

# AI AT THE CUTTING EDGE

Tech Expert insights on edge AI



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### ABOUT IPI TECH EXPERTS

IPI Tech Experts provide advisory and support to enterprises that are looking for technical expertise to enhance or complement their in-house capabilities. Businesses can tap into a pool of pre-vetted experienced experts with deep domain knowledge across different sectors and engage them to solve technical challenges that are encountered in various stages of their product development journey.

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# AI AT THE CUTTING EDGE

In the past decade, artificial intelligence (AI) has found its way out of the research setting and into our everyday lives. AI is now an integral part of many business capabilities, including processes automation, data analysis and engaging with customers and employees. For example, AI has helped General Electric to eliminate supply redundancies and re-negotiate contracts, saving them US\$80 million in its first year.<sup>1</sup>

Although AI is now ubiquitous, much of the magic happens remotely—on the cloud. AI algorithms typically require large amounts of data and computational power, features that lend themselves to cloud resources. However, sending data to and from the cloud requires an internet connection, where delays in responses may result in security breaches.

Instead of centralising all operations on the cloud, edge AI makes use of a network of devices on the ground, close to where the data is being generated. Equipping an Internet of Things (IoT) device with

edge AI allows it to process data and make decisions independently without a connection, avoiding the problem of streaming and storing data to a cloud. This not only mitigates privacy concerns, it also allows real-time optimisation of the system, a trend users will come to expect when upcoming 5G networks set the bar for low latency communication.<sup>2</sup>

Growing at a CAGR of 20.8%, edge AI promises to be the next frontier of AI, reaching a market size of US\$1.8 billion by 2026.<sup>3</sup> However, a number of challenges stand in the way of successful edge AI implementations, including the limited power, memory and compute capabilities of edge devices and the need to optimise complex AI models to fit within those limits.

In addition to these technical challenges, there are also human factors at play. With edge AI being an emerging field, there is a shortage of talent with the requisite experience in embedded systems, IoT and AI—or the ability to seamlessly traverse all three disciplines.

<sup>1</sup> Artificial intelligence for the real world (2018) Harvard Business Review. Retrieved on Mar 2021 from <https://hbr.org/2018/01/artificial-intelligence-for-the-real-world>.

<sup>2</sup> Will edge AI be the ML architecture of the future? (2020) Towards Data Science. Retrieved on Mar 2021 from <https://towardsdatascience.com/will-edge-ai-be-the-ml-architecture-of-the-future-42663d3cbb5>.

<sup>3</sup> Edge AI software market worth \$1,835 million by 2026 (2021) Markets and Markets. Retrieved on Mar 2021 from <https://www.marketsandmarkets.com/PressReleases/edge-ai-software.asp>.

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# BUILDING A BUSINESS CASE FOR EDGE AI

At the edge, AI involves only inferencing; it ultimately still depends on cloud and data centres for the important tasks of building and training the AI model, said Liang Kin Onn, deputy manager at the Centre of Innovation for Electronics & IoT (COI-EIoT) at Nanyang Polytechnic. But by conducting that inferencing directly on embedded systems instead of cloud-based servers, edge AI faces reduced privacy concerns, is more responsive and can make decisions locally.

The main obstacle to implementing edge AI is the need to shift large, complex machine learning (ML) models into resource-constrained IoT devices, which is a move into the embedded world. “In conventional AI, we have very powerful desktop machines, data centres and cloud resources,” Liang explained. In the edge environment, however, devices tend to have lower computing power and memory, which means that AI/ML models developed for conventional AI are unlikely to run directly on the edge devices without first going through compression and optimisation.

According to Liang, a practitioner in the field of embedded systems and IoT, there are three practical considerations to keep in mind when companies embark on designing edge AI based products or services: the rise of sensor fusion, the importance of cross-functional talent and the need for a realistic business plan.

## 01

### Sensor fusion: the future of edge AI

To give IoT devices the ability to make accurate localised decisions, context awareness is an important characteristic. Context-aware applications in turn rely on sensor fusion which merge information from multiple sensors or other connected sensor networks. “This is where sensor fusion solutions or platforms will play an important role, as you cannot rely on a single sensor to tell you the ground truth,” Liang explained.

Edge AI could possibly adopt some solutions from autonomous vehicle industry, which has highlighted the importance of sensor fusion in real-time decision making, fault diagnosis and tolerance, Liang said. For example, autonomous vehicles currently detect the environment using a combination of Global Positioning System (GPS), Light Detection and Ranging (LIDAR) technology, cameras and inertial measurement units. As signal processing techniques and data fusion algorithms become more advanced, other industries will benefit from the high quality spatial and temporal datasets enabled by sensor fusion. “Advancements in sensor fusion will thus ease some of the complexities and increase the accuracy of the AI algorithms, thereby enabling smarter devices and innovations at the edge,” Liang added.

## 02

### Talent that can speak both AI and IoT

AI inferencing is a challenging task for the edge IoT devices, particularly for battery-powered and memory constrained ones. Putting aside the concern of cost and energy, designing an embedded device with ML acceleration-based hardware will inevitably increase design complexity. Furthermore, AI models are typically trained with popular frameworks such as Caffe, TensorFlow, PyTorch, etc., which may not always allow the model to be easily imported or cross-compiled to the target processor. Therefore, the trained models must usually be compressed or at least optimised before they can be executed at the edge. “To do this, the engineer needs to be conversant with embedded software development as well as knowledgeable in AI model optimisation for inference at the edge,” Liang shared.

Unfortunately, engineers with the necessary talent spanning these areas are rare. “Edge AI projects of this kind will need very close collaboration between embedded systems engineers and machine learning engineers to shorten the otherwise lengthy product development cycles,” Liang said.

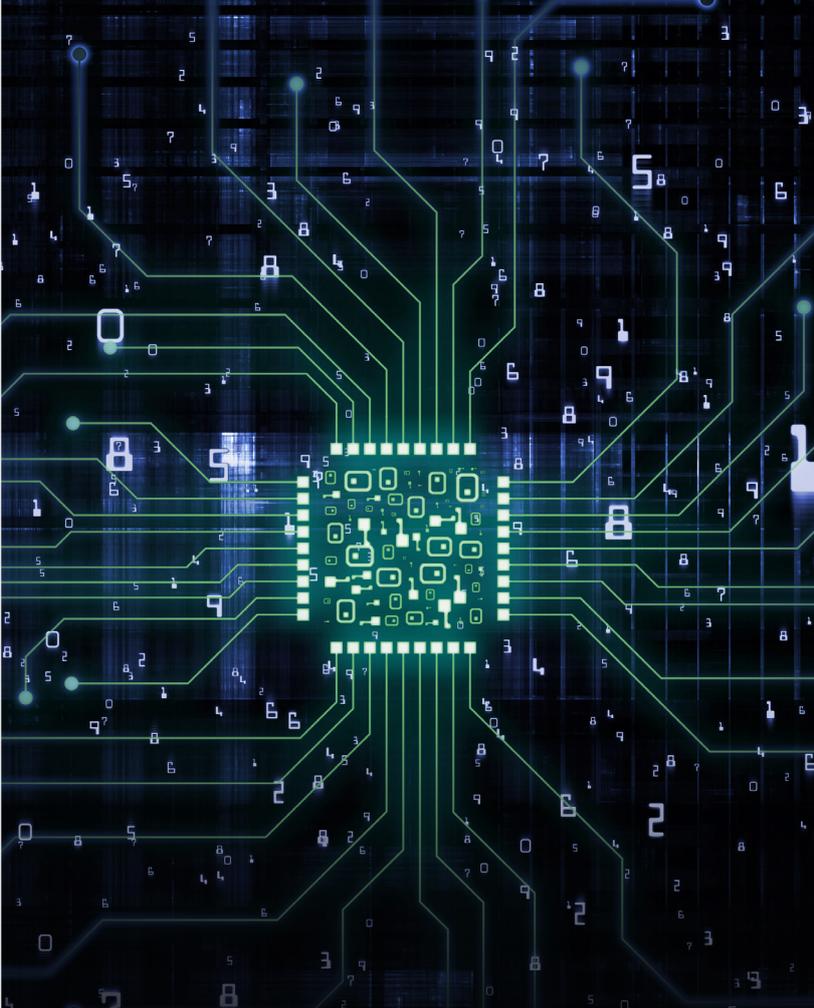
## 03

### Moving from pilot to proven business viability

Challenges aside, the undeniable trend is that intelligence is increasingly migrating to the edge, particularly with the proliferation of IoT. “I believe there is no shortage of use cases; it is human nature to strive for continuous improvement, be it in moving intelligence to the factory floors for operational efficiency or designing on-device machine learning wearables for personalised healthcare,” Liang said.

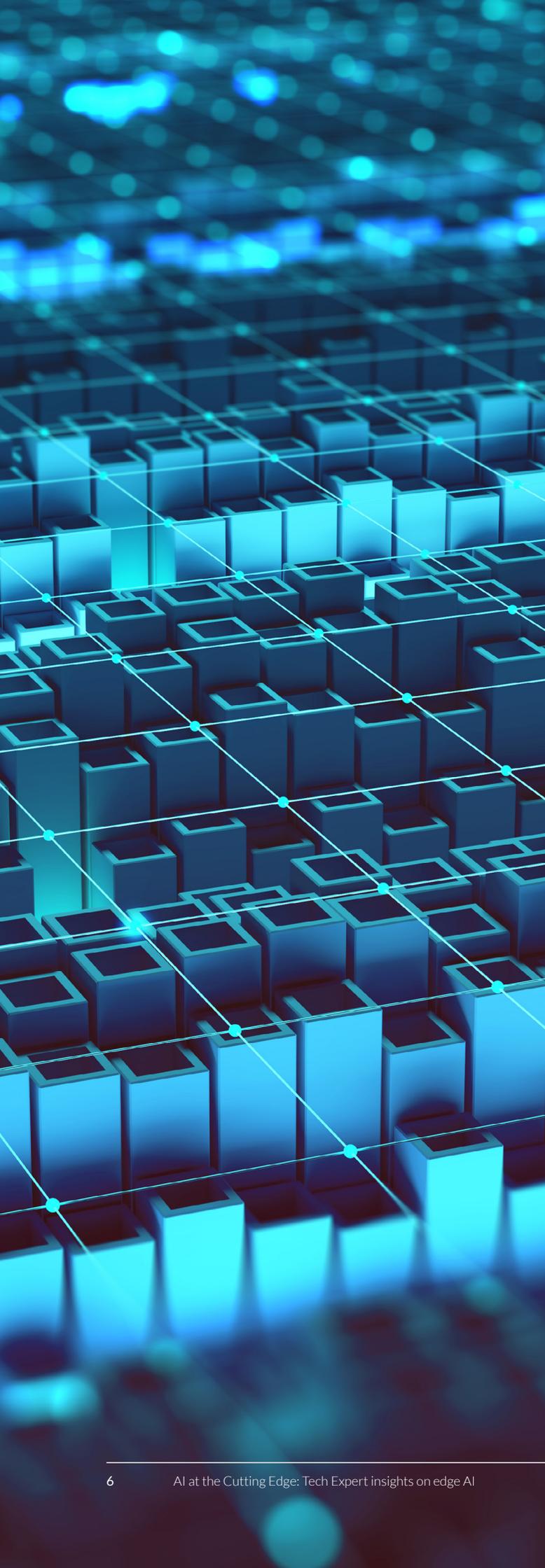
At the end of the day, Liang continued, many of the tools for edge AI already exist. What may not be so immediately obvious is whether edge AI represents a good business model for the types of problems a particular industry faces. Instead of immediately looking for a return on investment after a proof of concept, he advocates a more step-by-step approach. “You can’t expect edge AI to solve all your problems overnight. Perhaps you could start by implementing a sensor fusion at a gateway to give you some information before slowly creating plans to change other sensors,” Liang said. “It’s important to experience the benefits first before moving ahead to large-scale implementation.”

Nonetheless, edge AI is still at the early stages of market development, with most investments centred around vision. While this implies plenty of room for innovation and business opportunities in the space, industries are still observing and trying to assess the value of AI at the edge. Therefore, Liang concluded, companies must consider adopting a pragmatic approach that takes the maturity of the technology and the availability of talent into account, to build a viable yet realistic business plan that brings value to their customers.



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## CONCLUSION

Since its discovery, AI has evolved to cater to the ever-growing demand of users. In an age of innovation where data continues to grow, there is a trend of an increasing demand for privacy and immediacy. Edge AI could be a promising solution to both needs, as it does not send information to a cloud-based centre to be stored and analysed. Furthermore, edge AI will enable a more efficient Internet of Things, where a network of intelligent devices acts independently of a central server.

As an emerging field, there are aspects of edge AI that have yet to be developed and perfected. These pain points in edge AI could translate to opportunities for companies to capture value by developing solutions such as optimised algorithms with reduced memory requirements or more efficient processor hardware architectures. In particular, sensor fusion solutions are likely to be in demand.

Above and beyond the technical challenges, there is also a need for cross-functional talent. The new and developing nature of this field means that individuals who understand both AI and IoT are in short supply, highlighting the need for companies to generate talent through cross-training. This burden is not only on edge AI developers, but also on companies to develop a greater appreciation of the strengths and limitations of edge AI before embarking on implementation.

If you would like to find out more about edge AI and how your products or solutions could benefit from it, please contact Kin Onn via <https://www.ipi-singapore.org/tech-experts/liang-kin-onn.html>. You could also visit <https://www.ipi-singapore.org/tech-experts> to discover other experts relevant to address any challenges that you are currently facing in your business.

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Prior to joining COI-ElIoT, he spent over six years working for Motorola, Philips and Infineon before leaving to join a startup for another nine years where he led a team to design and develop firmware for mobile phones.

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