

Artificial Intelligence Technology Development and Its Practical Use at NTT DATA

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Abstract

NTT DATA established a new organization called the AI Solution Promotion Office on October 1, 2015, to promote artificial intelligence (AI)-related initiatives and to respond to customer inquiries regarding the utilization of AI. The new organization will promote AI-related technological know-how accumulated in-house, as well as the NTT research and development laboratories' world-class AI technologies. This article introduces some examples of NTT DATA's approaches regarding the utilization of AI technologies.

Keywords: knowledge acquisition, communication robot, traffic simulation

1. Introduction

In recent years, NTT DATA has been receiving inquiries from many customers asking how artificial intelligence (AI) can be utilized in work operations now that AI is experiencing exponential growth. The majority of these inquiries are made with an underlying sense of crisis in which customers wonder if they will be at a competitive disadvantage if they do not introduce AI technology.

The AI Solution Promotion Office was established at NTT DATA on October 1, 2015 in order to respond to these kinds of customer inquiries regarding the utilization of AI and to promote AI-related initiatives. One of the strengths of this division is utilizing NTT research and development (R&D) laboratories' world-class AI technologies, but NTT DATA has also been conducting its own business development and R&D of AI technologies since its establishment as a company in 1988, and it excels at accumulating AI-related technological know-how.

NTT DATA is focusing its AI utilization efforts in three important domains: 1) middle and back office operations such as examinations and analyses, 2) front office operations such as contact desk and call center support, and 3) various social infrastructures

developed using large-scale data analysis. The first two are Agent-AI target domains, and the third is an Ambient-AI target domain [1]. Three specific examples of NTT DATA's efforts regarding these domains are described in this article: the efficient examination of credit card member stores using knowledge acquisition technology, retail store customer support using communication robots, and traffic congestion management using multi-agent simulations.

2. Efficient examination of credit card member stores using knowledge acquisition technology

A major task in many industries involves examining the contents of applications, for example, credit card applications, and carrying out the preliminary work of gathering the necessary information to decide whether or not applications can be accepted. Many of these operations are done manually and consist of repetitive tasks to confirm whether there are any problems with the application contents. In addition, there are some cases in which specialized knowledge is needed to make decisions on the contents. There is also a risk of losing business opportunities if too much time is consumed performing the examinations. Consequently, these operations can

take a heavy toll on companies. It is for this reason that NTT DATA is advancing R&D on examination support technology that reduces the burden of these operations.

2.1 Reduced burden of credit card member store management operations

The use of examination support technology began two years ago, and results have already been obtained on six cases.

The credit card industry is one area where results have been obtained. This industry has seen an increase in the number of scenarios in which consumers use their credit cards with the rapid growth of e-commerce and the diversification of payment methods such as payment via smartphone. As a result, there is strong demand to develop secure environments where customers feel at ease when using their credit cards, and therefore, credit card companies are working urgently to increase the security and efficiency of managing a wide variety of retail stores (member stores) that accept credit card payments.

As part of its efforts towards increasing the security and efficiency of examination operations, NTT DATA began working with Sumitomo Mitsui Card Co., Ltd. in October 2013 to jointly initiate verification tests on the efficiency and automation of information gathering for member store examination, and in October 2014, these verification tests were implemented in Sumitomo Mitsui Card's member store management operations. Comprehensive decisions are made after referring to and analyzing a variety of information concerning member store examination operations, but particularly in cases when examinations are conducted on non-face-to-face merchants such as e-commerce and smartphone stores.

For this reason, it is important to determine how precisely and effectively this diverse information can be analyzed within member store examination operations. Examination support technology extracts and collects information necessary for examinations from a vast amount of information existing on the Internet such as reputation information from forums, content on e-commerce sites, and third-party information on the Internet.

A dashboard function has also been implemented that displays gathered information on one screen in an easy-to-understand fashion and increases the efficiency of examination operations such as automatically highlighting and displaying areas that need attention. The AI Solution Promotion Office is focusing on R&D of knowledge acquisition technology

that specifies which areas are important in examination operations by adding meanings to text information. In the example of credit card member store examinations, this technology is being utilized to not only specify corporate names, addresses, and hours of operation from e-commerce sites, but also to automatically gather the price range and price ceiling of products that those corporations sell. In addition to performing these tasks, this technology also gathers information on the reputation of the relevant companies and checks to see if there are any entries on social networking sites regarding those companies.

2.2 Semi-automatic generation of rules through the use of machine learning

Knowledge acquisition technology is a technology that estimates the structure of semi-structured and unstructured data such as sentences and lists. This is a combination of original structuring technology in line with the data format of extracted targets. To utilize this technology, rules are necessary to extract objective information, and to generate these rules, there is a need for not only business knowledge but also specialized knowledge on information extraction technology^{*1}, which is why specialists in the AI Solution Promotion Office have until now been receiving requests and performing operations manually. Consequently, the considerable cost and time required for this have been issues until now.

However, R&D is currently underway on technologies that semi-automatically create rules through machine learning by leveraging knowledge on rule generation that has been conducted manually up until now. For example, when creating rules that specify place names from text information, a person first confirms whether the candidate place name (written in red characters) on a screen listing example sentences is correct or not by selecting either "o" or "x" (**Fig. 1**). Next, the system uses machine learning based on this content to automatically generate new rules. Repeating this step increases the accuracy of the rules. This mechanism for generating rules and technology that increases the efficiency of examinations is collectively called *sensu* (tentative name), and verification tests on and application of *sensu* are currently progressing.

^{*1} Information extraction technology: One of several natural language processing technologies that extract useful information from non-structured data such as text information, and converts that information into a format that can be used by computers.

When you want to automatically generate rules that distinguish place names

Select either "o" or "x" here.

Operator decides whether or not the word written in red characters is the place name. If the word is the place name, the operator selects "o," if not the operator selects "x."

For complicated tasks where support cannot be given using automatically generated rules, support is provided by a specialist who understands individual enrichment engines.

Feedback	o	-	x	?	Revise	Text
						line in the speech says, 'I believe in America where the separation of church and
						"Businesses like Amazon rely on us to be their shop window.
						and play the way we played here in Portland ... that was a great game.
						the time ex-president Obama lands in Chicago we will have dismantled about 40
						more practical to become a resident of Singapore since he plans to live there for an
						announcement may well end up shutting Spain out of the sovereign bond market."
						"Going into Boston that day, we felt like we had a pretty
						amazing to me," Gifford told The Palm Beach Post in 2008.
						"I don't think Moon had his best with him today," McIlroy
						was very, very sorry in 2004 that the Spectator did carry an editorial that partially
						at this rate, they will all be in Israel by this time next year," he said.

Fig. 1. Rules can be generated through machine learning by performing simple tasks.

3. Retail store customer support using communication robots

The robotics market is expected to rapidly expand, and there is an increasing expectation that the market within the service field will grow quickly. However, issues still remain in terms of cost and technology; for example, robots themselves are expensive, and the data retained by robots must be protected. Accordingly, NTT DATA is making efforts to research and develop Cloud Robotics Platform^{*2} that simplifies the robots themselves and reduces their costs by gathering sophisticated functions on a cloud database and by integrating various devices such as robots and sensors connected to a network with various services on the cloud.

3.1 Provision of advanced services at low cost

Since data collected from robots and sensor devices are handled in an integrated manner, Cloud Robotics Platform utilizes the R-envTM technology developed by NTT Service Evolution Laboratories to control the integration of cloud support devices as well as the know-how accumulated by NTT DATA on M2M (machine to machine) and IoT (Internet of Things) (Fig. 2).

NTT DATA is already conducting verification tests

that utilize sensors and Cloud Robotics Platform. Two examples are verification tests of elderly support services in nursing homes and verification tests of visitor survey collected in public facilities. These tests use Cloud Robotics Platform and also leverage technologies such as the communication robot Sota^{TM*3} manufactured by Vstone Co., Ltd. and technology for speech recognition, dialogue control, and speech synthesis developed by NTT Media Intelligence Laboratories.

3.2 Support of guidance-related operations of bank clerks using sensors and robots

The number of overseas visitors to Japan is expected to increase in 2020, and efforts are therefore increasing to develop contact desk services utilizing communication robots such as those that support customers in multiple languages at reception desks in various industries. Accordingly, NTT DATA has been paying attention to customer support-related operations in financial institutions where there are great expectations for use scenarios involving communication

^{*2} Cloud Robotics Platform: An information integration platform that collects data from devices, analyzes the data, and controls devices such as robots.

^{*3} "Sota" is a trademark of Vstone Co., Ltd.

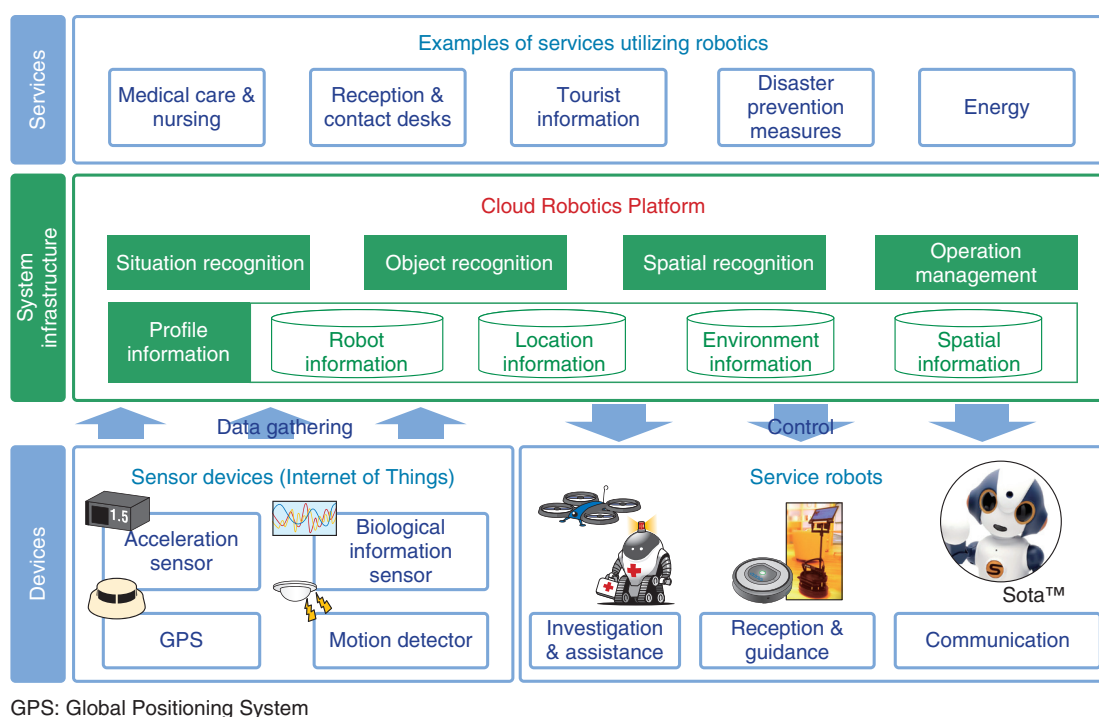


Fig. 2. Cloud Robotics Platform.

robots. NTT DATA and Vstone have been conducting joint verification tests towards realizing customer support using communication robots in actual branches of financial institutions.

The feasibility of providing customer support services via dialogues with communication robots was evaluated in verification tests conducted at the RESONA Bank Toyosu Branch (Seven Days Plaza Toyosu), a newly established branch, from the day of opening on November 15, 2015, until the end of April 2016. During these verifications, we extracted issues in business and operations while listening to the opinions of visitors and bank clerks. For example, high-sensitivity sensors installed in the ceiling above the building entrance on the first floor would detect people entering and leaving the facility and notify the communication robot stationed at the ATM (automated teller machine) corner. Along with communicating with customers by saying “Welcome!” or “Thank you for visiting us,” the robot directed visitors to the branch services located on the second floor. High-sensitivity sensors installed at the entrance of the branch notified the communication robot placed at the reception desk when visitors came close. The robot would then start a dialogue with the visitor by greeting them with “Welcome!” and then

prompt the visitor to use the self-reception tablet according to the contents of the robot’s conversation with the visitor. This endeavor achieved services that supported the guidance-related operations conventionally conducted by bank clerks (Fig. 3).

An increasing number of inquiries is being made regarding the utilization of communication robots in customer support-related operations. NTT DATA will continue conducting verification tests and is working to expand the range of support that communication robots provide in customer support-related operations such as customer guidance and product introductions in stores by utilizing AI technology. NTT DATA also intends to promote the early practical use of communication robots.

4. Traffic congestion management using multi-agent simulations

Traffic congestion is an important social issue that affects both advanced and developing countries. There are situations when applying basic solutions such as expanding roads and improving intersections is difficult due to cost and legal issues.

If the effects of multiple traffic congestion mitigation measures can be compared in traffic simulations,

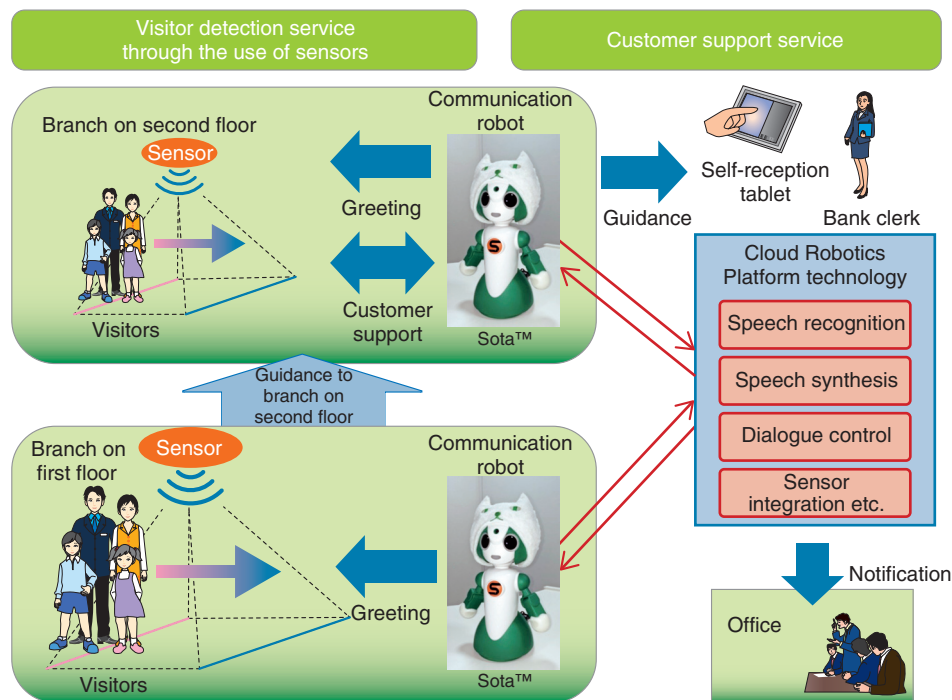


Fig. 3. Branch reception desk robot.

it will be possible to select the most effective measure. Accordingly, NTT DATA is conducting R&D on technologies that predict traffic congestion and control stoplights by utilizing traffic simulation technology.

4.1 Large-scale traffic simulation technology based on parallel distributed processing

NTT DATA's traffic simulation adopts a method using a multi-agent model. In this method, targets that influence cars, stoplights, roads, intersections, and other traffic elements are regarded as agents, and this method reproduces actual traffic congestion situations by operating an enormous number of these agents on a virtual network of roads generated on computers. However, conventional measures require high-spec computer resources to simulate situations where a high density of cars causes congestion in a broad area.

NTT DATA has successfully realized distributed processing by separating an original map into a mesh format and by using multiple general-purpose servers (Fig. 4). In addition, since one mesh is assigned to one core of a server and then calculated, distributed processing requires mesh partitions with equal computational complexity. The NTT Software Innovation

Center has developed graph data analysis processing technology called equal granularity clustering (Fig. 5) with which NTT DATA has succeeded in conducting fast mesh partitions and conducting traffic simulation in real time.

4.2 Mitigation of congestion by optimizing traffic congestion in predictions and signal controls

To verify the effectiveness of traffic control using this traffic simulation technology, NTT DATA cooperated with Jilin City in China in November and December 2014 in conducting verification tests in a city central area. During these tests, Jilin City buses equipped with on-board computer terminals were used to conduct traffic congestion prediction and stoplight control simulations in combination with statistical information such as traffic volume, routes, and information from approximately 200 probe units (the location and speed, etc., of each bus) concerning the eight routes gathered from those on-board computer terminals. Traffic was controlled by reflecting stoplight settings—which were optimized through prior assessments done in simulations—in intersection stoplight machinery found within the city, and the effects of traffic congestion mitigation and the improvement of bus service times was verified. As a

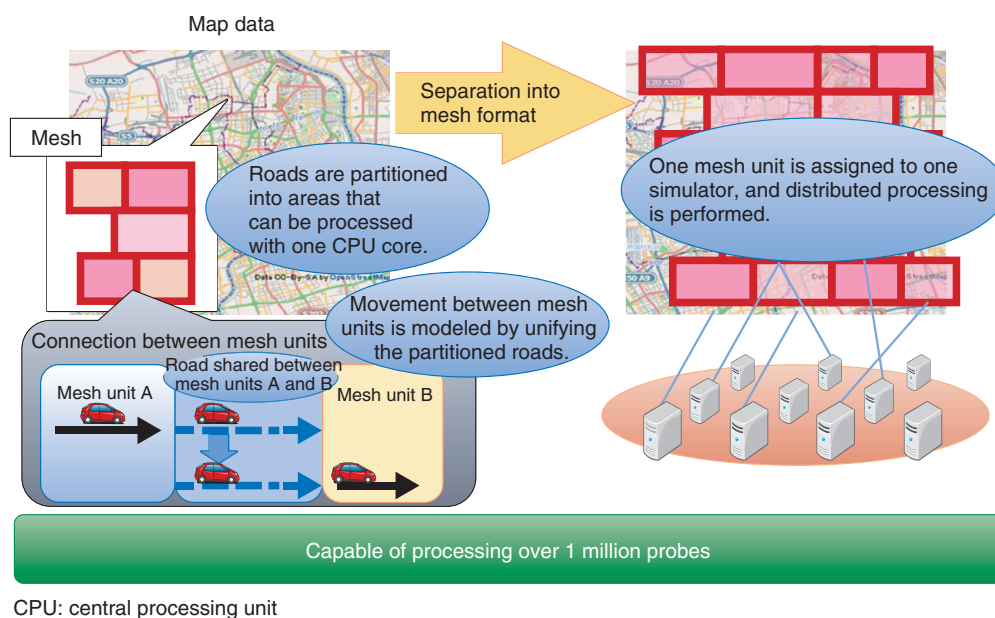


Fig. 4. Image of the use of distributed processing.

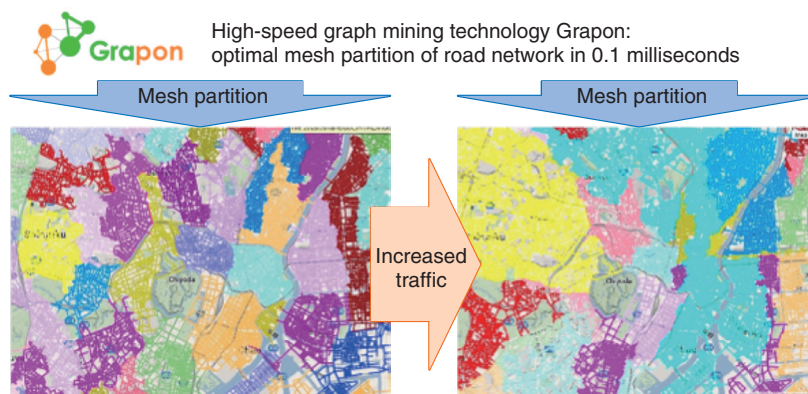


Fig. 5. Illustration of the application of equal granularity clustering technology.

result, the average speed of vehicles moving within the target area was increased, traffic congestion was reduced, and it was confirmed that the average bus service time for target bus routes was improved on average by 7% and up to 27%.

In 2015, NTT DATA cooperated with Guiyang City in China to develop technology that successfully mitigates traffic congestion by performing traffic congestion predictions and stoplight control simulations based on the data analysis results of cameras installed in Guiyang City used for managing traffic. This effort was done in collaboration with the Insti-

tute of Software, Chinese Academy of Sciences and was conducted as a horizontal deployment of know-how obtained from the verification tests conducted in Jilin City.

Initiatives promoting the practical use of traffic congestion mitigation solutions in combination with traffic simulation and stoplight control technology are progressing within NTT DATA in an effort towards successfully managing major events in 2020 and realizing smart cities in countries around the world.

5. Future development

This article introduced three important domains where AI technology is being utilized at NTT DATA, related utilization examples, and various types of AI technology applied in each of those cases. In order to broaden the utilization of AI technology within these important domains in the future, it will be essential for AI technology itself to further progress. We at NTT DATA will endeavor to strengthen our alliances with NTT R&D laboratories and other business firms as well as leading-edge research organizations such

as universities to develop an assortment of AI technologies with great potential in order to deal with social problems such as decreasing birthrates and aging populations, and to provide global support for disaster prevention and other situations.

Reference

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He received a B.A. in linguistics from the University of Tokyo in 1988 and joined NTT the same year. In 1989, he moved to NTT DATA Communications Systems Corporation (currently NTT DATA Corporation). From 1990 to 1991, he was with SRI International as a visiting researcher. His research interests include spoken dialogue systems, text mining, and AI-based decision support systems.
