In the eye of the beholder

Whether it is tracking people through the London Underground or identifying potential pick-pocketing, Innovation Science shows novel, niche technologies count for more than the size of a company, writes Tim Mendham.

Michael Haddy, chief executive officer, owner and founder of Adelaide-based Innovation Science, readily admits that the security and defence market is a challenging one – dominated by well-resourced, multinational corporations and augmented by a variety of small, innovative, niche players. But it is the small end of town that often comes up with the most novel technologies. The challenge is to commercialise them without going broke. This is where a market dominated by billion dollar companies can work to a niche player's advantage.

Having spent almost a decade of his software engineering career exposed to submarine sonar systems, Haddy was well placed to offer expertise in naval research programs. Innovation Science was launched in 1999 funded by Haddy's own long service leave money and quickly grew from providing expertise to developing software to support the research and development of future submarine combat systems.

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These activities exposed the company to the big end of town. EDS (now Hewlett Packard Enterprise Services) saw promise in Haddy's new company and awarded two fully-funded scholarships for Haddy to study management and commercialisation at the Australian National University and the University of Adelaide. The additional knowledge gave the company confidence to invest in the development and commercialisation of products in both the defence and security domains. The company now employs a team of creative software engineers who share their time between developing custom military and commercial software, and Innovation Science's own Horizon Warrior™ and UPoint software products.

NAVAL COMBAT SYSTEMS

Horizon Warrior is an "application framework for rapidly building and deploying command and control (C2) software". In relatively plain English, it is a software package that allows defence researchers to experiment with new concepts for naval combat systems. The software is capable of quickly and simply integrating numerous capabilities without complex programming, providing a base architecture that clients can use to construct custom applications.

These custom applications comprise any number of discrete plug-ins that can themselves come from a variety of sources, including other defence companies and government research organisations. The Horizon Warrior software focuses on managing the interaction between plug-ins, ensuring the integrity of the resulting application.

Configuring a new combination of plug-ins to form a custom application does not require programming knowledge. This gives researchers enormous flexibility to explore ways for presenting information to operators; optimising tasks performed by different nodes or operators within a control room; or to simply construct a solution to solve an urgent need at short notice.

The software is primarily used for defence simulation and experimentation, and has been deployed in aircraft and submarines to support a range of research programs. Originally developed by Innovation Science in collaboration with the Australian Defence Science & Technology Organisation (DSTO) for use by DSTO, the technology has since been adopted by overseas defence clients in Canada and the United Kingdom.

Haddy says that Horizon Warrior applications dramatically reduce the cost of development and experimentation – savings of up to 36 per cent having been achieved when developing applications using the framework compared with developing the same applications using traditional methods.

TRACKING PASSENGERS

While the Horizon Warrior was the result of longer term development with a major customer on board, the Rapid Passenger Tracking software had a slightly different genesis – Haddy sitting on a plane flying between London and New York, eschewing the usual airport novel in favour of tapping out elaborate graph theory algorithms on his laptop. Realising he had devised an approach that had real potential, he calls this his Eureka moment.

The London Underground (the Tube) carries four million passengers a day. These passengers can arrive at any one of the network's 270 stations, change to any of the 11 lines and other stations at will, and leave by another with complete autonomy.

Tracking this number of passengers is a daunting task, to say the least. But it is an important issue when identifying, locating and responding to incidents such as terrorism, theft, violence and vandalism.

Facial recognition systems by themselves have limited efficacy. The computing resources required to process raw video from 12,000 surveillance cameras is phenomenal. Then the systems have to consider widely varying lighting conditions, crowded platforms and be clever enough to identify someone with just a few pixels on a video image. Manually tracking someone through the masses of data is simply a lengthy and frustrating experience, let alone trying to manually track thousands of people. With so many stations and lines to consider, where to start and where to continue your search for protagonists or witnesses is almost impossible – and that assumes you know who you are looking for.

This is where Innovation Science's tracking system, nicknamed UPoint, comes into play.

Passengers on the Tube are largely a law-abiding bunch. Ticket fraud is extremely low, so the vast majority of people, even those planning a crime, carry a legitimate ticket. In fact, those planning a serious crime, such as terrorism, are much more

likely to buy a ticket than try to jump the barriers – they are thus less likely to bring unwanted attention to themselves. (It was the London Underground bombings in 2005 that initially inspired Haddy to work on the product.)

ENTERING AND EXITING

Tickets passing through entry and exit turnstiles represent a largely untapped security infrastructure. Although they can be supplemented by other technologies to counter the less scrupulous traveller, ticket transactions provide an ideal indication of when and where most individuals enter or exit the rail network. Ticket transactions, therefore, contribute basic intelligence that can support more complex analysis.

UPoint then provides what it is impossible for a human analyst to do. Using a patented technique, the software can almost instantly determine which passengers can be at any given location (including on a train) at any given point in time. On the surface, this may sound simple, but consider the billions of journey combinations that four million passengers could take when, as there are on the London Underground, some 520 trains servicing a highly-interconnected network of 270 stations.

If an incident happens, the software will provide a short-list of passengers that are relevant to that incident. Although the names and addresses of most passengers will not be known, the software will identify where and when each relevant passenger entered the network, how they got to the incident, and an image that can be used for facial recognition and, with very serious incidents, for police call-centre and casualty management.

What comes next is even more clever. Low value crimes, such as pick-pocketing, are the most common crimes to occur on most rail networks. Limited police resources mean that they often do not get investigated. However, these kinds of crimes contribute significantly to the public's perception of safety on the network. UPoint is able to identify potential repeat offenders by simply specifying where and when each pick-pocketing incident occurred. Similarities between incidents are automatically mapped against knowledge of who can be where and when. As soon as UPoint gathers sufficient evidence, it alerts security personnel so that resources can be efficiently directed to monitoring individuals that are considered likely offenders.

Sophisticated questions can be asked of UPoint, such as "where and when could two given passengers have been in contact with each other during their journeys?"; or "can multiple incidents be linked back to a group of passengers that were physically together somewhere else on the network?"

It is all about information, correlation and identification, which is the role that Innovation Science's technology plays in this important urban environment.

The software relies on a train network being complex and, ideally, having a ticketing system that registers entry and exit movements through its turnstile infrastructure. This makes it ideal for cities such as London, Seoul and Hong Kong. Admittedly, local rail systems may be less likely candidates for its use, either because they require significant additional security infrastructure, or because the networks themselves are not sufficiently interconnected. But where the infrastructure is in place and the network is complex, then such networks are likely candidates for a solution that helps detect and sometimes even solve or prevent incidents and crime.

UPoint has been patented, and in 2009 won an Asia Pacific ICT Alliance (APICTA) award for research and development, out-gunning more than 150 other organisations from 16 countries across the Asia-Pacific region.

This all goes to show the benefits of using a plane trip for more than reading the latest pulp novel.

If Haddy can keep making those sorts of trips, then there is a strong likelihood of him and his company developing more cutting-edge software with significant global application.