### The Big Read Technology

### Computer vision: how Israel's secret soldiers drive its tech success

The country has become a leader in image analysis thanks to the alumni of its elite surveillance group Unit 9900

### Mehul Srivastava in Tel Aviv 4 HOURS AGO

When Ofir Schlam, the co-founder of Taranis, an Israeli agriculture tech start-up, was growing up on a farm in Israel, he would regularly wake up at 5am to go to search through the crop for the tiniest caterpillars, pests and rot. Years later, when he joined the military and was attached to the prime minister's office, he adapted that skill set to analyse thousands of surveillance images, looking for the smallest anomaly.

One of his key senior executives at Taranis, Amihay Gornik, developed his expertise working at large aerospace companies, designing imaging parts for military drones. He figured out a way to make a fast-moving camera think it was standing still by nestling it inside a proprietary pod he had fitted with a gyroscope, which helped cancel out vibrations and resulted in less blur.

At Taranis they insert the pods on to Cessna aircraft, fly them up to about 100ft and then zoom over tens of thousands of acres of farmland at 200km an hour, taking photographs with an off-the-shelf camera. Even at that speed, their software can spot the tiniest pests or signs of disease, and the planes can map thousands of acres in the time it takes for drones to travel just a few. More scale, more caterpillars caught.



A Mobileye autonomous driving vehicle is checked at the company's headquarters in Jerusalem © Reuters

The element that makes Taranis possible, says Mr Schlam, is the melding of their uniquely Israeli experiences and the way they have applied them to business. "It's a small place," he says. "And yet, it's not that hard to find someone who's into farming, into tech and has done this kind of thing before — maybe in the army, maybe at another start-up."

It is those experiences that have helped such a tiny country become a leader in one of the most promising frontiers in the technology world: computer vision. Despite the unwieldy name it is an area that has come of age in the past few years, covering applications across dozens of industries that have one thing in common: the need for computers to figure out what their cameras are seeing, and the need for those computers to tell them what to do next.

The biggest success story is Mobileye, which uses a dozen cheap cameras to see the traffic around prototype autonomous cars and then guides them through traffic. In 2017, Intel paid \$15.3bn to acquire the technology, as carmakers plunge billions into building self-driving cars.



Computer vision has become the connecting thread between some of Israel's most valuable and promising tech companies. And unlike Israel's traditional strengths— cyber security and mapping - computer vision slides into a broad range of different civilian industries, spawning companies in agriculture, medicine, sports, self-driving cars, the diamond industry and even shopping.

In Israel, this lucrative field has benefited from a large pool of engineers and entrepreneurs trained for that very task in an elite, little-known group in the military – Unit 9900 – where they finetuned computer algorithms to digest millions of surveillance photos and sift out actionable intelligence.

Source: Start-up Nation Central © FT



Cortica, which uses mapping, sensors and artificial intelligence to try to mimic the way the human brain sees the world, is involved in research into selfdriving cars and screening programs © Company

"There are a lot of areas we are strong at, but at computer vision we rock," says Jon Medved, chief executive of OurCrowd, a \$750m crowdfunded investment vehicle based in Jerusalem, who has put millions into computer vision start-ups. "This is the kind of thing that's really hard to duplicate and Israel is way ahead. There are good pockets of technology for this stuff in the US, Japan, China. But nothing like in Israel."

**Zebra Medical, backed by** \$50m in venture capital funding, uses artificial intelligence to scan millions of MRI and other images from around the world, guiding radiologists to the slightest sign of disease. At medical diagnostics start-up FDNA, engineers are figuring out how a picture of someone's face could reveal rare genetic disorders. Cortica, with about \$70m in funding, is trying to replicate how the human brain sees the world in a quest to teach a computer to understand its environment.

Israeli start-ups working in computer vision have attracted more than \$1bn in seed and venture capital funding over the past three years, more than half of it this year alone. That is an increase from \$56m in 2015, according to Startup Nation Central, which supports investments in Israel's tech scene.

This phenomenon is powered by a new generation of sophisticated cameras, especially on smartphones, just as the vast computing power needed to process millions of images has become much cheaper.

The full name for Unit 9900 — the Terrain Analysis, Accurate Mapping, Visual Collection and Interpretation Agency — hints at how it has created a critical mass of engineers indispensable for the future of this industry. The secretive unit has only recently allowed limited discussion of its work. But with an estimated 25,000 graduates, it has created a deep pool of talent that the tech sector has snapped up.



An Israeli soldier with a mini-drone at a cyber-security training course in Beersheba. Israelis have developed expertise in drone-making © Reuters Soldiers in Unit 9900 are assigned to strip out nuggets of intelligence from the images provided by Israel's drones and satellites — from surveilling the crowded, chaotic streets of the Gaza Strip to the unending swaths of desert in Syria and the Sinai.

With so much data to pore over, Unit 9900 came up with solutions, including recruiting Israelis on the autistic spectrum for their analytical and visual skills. In recent years, says Shir Agassi, who served in Unit 9900 for more than seven years, they learned to automate much of the process, teaching algorithms to spot nuances, slight variations in landscapes and how their targets moved and behaved.

"We had to take all these photos, all this film, all this geospatial evidence and break it down: how do you know what you're seeing, what's behind it, how will it impact your intelligence decisions?" explains Ms Agassi, who now helps run an association of about 1,000 graduates of 9900. "You're asking yourself — if you were the enemy, where would you hide? Where are the tall buildings, where's the element of surprise? Can you drive there, what will be the impact of weather on all this analysis?"

Computer vision was essential to this task, says Ms Agassi. Teaching computers to look for variations allowed the unit to quickly scan thousands of kilometres of background to find actionable intelligence. "You have to find ways not just to make yourself more efficient, but also to find things that the regular eye can't," she says. "You need computer vision to answer these questions."

**When he was in** the military, Eran Shir worked in ballistic missiles. To manipulate a missile accurately at several times the speed of sound, Mr Shir and his colleagues used radars, high-definition video and maps to create a precise replica of the missile's surroundings.



Eran Shir of Nexar, which uses artificial intelligence to create a dashcam operating on a smartphone that issues alerts about impending problems © Caompany

Now, at Nexar, which analyses traffic and collision data from driver's smartphones, he has helped map millions of miles of road around the world. Propped on a driver's dashboard, the camera on the phone tracks the traffic around it and warns him of risks while creating a video of the drive for insurance records, as well as alerting cities to potholes or dangerous intersections. With all the phones sharing data, it helps create a more detailed map.

"The Israeli tech ecosystem has been dealing with understanding reality in its various forms for a long time, using vision, lasers, kinematic sensors," he says. "We are [now] dealing with the real problems of the world — health, agriculture, transportation — and our tech system is optimised for that."

Nexar has made use of other graduates from Israel's military. It needed physicists to match up the sensors on different phones from around the world and engineers who had worked with missiles and who built helmets for combat pilots. This is "the kind of work where you can't settle for good enough — you have to get closer", he says.

That sort of sophisticated talent gives Israel a means to compete with the US and China and allows niche companies to thrive, says Aviv Zeevi Balasiano at the Israel Innovation Authority, an arm of the government that vets and invests in start-ups. The industry received a big injection of knowledge from Russian Jews who migrated en masse to Israel after the collapse of the Soviet Union in the 1990s.

"Some of the knowledge they brought with them was creating computer algorithms and machine engineering, fields which no one in Israel had ever heard about," he says. That kicked off the earliest iterations of using computer vision in Israel's military.

But the field took years to mature. Daniel Gabay, the co-founder of Trigo, which wants to automate the checkout in grocery stories, jokes that not so long ago computers couldn't tell the difference between a cat and a dog. Now computer vision can tell a car to swerve when a child appears on the road — or in his case, tell the difference between a bag of Doritos or a bag of regular crisps.

Also a graduate of an elite military unit, Mr Gabay is racing against Amazon to perfect the technology for a cashier-less store, where sophisticated code helps a small number of cameras figure out what shoppers have in their baskets, and charge them automatically. The system is being trialled in several hundred stores in Israel. He is vague about his time in the army, but says he "learned to do the practical things — how can you take vision and create a working system".



The Indiana Pacers US basketball team and Brazil's Flamengo both use Physimax, an Israeli company, which employs medical scanning to improve performance © Getty Images

Almost all of the engineers working at Trigo were "cherry-picked from elite military units", says Mr Gabay.

**Yet despite their growing** reputation, Israeli companies have to remain focused on what they are best at, says Ronny Cohen, who runs Vayavision, rather than spreading themselves too thin. His company is betting that the use of better software will allow self-driving cars to map the environment around them with fewer and cheaper cameras or radars.

"It's too difficult to do all this alone, so I am not going to build a car, or even tell the car where to go. I just need to build the best environmental model for cars," he says, describing how he turned down an offer to develop his system for vehicles in Amazon warehouses.

Having built massive databases — from close-ups of farm insects to medical scans to traffic data — has given Israeli companies a valuable head start over rivals. And in an industry where every new image teaches the algorithm something useful, that has made catching up difficult.

It has also created opportunities in unexpected sectors. Physimax, a start-up run by Ram Shelev, uses a bank of cameras to analyse the posture of athletes, then suggests changes to their exercise routines and techniques. It is already being used by the US military, the Indiana Pacers, a professional basketball team, and Brazil's Flamengo football team.

"Computer vision is absolutely the thread that ties us to other Israeli companies," he says. "I need people with the same unique DNA — smart PhD's in mathematics, neural network analysis — to tell a player in the NBA how to improve his jump shot."

# Surveillance complex: military expertise has also created

## defence industry



A soldier is trained to use a drone in the Negev desert. Military technology knowhow is being transferred into the defence and surveillance industries © IDF

Israel's developing expertise in computer vision has spawned companies in many of the most dynamic modern industries. But the deep pool of army-trained engineers has also fuelled less benign activities: a vast private industry of surveillance and defence sales.

Companies staffed by veterans of intelligence units such as 8200 and 9900 also sell some of the most sophisticated surveillance software to all sorts of countries, some with less than savoury human rights records.

Most recently, Herzliya-based NSO Group has faced criticism that it has sold its Pegasus cellphone surveillance software to the UAE, Kuwait and Kazakhstan, where it has been used to penetrate the cell phones of political dissidents and human rights activists, according to the University of Toronto's Citizen Lab. The company says it only sells to governments for the use of preventing crime and terrorism, and that its sales are approved by the Israeli government.

The tiny nation's defence exports also soared to \$9bn in 2017, an increase of 40 per cent, on the back of a \$2.5bn deal to sell missiles to India. Prime minister Benjamin Netanyahu has claimed that demand for Israeli military technology is one of the key reasons for a recent thaw between Israel and its Arab neighbours.

But the fact that these technologies and weapons were often developed for the surveillance of Palestinians, or for fighting Hamas in the Gaza Strip, where thousands of Palestinians have died in four wars, has made Israel's defence exports a target of international criticism.

And the reported use of Pegasus by Saudi Arabia to track the phones of dissidents living abroad, including friends of Jamal Khashoggi, the slain journalist, has pitted one of Israel's most secretive exports against a global outcry against surveillance.

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