

DENSO and Toshiba Agree to Develop Artificial Intelligence Technology, Deep Neural Network-IP, for Next-generation Image Recognition Systems

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KARIYA and TOKYO (Japan) – DENSO Corporation and Toshiba Corporation have reached a basic agreement to jointly develop an artificial intelligence technology called Deep Neural Network-Intellectual Property (DNN-IP), which will be used in image recognition systems which have been independently developed by the two companies to help achieve advanced driver assistance and automated driving technologies.

DNN, an algorithm modeled after the neural networks of the human brain, is expected to perform recognition processing as accurately as, or even better than the human brain. To achieve automated driving, automotive computers need to be able to identify different road traffic situations including a variety of obstacles and road markings, availability of road space for driving, and potentially dangerous situations. In image recognition based on conventional pattern recognition and machine learning, objects that need to be recognized by computers must be characterized and extracted in advance.

In DNN-based image recognition, computers can extract and learn the characteristics of objects on their own, thus significantly improving the accuracy of detection and identification of a wide range of objects.

Because of the rapid progress in DNN technology, the two companies plan to make the technology flexibly extendable to various network configurations. They will also make the technology able to be implemented on in-vehicle processors that are smaller, consume less power, and feature other optimizations.

DENSO has been developing DNN-IP for in-vehicle applications. By accelerating the process to commercialize DNN-IP through the joint development and incorporating DNN-IP in in-vehicle cameras, DENSO will develop high-performance, advanced driver assistance and automated driving systems, and continue to contribute to building a safe and secure automotive society for people around the world, not just for drivers and pedestrians.

In addition to its conventional image processing technologies, Toshiba will partition this jointly developed DNN-IP technology into dedicated hardware components and implement them on its in-vehicle image recognition processors to improve their image processing performance and enable them to process images using less power than image processing systems with digital signal processors (DSPs) or graphics processing units (GPUs).

About DENSO Corporation

DENSO Corp., headquartered in Kariya, Aichi prefecture, Japan, is a leading global automotive supplier of advanced technology, systems and components in the areas of thermal, powertrain control, electronics and information and safety. Its customers include all the world's major carmakers. Worldwide, the company has more than 200 subsidiaries and affiliates in 38 countries and regions (including Japan) and employs more than 150,000 people. Consolidated global sales for the fiscal year ending March 31, 2016, totaled US\$40.2 billion. Last fiscal year, DENSO spent 8.8 percent of its global consolidated sales on research and development. DENSO common stock is traded on the Tokyo and Nagoya stock exchanges. For more information, go to www.globaldenso.com, or visit our media website at www.globaldenso.com/en/newsreleases/media-center/

About Toshiba Corporation

Toshiba Corporation, a Fortune Global 500 company, channels world-class capabilities in advanced electronic and electrical product and systems into three focus business fields: **Energy** that sustains everyday life, that is cleaner and safer; **Infrastructure** that sustains quality of life; and **Storage** that sustains the advanced information society. Guided by the principles of The Basic Commitment of the Toshiba Group, "Committed to People, Committed to the Future", Toshiba promotes

global operations and is contributing to the realization of a world where generations to come can live better lives.

Founded in Tokyo in 1875, today's Toshiba is at the heart of a global network of 550 consolidated companies employing 188,000 people worldwide, with annual sales surpassing 5.6 trillion yen (US\$50 billion). (As of March 31, 2016.)

To find out more about Toshiba, visit www.toshiba.co.jp/index.htm