Alarm Rate		False Positive (high)		Low
Recovery Time		>10 Minutes		<3 minutes
Analyzing Time				
	Vapor	20 sec.		10 sec.
	Particles	10-20 sec.		
Sampling Mode				
		Single, Multiple Vapor Sampling and Direct Sampling		Direct
Sensitivity				
	Explosives	Nano to 100 Picogram		Nano to 10 Picogram
	Drugs	Nano to 100 Picogram		Nano to 10 Picogram
	Black-Powder	???		Nano to 10 Picogram
	Hydrocarbons (C4-C25)	???		Nano to 10 Picogram
Dimension	(in.)	14.5" X 4" X 4.5"		12" X 10" X 6"
	(cm)	36 X 10.16 X 11.43		30X25X15
Power		110/220AC (50-60Hz)		110/220AC (50-60Hz)
		Battery Operated		Battery Operated

Consumables	Wipe Paper, Membrane, Desicant	SAW Detector, Chemical Column, Helium Gas
New Chemical Input	Limited	Easy and Broad
Results Storing	>1000 Reports	>1,000,000 Reports

Note: The above chart was provided in part by SUNOCO and the US Military. Both are users of the EST- Vapor Tracer.

Summary:

Ion Mobility Spectrometry (IMS) Technology is a much slower, less accurate process. It is much less sensitive than the GC technology and it requires using a swab, and wiping off certain areas outside the surface of the suspected objects like; packages, briefcases, luggage etc., trying to pick up traces of harmful or dangerous substances which are presumably carried inside the object. Then this paper or cotton-type material (swab) is placed into a special chamber where it is analyzed.

The problem with this technology is that it can only detect traces & deposits of dangerous particles on the outside of the objects left presumably by the person handling it. This process can only produce good results if the person who planted the dangerous substance does not wear gloves or does not wash his hands regularly after handling the dangerous materials. Today's terrorists are well aware of this technology and they know how to protect themselves from being discovered.

The human error factor must also be taken into consideration, which can very easily occur when they are too busy, sometimes under very difficult & stressful circumstances, like at large public gatherings, border crossings, airports & government & military installations. A slight human error can easily contribute to a major human catastrophe. Personnel using IMS technology must pay close attention to each step during the entire process of examination and just a small mistake can cost many lives.

Examples of possible human errors & faults by using IMS technology:

Wiping off the wrong area of the objects surface

Forgetting or mixing up the test swabs

One can only wipe & test what is on the outside of the surface

The cost is very high for each swab can only be used once

Baggage & Parcels are handled (being touched) by too many personnel

The EST-4300 Vapor Tracer uses a well-know gas chromatography (GC) technology. This super-sensitive, vapor vacuum process can sniff-out & detect one-millionth (Pico-grams) of any vapor (smell) traces emitted by organic, biological & chemical compounds. It analyzes & identifies them quickly & extremely accurately. It can actually sniff-out (smell) and identify dangerous contents of postal packages, containers, briefcases, luggage and all types of cargo including automobile trunks, and even the undercarriage of vehicles **without having them open and without swabbing or**

wiping, ideal for use by Customs, cruise ships, governmental & military installations & vehicles.

It can accurately detect and identify:

- All types of military, commercial and home made explosives including: RDX, PETN, Tetryl, TNT, NG, DNT, Ammonium Nitrate, HMX, Black Powder, nitro-methane and others.
- All types of drugs & illicit narcotics including: Heroin, Cocaine, Marijuana, PCP, Methamphetamines, LSD, THT and others.
- All types of biological, nerve & chemical agents including: Sarin, Soman, Mustard Gas and others.

Because of its sensitivity & versatility, the SAW/GC Vapor Tracer can effectively replace several sniffing dogs at borders & seaports custom departments, since each dog can be trained to sniff-out & detect only one substance at a time, either explosives or narcotics. zNose® is all solid state, very rugged & durable construction. It is the most sensitivity technology (down to pico-grams) on the market. **No radioactive elements used**. It is proven by the US Military as the most sensitive portable Explosive/Contraband/Narcotics/Chemical agents Detector on the market.

*