Just when you thought tablets were the new, high-tech clipboards on worksites, along comes the DAQRI Smart Helmet – a hands-free, wearable augmented reality platform that makes other solutions look old hat. By Gemma Chilton.

Thinking Cap

What are hard hats for?

We wear them in potentially dangerous environments to protect the grey matter between our ears – our brains. Our 'wetware'.

So there's a certain irony in the development of the world's first 'Smart Helmet' – a functioning hard hat that continues to offer protection for a worker's own internal processor, while effectively improving on that processor's ability to interpret and respond to its surroundings in an industrial environment.

American tech outfit DAQRI created the Smart Helmet specifically as an industrial solution – aimed at improving the efficiency, effectiveness and safety of the workforce using the latest in 'augmented reality' technology – what DAQRI calls '4D content'; overlaying digital information on the real world.

The Smart Helmet allows people to look at gauges or components and see live information on them.

Augmented reality leader DAQRI, came up with the Smart Helmet in response to existing customers' requirements.

"We went with the helmet because it was a flexible hardware platform. It wasn't too small and there was huge demand from our partners," says DAQRI's vice president of Research and Development, Chris Broaddus.

Using advanced sensor and navigation technology (see breakout, 'Tech low-down'), the hard hat is able to respond to its exact location in real time and recognise objects around it, then present the wearer with contextual information based on what he or she is seeing – such as historic readings from an instrument display or machine operation instructions.

This information is presented on transparent display screens which drop down when needed in front of the user's eyes (from underneath the hard hat's protective visor) and are readable in both low light and bright conditions.

The information can communicate with other smart helmets on the work site, or Android mobiles and tablets, as the software is based on Android.

Currently being tested in a number of pilot projects – with contract discussions underway to set up assembly lines for commercial manufacture in the near future – the Smart Helmet is the product of almost two years' full-time development by a team of more than 40 engineers and scientists from a range of disciplines.

Over the past two years, we've been hiring the best engineers in the world from all the disciplines needed to build the hardware and software platform for the Smart Helmet.

"One of the biggest challenges was hiring the right engineers to build a wearable augmented reality platform like we were trying to do," says Broaddus. "Over the past two years, we've been hiring the best engineers in the world from all the disciplines needed to build the hardware and software platform for the Smart Helmet," he says.

For example, DAQRI drew on the expertise of mechanical engineers to build a product that not only housed all the necessary technology, but continued to meet the specifications of a basic hard hat.

Experts were also needed to develop the advanced optics in the display screen, while electrical and computer engineers were employed to build the computational power needed to meet the processing requirements.

All of this also had to be designed to be protected from the elements and work site environments – anywhere from factory floors to construction or mine sites.

"That's just the hardware side," adds Broaddus. "On the software side, we needed to employ engineers to build the computer vision systems, 'Intellitrack'; to develop the capacity to process and interpret all of the information being picked up by the sensors; and to develop the best platform to present information to the user," he says.

Intellitrack includes a visual-inertial navigation system that estimates the helmet's position and orientation in indoor and outdoor environments. It is one of the most advanced features on the Smart Helmet.

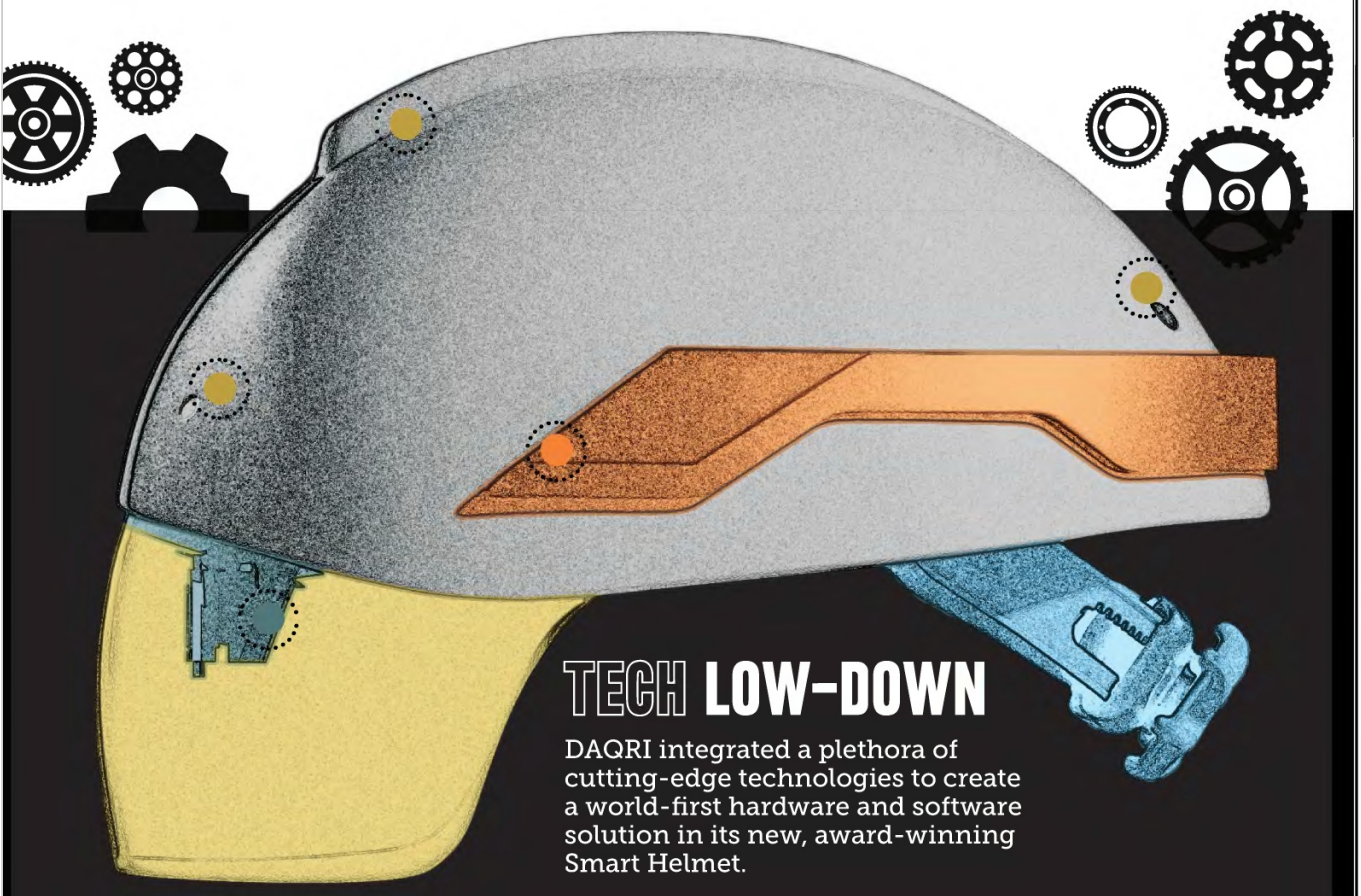
> Detection and recognition based on object features from a large object database is still a problem under research.

The result won DAQRI a Gold in the Industrial Solutions category at the 2015 Edison Awards in April, which recognise excellence in new product design and innovation.

Indeed, much of the technology incorporated into the DAQRI Smart Helmet is so innovative it's still effectively in the research stage – as PhD student Mohammad Hosseini at the University of NSW School of Computer Science and Engineering points out, "detection and recognition based on object features from a large object database is still a problem under research".

However, Broaddus explains that this problem is managed by limiting the Smart Helmet to the industrial environment. "We are able to accomplish what we're trying to do because we're working in an environment where we can know a lot about the space. It's different to a consumer situation, where you're in the open or 'in the wild' and the computer is trying to recognise anything and everything that's out there," he says.

While the DAQRI Smart Helmet already has the ability to send and receive information with other helmets on the work site, Broaddus says his team of engineers is currently looking at the potential for 'collaborative learning' as a future development.



TECH LOW-DOWN

DAQRI integrated a plethora of cutting-edge technologies to create a world-first hardware and software solution in its new, award-winning Smart Helmet.

Computer vision and navigation (Intellitrack)

The Smart Helmet is equipped with an array of sensors in order to understand the surrounds in real-time, including an industrial-grade inertial measurement unit (IMU), a high-resolution 3D depth camera, and four 360-degree navigation cameras.

Optics

Information is displayed in high-definition on dual-screen fully transparent displays, readable in both low light and bright conditions. The display system is synchronised with the position and orientation information from Intellitrack to overlay registered content.

Software

The Smart Helmet is based on an Android operating system, enabling communication with multiple devices including mobiles and tablets, and for existing Android apps to be updated for use with the helmet.

Processing

All processing is carried out in the helmet itself, using an embedded Qualcomm Snapdragon processor. The helmet is able to communicate with remote servers using a WiFi antenna in order to download data.

Power

The helmet is powered by both a built-in and tethered battery which currently lasts several hours and DAQRI is working towards a 'full shift' battery life of eight to 12 hours.

WATCH THE VIDEO: *DAQRI Smart Helmet: Under the Hood*
https://www.youtube.com/watch?v=BmqmgsAYJiI

TECHNOLOGY

INDUSTRIAL APPLICATIONS

The Smart Helmet is suitable for a range of industries, from mining to energy to process control or construction. Apps can be built to integrate with existing hardware and software.

The question is, says Broaddus, "if you have 20, 30 or 50 smart helmets walking around in an environment, can you use those massive amounts of information to learn?"

Broaddus is adamant that the Smart Helmet is not a stepping stone towards replacing workers, but a tool to enable them. "You always need a workforce," he says.

"We want to make their life easier, to get information to them faster and to make their work environment safer."

However, as the processing power of wearable tech like the Smart Helmet inevitably improves, will there be in an inverse relationship with the processing power required of its wetware user?

It's a question worth considering – and one that has already caught the attention of the world's intellectual community with this year's Edge.org question: "What do you think of machines that think?" As neuroscientist and philosopher Sam Harris says in his response: "there is no law of economics that guarantees that human beings will find jobs in the presence of every possible technological advance". ●

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