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Kudan Inc.

Kudan's insight ~The Future Integration of Artificial Perception (SLAM) with Semiconductors~ is now available

Kudan Inc. (headquarters in Shibuya-ku, Tokyo; CEO Daiu Ko, hereafter "Kudan"), a global leader in advanced SLAM (Simultaneous Localization and Mapping) technology, is pleased to announce that we have released an article titled "Kudan's insight ~The Future Integration of Artificial Perception (SLAM) with Semiconductors~".

This series provides an explanation of Kudan's business environment, future forecasts and management strategy within this environment, and in this article, we explain the relationship between the semiconductor industry, which is attracting increasing attention worldwide, and Kudan's artificial perception (SLAM) technology, and its future prospects.

About Kudan Inc.

Kudan is a deep tech research and development company specializing in algorithms for artificial perception (AP). As a complement to artificial intelligence (AI), AP functions allow machines to develop autonomy. Currently, Kudan is using its high-level technical innovation to explore business areas based on its own milestone models established for deep tech which provide wide-ranging impact on several major industrial fields.
For more information, please refer to Kudan's website at https://www.kudan.io/.

■Company Details

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Securities Code: 4425 (TSE Growth)
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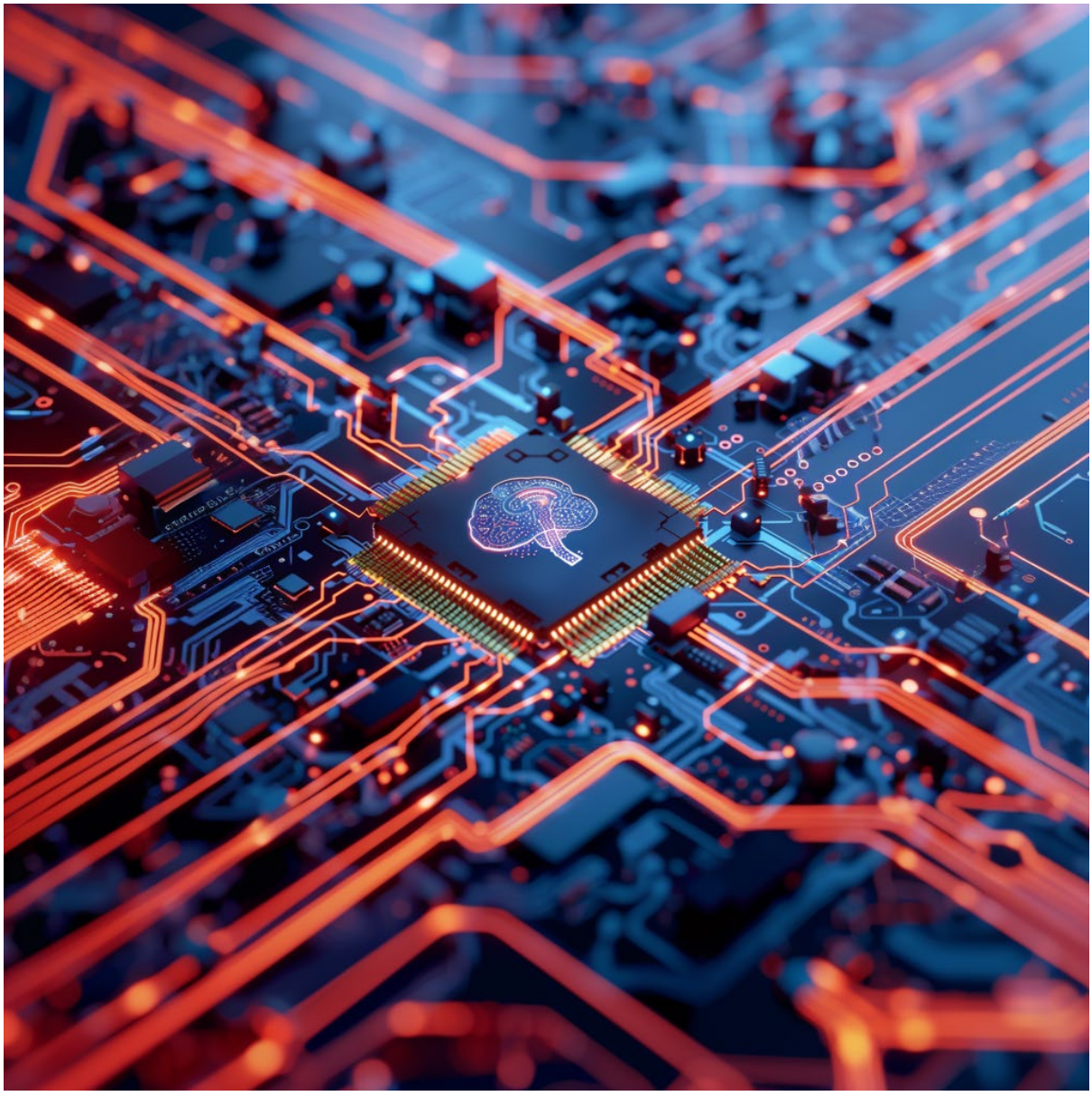
Kudan's insight ~The Future Integration of Artificial Perception (SLAM) with Semiconductors~

The semiconductor industry is now entering a new golden age, and one of the most notable catalysts is the synergy with artificial intelligence: AI chips are seeing a dramatic increase in demand due to the rise of generative AI. This phenomenon is not just an economic trend but a sign that we have entered a new era.



The interdependence of software and hardware

Why is the relationship between artificial intelligence and semiconductors so important? To understand this let's first explore the essence of artificial intelligence and semiconductors.

Artificial intelligence consists of algorithms —a software concept. They have no physical hardware component, and serve as a 'design document' for information processing. Semiconductors, in contrast, are tangible circuits designed to process information. Utilising advanced nanoscale technology, they efficiently handle vast amounts of information through electrical signals.

The interplay of software and hardware might, at first glance, seem to be combining two distinct things. From a technical perspective however, they are intricately linked. By optimising each to work seamlessly with the other, significantly enhanced processing efficiency can be achieved.

To illustrate the point, let's say you want to calculate the result of 8 x 7. If you use a semiconductor chip which only has an adder circuit, then you need to run that circuit seven times to get the answer 8 + 8 + 8 + 8 + 8 + 8 + 8 = 56. If, on the other hand, you have a chip which contains a multiplication circuit, then only one multiply operation would be needed, giving the answer with only 1/7th of the effort.

The efficiency gain is due to the semiconductor chip being equipped with circuits specifically designed to execute the operations required by the software more effectively. In extreme cases, if a chip were to be designed with a circuit that embodies the complete 'information processing blueprint' for a specific function, it might execute the entire process in a single step. Imagine a specialised calculator with a dedicated button for a particular complex equation: with just one press, the solution is provided. Software algorithms can be transformed into dedicated hardware circuits on a semiconductor chip to improve efficiency and performance.

Conversely, software can also be customised and optimised for specific hardware. For instance, when efficient circuits are already present on a chip, software developers can modify the flow and processing of information to fully exploit these circuits' capabilities.

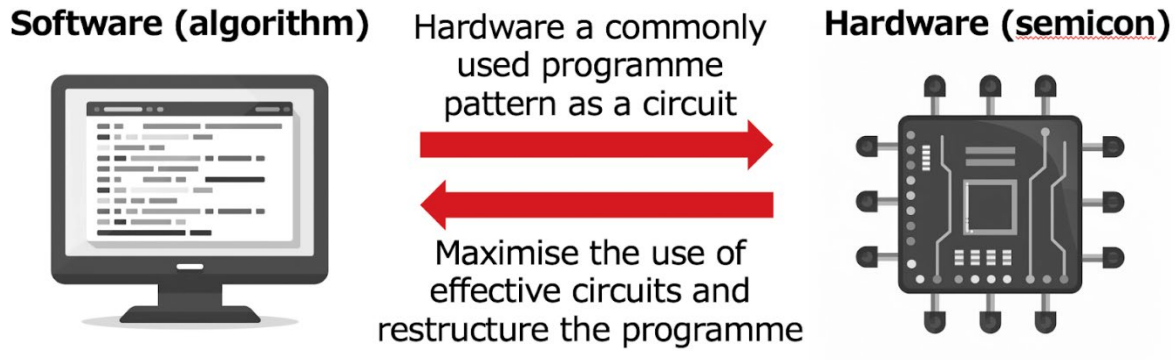


Image of mutual optimisation between software and hardware

A royal road for deep tech algorithms

It is therefore clear that the rise of AI chips is underpinned by a symbiotic relationship between software (artificial intelligence) and hardware (semiconductors). Artificial intelligence demands extensive information processing, making the enhancement of processing speed a critical objective. To address this, semiconductor manufacturers are making AI processing more efficient by embedding common information processing patterns directly into the hardware as electrical circuits. This approach makes it easier for the chips to be used in a wider array of use-cases, together with software that has been adapted for them.

This symbiotic relationship between hardware and software underpins the advancement of technology, particularly with deep tech algorithms that operate near the hardware level, and can be thought of as a royal road for the spread of technology. Although outside the realm of artificial intelligence, Kudan's work on artificial perception (SLAM) also leverages algorithms that have been implemented 'close to the metal', enabling a natural and seamless integration with semiconductor technology.

This is only feasible for software algorithms that operate close to the hardware. In contrast, software such as smartphone apps and SaaS platforms are typically built using frameworks that introduce many layers of abstraction. Embedding these types of applications directly into hardware circuits would be impractical and would significantly restrict the flexibility and utility of the resulting semiconductor chips. This underscores the difference between merely using semiconductor technology and actively partnering in its development.

Deeper and broader integration than artificial intelligence

As Kudan's artificial perception technology (SLAM) gains widespread adoption, its integration into semiconductor chips will be inevitable as long as the demand exists. However, this integration has some differences from the current landscape of AI chips.

Firstly, artificial perception (SLAM) embodies a much more complex form of software than typical artificial intelligence applications. For instance, while an artificial intelligence algorithm might span a few hundred lines of code, an artificial perception (SLAM) algorithm can extend to hundreds of thousands. This vast difference in complexity underscores the potential for deeper semiconductor integration, promising significant speed enhancements through software optimization and hardware adaptation.

Secondly, artificial perception (SLAM) can be integrated with a wider range of semiconductor technologies than artificial intelligence. AI applications often rely on processing large volumes of data in a relatively straightforward manner, leading to their optimisation for semiconductors specialising in parallel processing circuits, such as GPUs.

In contrast, artificial perception (SLAM) involves processing complex patterns, necessitating a more balanced integration with various types of semiconductor technologies. The

semiconductor product packages seen in recent years consist of several processors, such as CPUs as information processing command centres, GPUs specialising in heavy information processing, DSPs and VPUs with characteristics in between, FPGAs programmable to meet niche demands, ISPs attached to cameras, and so on. Artificial perception (SLAM) elements can be fused with the diverse characteristics of each of these. If this comprehensive integration can be achieved, it will be possible to benefit from dramatically higher performance.

Kudan's role in semiconductor innovation

Kudan has spent significant time working on artificial perception (SLAM) and has been involved in a wide range of collaborations with leading semiconductor companies, including the world's first commercial SLAM package on an Intel platform. Kudan aims to enhance the semiconductor industry by furthering the integration of semiconductors and artificial perception (SLAM) software, in order to achieve more efficient information processing.

While artificial perception (SLAM) is still on the brink of achieving widespread adoption, its trajectory will mirror the path taken by artificial intelligence. Because of this, we believe that Kudan's efforts will be of great significance to the semiconductor industry.

(Image: List of partners extracted from Kudan HP)