



**Pictures
by David
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FEELGOOD DOCTOR

Cydar is developing a 'sat-nav' to help surgeons navigate the body. Matthew Gooding reports on the progress of this innovative firm based just outside Cambridge

'The idea is that it mimics the sat-nav in your car, giving you absolutely dependable information as to where you are and what you're operating on," says Cydar CEO

Tom Carrell, as he attempts to explain his company's groundbreaking surgical guidance system. "You're not having to recalibrate and recalculate as you go."

I decide this probably isn't a good time to mention that my wife once used our sat-nav for a journey into unknown territory and ended up being directed to a stretch of motorway which had closed two years previously. I suspect this problem occurred because we didn't update our maps properly, but even so, it didn't feel very dependable when she reached a dead-end in the middle of Hampshire.

Anyway, there are no such issues associated with Cydar's extremely clever technology, which uses machine learning to ensure doctors don't take a wrong turn in the operating theatre. Founded by Tom, who is one of the country's leading vascular surgeons, and imaging scientist Graeme Penney, it aims to solve a problem which has been bugging surgeons since keyhole techniques replaced open surgery as the standard operating procedure.

"When you're operating inside blood

vessels, doing surgery on the heart or arteries, as well as operating on bones or solid organs, you can't use optical cameras," Tom explains.

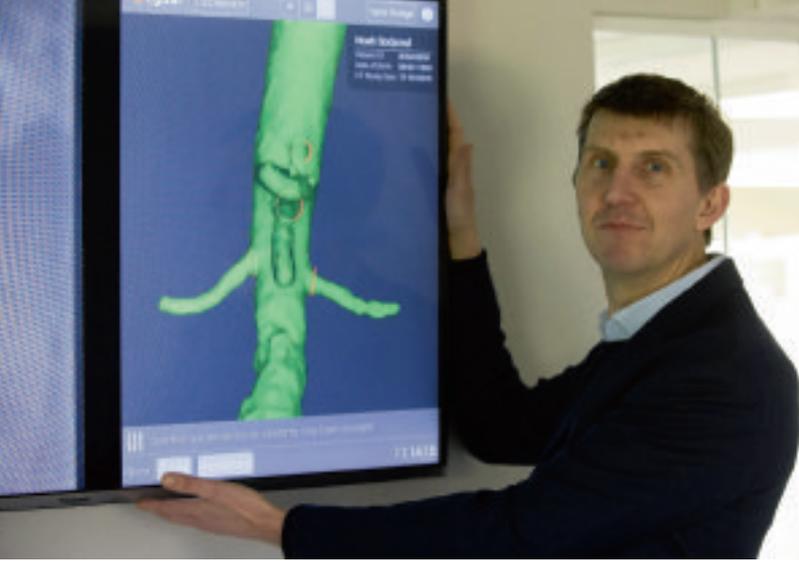
"Instead you watch a grainy video that updates at a few frames a second. At no time in your life is being accurate as important as it is during these procedures, getting things wrong by even a few millimetres can be fatal. And yet this is all you have as guidance. It's pretty rubbish."

The standard video view is based on X-rays, which means things like arteries and blood vessels don't even show up. Which is where Cydar, winners of the Hewitsons Award for Business Innovation at this year's Cambridge News & Media Business Excellence Awards, comes in.

"We take existing scans of the patients, standard cross-sectional slices, and reconstruct that into 3D," Tom says. "Then we give physicians the tools so they can pick out the bits they're interested in, and that anatomy gets highlighted. We can then select it so that the relevant information is segmented out. The physicians can put on planning annotations, bits that are important for them to do the procedure.

"Our 'magic sauce' is that we've developed technology that fuses all this stuff together, so we can overlay it in real time in the operating room. Now, instead of just seeing the black and white images, you see the superimposed anatomy, then the computer vision kicks into action, works out exactly where the patient is with incredible accuracy and really quickly."

The system is also based in the cloud,



Tom Carrell, left, and below, the Cydar team receives the Hewitsons Award for Business Innovation at this year's Cambridge News & Media Business Excellence Awards from John Pienaar

meaning no expensive hardware is needed, something that is kind of a big deal for cash-strapped health providers like the NHS.

"If you were to put the level of data centre into a hospital needed to run this it would be prohibitively expensive and difficult to run," says Tom. "But with our systems in the cloud running it, with a huge amount of engineering behind it, we don't have to worry about a server flaking out because we're not dependent on every server performing at once."

But what happens if your internet connection goes down, I ask?

Tom explains: "The system is designed to be failsafe, so if the connection goes down, the overlay will continue showing if it remains in the right place. If the image changes it removes the overlay and you're left with what is currently the standard view."

"So far we've done about 700 procedures and it's only happened once, and to be honest nobody noticed because they were far more concerned about the fact the anaesthetic machine wasn't connecting. They had bigger problems. We've also run it over 3G and 4G mobile networks to show it doesn't need high-end hardware."

Cydar was born in 2008 when Tom met Graeme, a leading figure in the field of imaging science who had already been working on several of the ideas on which Cydar's system is based as part of his PhD.

"I was doing this kind of surgery down in London and I was utterly frustrated with these problems. I went round knocking on doors, and heard about this guy who had done some work on it in the 1990s," Tom says.

"That turned out to be Graeme, so we got together and started a research programme, and we were in the operating room day in, day out from then on. We had a 50/50 way of working, I was giving Graeme problems and he was coming up with solutions."

The company eventually spun out of King's College London, where Graeme is a lecturer, in 2011 and relocated to Barrington in 2014, taking the Barrington



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Mill offices previously occupied by Granta Instruments. Cydar looks likely to outgrow its surroundings at some point in the near future, so the picturesque location could be on the market again soon. If I were a company I'd be keen to snap it up – there aren't many offices in Cambridge with their own mill pond.

But why move out of London in the first place? Tom says: "We looked at the thing we needed, which was people who are experts in computer vision, cloud computing and software engineering. It's a very rich vein of talent in Cambridge, we've got seven PhDs here, and the other thing is the guys come and work for us

and see that the code they've written is being used in operating rooms. That's a very powerful thing, to see the stuff you've written having a real impact."

With FDA and CE mark approval achieved, Cydar's system is already installed in test sites in the UK and the US. Initially aimed at vascular surgery, it could branch out into other areas such as oncology, and Tom believes the company can have a truly global impact.

"Duke University Hospital, our first partner in the US, did a study of the health economic impact of using the overlay, and it showed that the operations take less time, patients have fewer complications, particularly kidney complications, and there's a reduced exposure to X-ray radiations for both patients and staff," he says.

"They're the things that underpin the business case for this, it's making operations faster, safer and cheaper. That's what every health system in the world needs, not even the Americans have money to throw at things just because they're shiny and new – you have to prove the value of what you're doing."

"We would like this to become the standard of care, so any patient having an operation anywhere in the world should be able to get the benefit of enhanced guidance and intelligent planning we're developing." ♦

