COTOHA™: Artificial Intelligence that Creates the Future by Actualizing Natural Japanese Conversation

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Abstract

NTT Communications began offering the communication engine "COTOHA™" (COTOHA) in October 2016. This is a service in which interactive conversations are conducted with customers through the use of artificial intelligence (AI) technology. In the hundreds of contacts from customers since this service was launched, we have been able to understand the high expectations customers have of AI, as well as other issues that have come to the surface. Here, we introduce COTOHA and the related business opportunities and market trends we have observed since launching the service.

Keywords: artificial intelligence, natural language processing, communications

1. Introduction

The communication engine "COTOHA™" (COTOHA) is a service that achieves interactive dialogue naturally. It was created by combining Japanese language processing technology developed by NTT Media Intelligence Laboratories (MD Labs) and an inference engine developed by IPsoft[*1]. The concept of COTOHA is a human-like artificial intelligence (AI) that replaces humans in providing certain services (**Fig. 1**). Our aim was to develop an AI that can act and work like a human instead of creating an AI that simply does things humans cannot do. COTOHA can converse naturally and is also able to process simple tasks such as creating orders or making appointments.

Certain problems have become apparent in interactive AI systems developed so far. Most of them are not proficient at understanding the Japanese language, are only able to execute conversations based on the scenario, consume a huge amount of time for scenario creation, and also take a lot of time when they require tuning. However, COTOHA overcomes these problems and achieves more flexible dialogue with efficient functions in construction and operation (**Fig. 2**).

Another important feature of COTOHA is that it can solve problems that other AI systems cannot by automatically escalating the inquiry to a human operator. Therefore, it is possible to improve the outcome of a response, which cannot be achieved by either a human or AI alone, through cooperation between them and by handling what each excels at. Moreover, with COTOHA, it is possible to extend the process range when needed. After the escalation to an operator, COTOHA will accumulate real conversation data between the end user and the operator.

COTOHA can also analyze, classify, and accumulate the customer's dialogue during the sessions, understand the context, and utilize it while having a conversation with a customer in real time. In the future, we will use this powerful Japanese language analyzer to automatically analyze the knowledge

*1 IPsoft: AI technology and information technology automation management service provider.

COTOHA is a communication engine that provides appropriate responses and conducts business processing like a real human by analyzing and understanding the context and meanings of multiple sentences.

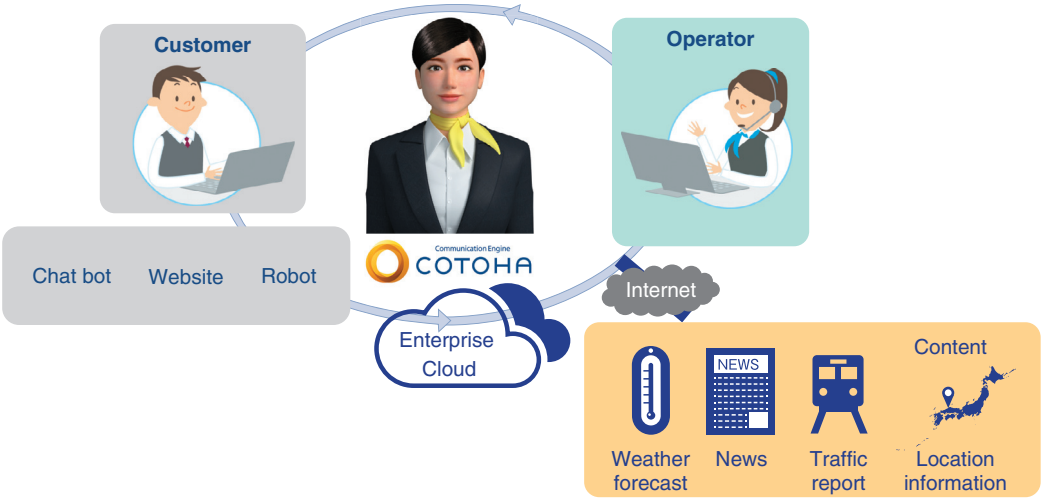

Fig. 1. What is COTOHA?

■ COTOHA's strengths are as follows:

	Previous AI	COTOHA
Accuracy	Understands keywords	1. Good understanding of Japanese • Analyzes the meaning and context • Memorizes customer data
Expression	Expression based on rules	2. Flexible communication • Understands customer's intention and asks automatically what customer doesn't mention • Answers customer's questions during conversation flow
Implementation	Necessary to set all scenarios	3. New setting style; goal matching • Adopts not only ordinary scenario settings but also new settings that don't require complex scenario setting capabilities
Maintenance	Requires a lot of time for tuning	4. Reuse escalation flow • If COTOHA can't answer a customer's question, COTOHA escalates it to an operator and memorizes the dialogue between the customer and operator.

Fig. 2. Strengths of COTOHA.

from manuals and textbooks. We also aim to completely automate the settings. Thus, the feature functions mentioned above are supported by our Japanese language processing technology.

2. Japanese language processing technology that supports COTOHA

In COTOHA, the Japanese language processing technology developed by MD Labs has been applied to understand user speech. We explain two features of the technology here: predicate-argument structure analysis and Japanese language natural sentence identity determination technology.

2.1 Predicate-argument structure analysis

The predicate-argument structure analyzer can identify the semantics of things and actions in a user's speech. For example, "Haha to yakiniku wo tabeta." (I ate Yakiniku with Mom.) and "Sarada to yakiniku wo tabeta." (I ate salad and yakiniku.). In the Japanese language, the subject is often omitted, so those sentences have no subject. However, we need to add a subject when translating them into English. From the first sentence, we know that "Haha" (Mom) and "sarada" (salad) have different roles and functions. The predicate-argument structure analysis technology can analyze the role of "taberu" (eat) as a basis predicate, "Haha" as a joint subject, and "sarada" as an object. With this technology, we can prevent incorrect utterances.

2.2 Japanese language natural sentence identity determination technology

Japanese language natural sentence identity determination technology can determine how similar two sentences are. It is mainly used in two situations in COTOHA. The first is in creating a conversation scenario. COTOHA is able to branch off scenarios according to the user's speech. However, since users tend to speak freely, it is necessary for COTOHA to determine whether or not the estimated user's speech that has been set in advance matches the actual user's speech. The other situation occurs with FAQ (frequently asked questions). By determining the similarity between a user's actual question and an anticipated question, COTOHA can identify the appropriate answer.

Both of these technologies use morphological analysis technology. Open source software has often been used recently to support this technology, but MD Labs has achieved high accuracy analysis by using a dictionary that is constantly updated by experts and a large-scale thesaurus[*2] of the Japanese lexical system that was modified independently by MD Labs.

3. Social issue in Japan and the hope for AI

COTOHA has a high-level ability to understand the Japanese language. It is also *close* to humans in that it is considerate of human feelings. At the same time, it can replace humans when performing various functions. It is therefore expected to be a solution for the declining labor force, which Japan will face in the near future. According to statistical data provided by the Ministry of Internal Affairs and Communications, 40% of Japan's population will be elderly people in 2060—44 years from now—and the working population will halve from its peak to 44.2 million [1]. Furthermore, according to the "New Industrial Structure Vision" issued by the Ministry of Economy, Trade and Industry [2], if this situation is not addressed, it is estimated that by the year 2030 the working population will decrease by 7.35 million people.

In contrast, if the labor force can be shifted to high-value added work by effectively utilizing AI and robots, the number is only expected to decrease by 1.61 million, and Japan's gross domestic product is estimated to increase to 222 trillion yen. Approximately 49% of the Japanese working population will be technically replaced by AI in the next 10–20 years [3]. This number is higher than 47% for the United States and 35% for the UK. The utilization of AI and robotics is expected to be an important factor in fostering the growth and prosperity of Japan by changing the way we work, replacing routine tasks, and increasing productivity.

However, AI is not *God-like* or almighty in its capabilities. In a narrow sense, areas replaced by AI will be different depending on the technology making up that AI. For instance, as introduced in the previous section on technology that supports COTOHA, in order to realize a chat bot, technology and/or functions such as deep learning, a similarity engine, a semantic analyzer, parsing, and various others need to be combined. However, there are only a few products that use all of the mentioned technologies. That is why customers must identify which method or technology they want to use in order to improve the

*2 Thesaurus: A reference work that lists words grouped together according to similarity of meaning (containing synonyms and sometimes antonyms).

efficiency of the current conversation and work process.

In a broad sense, it is impossible to leave the entire process to AI itself. There are still areas that humans are good at but that are difficult for AI, for example, the ability to sympathize with others, judge moral values, and understand irregular or unexpected scenarios. Thus, the task is not to replace everything with AI but identifying which areas need to be handled by AI, and which areas still need to be handled by humans. By creating synergies and approaching this task in a complex manner, we can achieve positive effects such as higher efficiency and improved customer satisfaction.

4. Opportunity for chat bot business

Some leading industry players such as Google, Apple, and Microsoft are also working to develop chat bots and conversational platforms. This has resulted in innovative new services for consumers such as messaging applications and SNS (social networking service) chat platforms, which are spreading as a new medium for information acquisition and communication interfaces with companies and services. The interface becomes a conversation, and everyone can easily use it; consequently, the added value of technologies and systems that were not widely used until now can finally come to light.

Such conversational exchanges can be a major factor in evaluating the value of a service. For instance, Domino's Pizza Japan launched an ordering system on LINE*3 (an SNS) using a chat bot, and they have steadily and significantly increased their sales through LINE, reaching 100 million yen in sales in 4 months and 200 million yen in 7 months [4].

Chat systems have become a third channel after telephone and the Internet, and their operation is becoming increasingly easier to use. This is expected to reduce the load on ordering systems—such as those used by Domino's and other companies—as the acceptance of this new technology increases. It is considered that services such as e-commerce, news searching, and customer support, in which users must be able to handle a certain degree of operability on a website, will soon be converted to chat bot systems in accordance with the necessity of the service.

Communication between chat bots and users can be a new hope for marketing utilization. Since one-way communication has mostly been used in online marketing so far, there have been only a handful of opportunities to get honest responses from users. Chat bots that can conduct conversations with hundreds or even thousands of users at once will be able to compile conversation logs. Although chat bots can only answer questions, the service provider will be able to obtain valuable data such as recordings of live voices that will convey information such as user reactions that service providers have not been able to estimate so far. This is expected to improve the quality of chat bot conversations and to improve the usage in various situations such as determining the potential needs of users and improving services.

Various tools are available to develop chat bots today, but the chat bots typically have limited capabilities. For example, they are confined to a certain fixed conversation, they exit the conversation unnaturally, they are only able to answer general questions, and most of them do not have any developed personality. To increase the utilization of chat bots and the number of users in the future, it is important to have a personalized chat bot that can answer complicated questions while drawing out the user's individual intentions. We will most likely require specialty chat bots for different fields, with another chat bot serving as a *hub* among them. The important elements to achieve this are the abilities to carry out natural conversation and to understand speech. As previously mentioned, we have steadily been improving the Japanese language accuracy and the inference function in chat bots.

To achieve a more sophisticated level of conversation and the necessary information and tools, we will continue to approach AI—which will continue to expand around COTOHA—by focusing on communication.

*3 LINE is a registered trademark of LINE Corporation.

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