Technology Reports

Translation Application with a View to 2020: Tegaki Hon'yaku

NTT DOCOMO has come to provide translation applications for smartphones for use in a variety of scenarios as consumer-oriented translation services. These began with Hanashite Hon'yaku®*1 (speech recognition translation) in 2012 and continued with Mail Hon'yaku®*2 (text translation) and Utsushite Hon'yaku (recognition and translation of camera-captured characters). This article describes NTT DOCOMO's translation services with a focus on the new Tegaki Hon'yaku®*3 (handwriting translation) service.

Communication Device Development Department

Shin Oguri
Yoshinori Ikehata
Masayoshi Shiota
Misa Tanaka

1. Introduction

Thanks to a weak yen and easing of visa requirements for visitors to Japan as well as an expansion of international airline routes in the Asia region, it appears that the initial target of "20 million foreign tourists by 2020" set by the Japanese government will be reached earlier than expected. New targets have therefore been set in the form of "40 million visitors by 2020 and 60 million visitors by 2030" [1]. Consequently, to provide hospitable services to foreign tourists who are rapidly increasing in number, the need is growing for translation services that can overcome the language barrier and promote communication.

Against the above background, NTT DOCOMO has come to provide smartphone-based translation applications that can be used in a variety of scenarios as translation services for consumers. These began with the release of Hanashite Hon'yaku in 2012, which was followed by the launching of Mail Hon'yaku, Utsushite Hon'yaku, and Jspeak®*4.

There is also "Hanashite Hon'yaku for Biz" that NTT DOCOMO provides as a service for Japanese businesses to support reception of foreign visitors. This article describes NTT DOCOMO's translation services with a focus on a new addition to these services called "Tegaki Hon'yaku" (handwriting translation).

2. Comprehensive View of Translation Applications

2.1 Overview of Translation Applications

NTT DOCOMO's translation applications use four means of input depending on the service: speaking, typing (by keyboard), writing, and camera capture. They also employ a variety of NTT DOCOMO assets*5 (**Figure 1**). Speech recognition and translation technologies are typical of NTT DOCOMO assets used

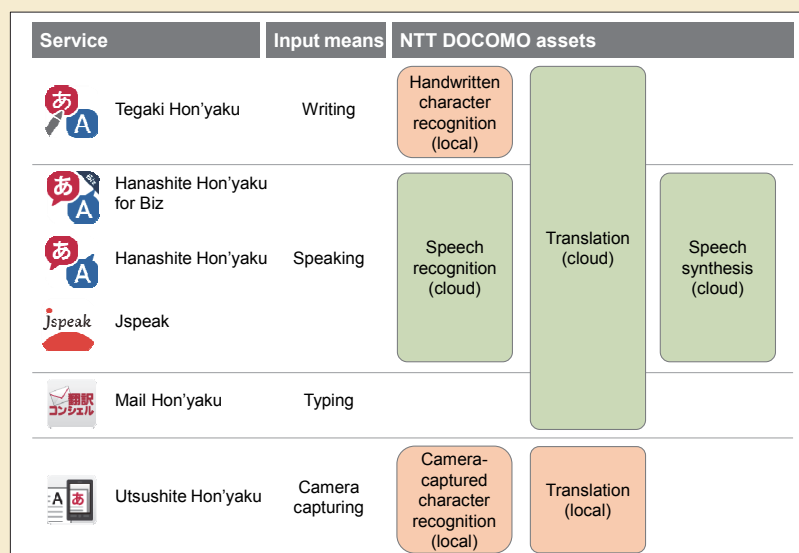| Service		Input means	NTT DOCOMO assets			
あ A	Tegaki Hon'yaku	Writing	Handwritten character recognition (local)	Translation (cloud)		
あ A	Hanashite Hon'yaku for Biz	Speaking	Speech recognition (cloud)		Speech synthesis (cloud)	
あ A	Hanashite Hon'yaku					
Jspeak	Jspeak					
翻訳 コンシェル	Mail Hon'yaku	Typing				
A あ	Utsushite Hon'yaku	Camera capturing	Camera-captured character recognition (local)	Translation (local)		

Figure 1　Translation applications and NTT DOCOMO assets

for translation. The recognition and translation of these different forms of input data can be divided into cloud-type and local-type processing. Cloud-type processing provides server-based functions via packet communications and excels in vocabulary size. Local-type processing, on the other hand, provides functions via the smartphone application only, which means no need for packet communications and fast response times. NTT DOCOMO selects either cloud-type or local-type processing for a translation service depending on the features and characteristics of that service. The architecture adopted for implementing these translation services is shown in **Figure 2**. This architecture deploys engines appropriate for each application and language while each service uses whichever engines it needs to function.

2.2　Overview of Each Translation Service

The following presents an overview of each translation service. A screen shot of each translation application is shown in **Figure 3**. A detailed explanation of Tegaki Hon'yaku (handwriting translation) is provided later.

1) For Consumers

　(1) Hanashite Hon'yaku

　　Hanashite Hon'yaku is an application that translates a conversation into each party's language via a smartphone. It is equipped with a "speech translation function" for translating a face-to-face conversation using one smartphone and a "phone-call translation function" for translating a call with a person located elsewhere.

　(2) Jspeak

　　Targeting overseas visitors to Japan, Jspeak provides total support for a wide range of activities related to a Japan visit. The application is equipped with an information-provision function to help visitors learn more about the attractive features of Japan through coupons and information on tourist attractions, popular stores, etc. It also incorporates a communication-support function featuring speech translation and a convenient phrase book. It implements the speech translation function using Hanashite Hon'yaku technology and provides a large collection of phrases.

　(3) Mail Hon'yaku

　　The Mail Hon'yaku application helps to smooth out e-mail exchanges with a person writing in a different language through translation functions for creating and receiving mail.
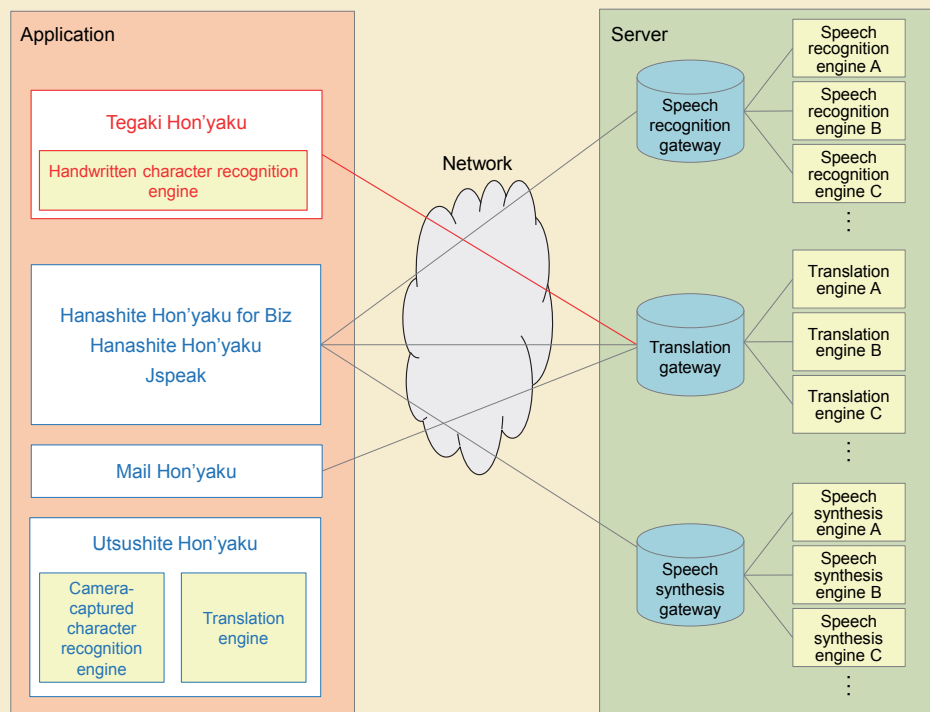
Figure 2   Architecture of translation services

Hanashite Hon'yaku

Jspeak

Mail Hon'yaku

Hanashite Hon'yaku for Biz

Utsushite Hon'yaku

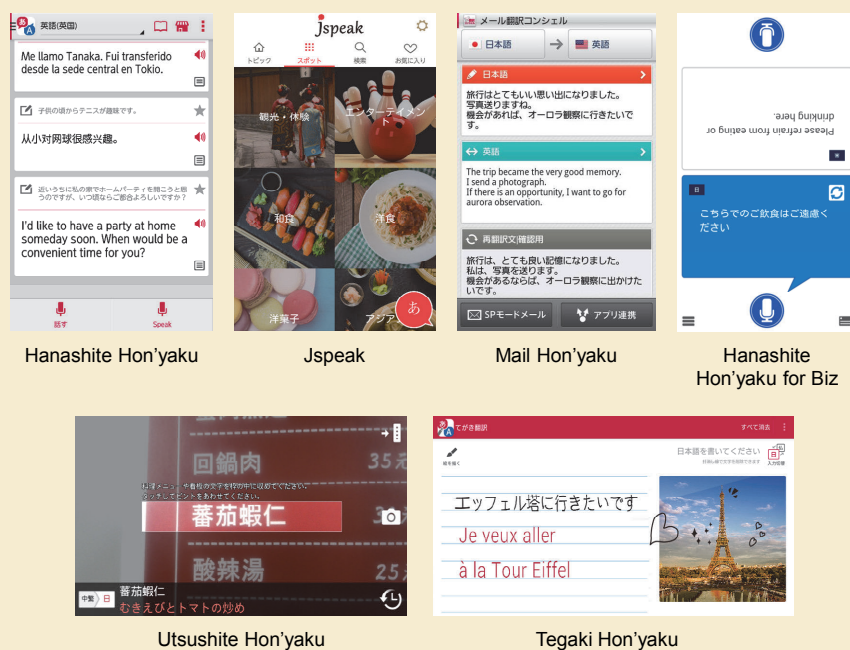Tegaki Hon'yaku

Figure 3   Screenshot of each translation application

Its User Interface (UI) assumes linking with other applications and features enhanced linking with docomo mail in particular.

(4) Utsushite Hon'yaku

This application provides real-time display of translation results when a picture taken by the smartphone's camera includes characters representing a place name, an item from a restaurant menu, etc. Translation is performed by a camera-captured character recognition engine and translation engine incorporated in the application itself. This enables the user to use a translation function without having to use packet communications.

2) For Business (Hanashite Hon'yaku for Biz)

Hanashite Hon'yaku for Biz targets airports and railroad companies in the transportation industry and hotels and inns in the lodging industry as well as restaurants, retail establishments, etc. as an application supporting the reception of foreign visitors to Japan [2].

This application integrates a speech translation function based on consumer-oriented Hanashite Hon'yaku technology, a collection of phrases having a high frequency of use in reception settings, and a video calling function for connecting with a bilingual operator to deal with more complicated conversations.

Trials were performed repeatedly with companies in various industries to make the application easy to use by receptionists and easy to understand by customers. As a result, the application was designed to support not only over-the-counter reception scenarios but also joint viewing of a screen by the receptionist and customer. Hanashite Hon'yaku for Biz supports ten languages: English, Chinese, Korean, Italian, French, Portuguese, German, Spanish, Thai, and Indonesian.

NTT DOCOMO is putting a great deal of effort in spoken-language translation assuming diverse usage scenarios including Hanashite Hon'yaku for Biz. It is in the process of developing technologies and services applicable to meeting minutes and SNS postings where translation needs are high [3].

3. Tegaki Hon'yaku

3.1 Overview of Tegaki Hon'yaku

Tegaki Hon'yaku is an application for translating handwritten text. It currently supports six languages: English, Chinese (Mandarin), Chinese (Taiwanese), Korean, French, and Spanish. It achieves recognition of handwritten text by a built-in recognition engine that analyzes the locus and speed of a pen tip moving on the screen and converts the results of that analysis to character data.

The application is also equipped with a drawing function as a complement to the handwriting translation function. This function can be used, for example, to draw a map on a smartphone screen when giving directions to a foreign visitor. If the user then handwrites words on top of that map, the application will translate and display those words in the visitor's language in real time.

An example of such a text conversion is shown in **Figure 4**. This example shows Japanese words written on a map drawn with the drawing function and the translation of those words into English.

In this way, it becomes easy to communicate something that may be difficult to convey by words only.

3.2 Background to Development of Tegaki Hon'yaku

1) Issues with Hanashite Hon'yaku

The following two issues came to light when attempting to analyze a customer's voice with the previously launched Hanashite Hon'yaku application.

(1) Speech translation could not be used in a noisy environment that made conversation difficult.

(2) Asking foreign visitors with no experience in using a translation service to talk into a smartphone or tablet was a high hurdle to overcome.

2) Solutions

Tegaki Hon'yaku was developed to resolve these issues using the following two methods.

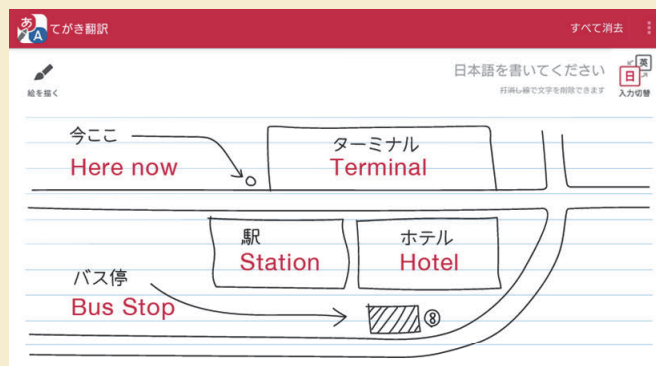• For issue (1): Change the input method from speech to handwriting to eliminate the effects

Figure 4　Example of handwriting translation

of noisy environments.

- For issue (2): Make use of everyone's experience of communicating by handwritten text to make it easy to use a translation application even for users resistant to talking into a smartphone.

During initial studies for this application, we were particularly aware of the need for a UI that would preserve the natural act of "handwriting" and support communication in the form of writing characters on a guidebook or map to ask or give directions. Furthermore, in the trial period, we wanted even customers with no opportunity to take an overseas trip to experience Tegaki Hon'yaku. We therefore asked subjects to try a version of the application equipped with a function for translating handwritten text into a regional dialect and received a good evaluation (the commercial version does not support such a dialect function).

3.3　Translation-range Judging Logic

The initial version of the application had no function for automatically judging the translation range of sentences written on the screen. As a result, translation errors would sometimes occur when continuing a sentence that could not fit on the screen onto another line or when writing two sentences on the same line. We therefore equipped the application with translation-range judging logic that uses the coordinates of handwritten text to decide whether to translate that text as one sentence or multiple sentences (**Figure 5**). The process flow of this logic is as follows.

(1) Determine whether handwritten text is on one line or multiple lines.

(2) If on one line, compare each character with the one to its immediate right in order from left to right and use the interval between two such characters to

judge whether the handwritten text consists of one sentence or multiple sentences. Here, H in Fig. 5 (a) is the distance between the bottom edge and top edge of adjacent characters, while W is the distance between the right end and left end of adjacent character strings.

(3) If on multiple lines, compare the coordinates of characters on the first line with those on the second line to judge whether the handwritten text consists of one sentence or multiple sentences. Here, H in Fig. 5 (b) is the distance between the bottom edge of the characters on the first line and the top edge of the characters on the second line, while W is the distance between the right end of the character string on the first line and the left end of the character string on the second line.
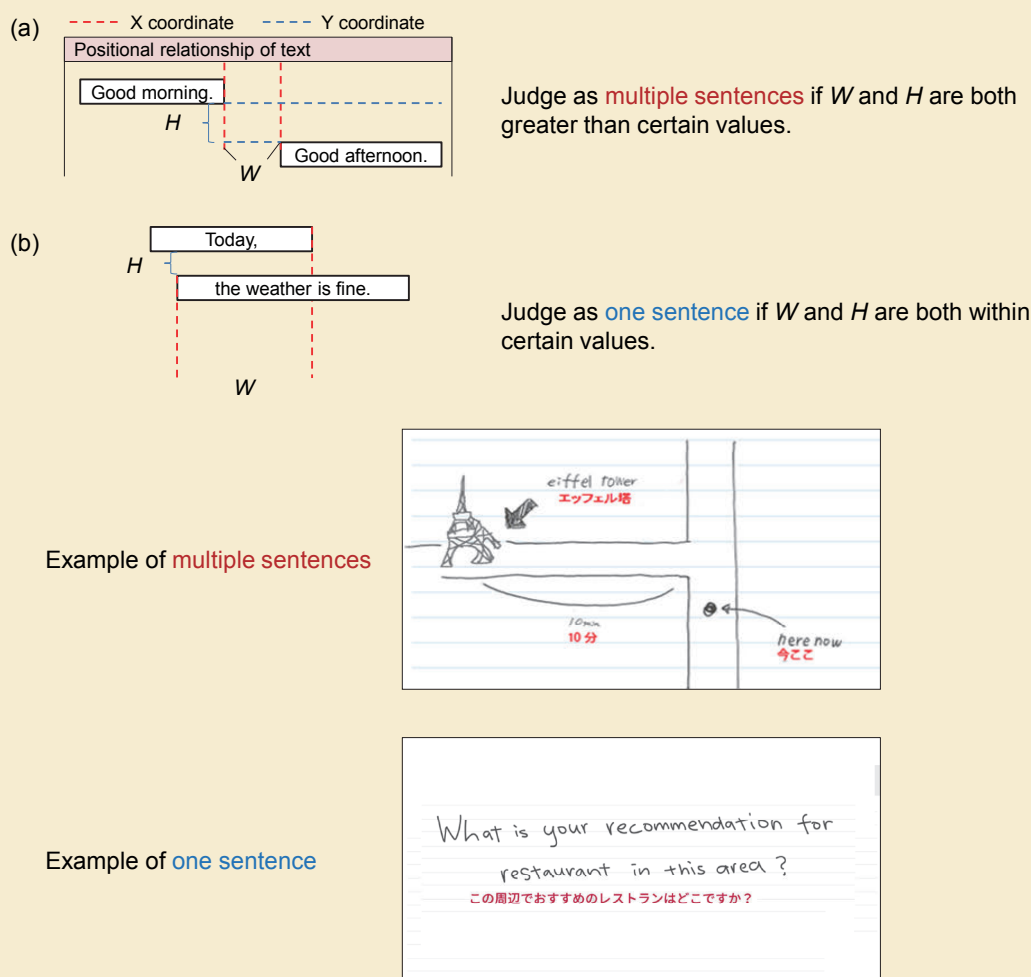
(a)
- - - - X coordinate   - - - - Y coordinate

Positional relationship of text

Good morning.

H

W

Good afternoon.

Judge as multiple sentences if *W* and *H* are both greater than certain values.

(b)

Today,

H

the weather is fine.

W

Judge as one sentence if *W* and *H* are both within certain values.

Example of multiple sentences

Example of one sentence

Figure 5　Judging translation range

4. Tegaki Hon'yaku Trials

4.1 Tokyo International Air Terminal Corporation

1) Experiment Overview

In cooperation with Tokyo International Air Terminal Corporation, NTT DOCOMO introduced Tegaki Hon'yaku at information counters manned by guides and concierges inside the Haneda Airport International Passenger Terminal and launched a trial in September 2015 with the aim of enhancing the assistance given to foreign visitors [4].

In this trial, Tegaki Hon'yaku was used to help foreign visitors who had just arrived in Japan and were unsure of how to proceed. For example, it could be used to draw maps and give directions to where one would be staying or information on airport facilities. The trial also included interviews with guides and concierges to hear about their impressions of using the Tegaki Hon'yaku application.

2) Issues Uncovered by Experiment

The results of the experiment showed that Tegaki Hon'yaku could be an effective means of communication even in noisy environments or places where verbal communication is difficult. However, they also revealed that the time taken up by handwriting on a screen

and translating that input could sometimes be unacceptably long relative to the reception speed required for handing many inquiries at an information counter.

3) Improvement Measures

To resolve the above issues, the application was equipped with a "point-to-it phrase book," which facilitates communication by displaying frequently used phrases that can be pointed at to convey intent, a "suggest function" that can call up fixed phrases from a single handwritten word, and a function for linking to Hanashite Hon'yaku for Biz that can provide machine translation of speech and access to and interpretation by a human operator.

These functions can be used as needed by a receptionist according to the current situation. For example, the "point-to-it phrase book" can be used to provide a quick response when dealing with a foreign visitor for the first time, "writing" by Tegaki Hon'yaku can be used when solving a problem by the "point-to-it phrase book" is difficult, and "speaking" by Hanashite Hon'yaku for Biz can be used to enable verbal communication (**Figure 6**).

We also added a screen rotation function to facilitate communication and changed to a UI that can smoothly request re-input when the intention of the sentence to be translated cannot be understood.

4.2 Tokio Marine & Nichido Fire Insurance Co., Ltd.

A trial use of Tegaki Hon'yaku was performed at the Kaijo Building Clinic of the Tokio Marine & Nichido Fire In-

surance Co., Ltd to receive visiting and resident foreigners and process their applications for medical interviews [5].

In this trial, we assessed the application in conjunction with business needs of the Kaijo Building Clinic. Specifically, we evaluated the translation performance of terms and sentences actually used in clinic settings and used the results obtained for developing the application further.

5. Conclusion

This article described NTT DOCOMO translation applications with a focus on Tegaki Hon'yaku (handwriting translation). With a view to 2020, NTT DOCOMO plans to improve the accuracy of these applications and increase the number of supported languages with the aim of providing translation services of even
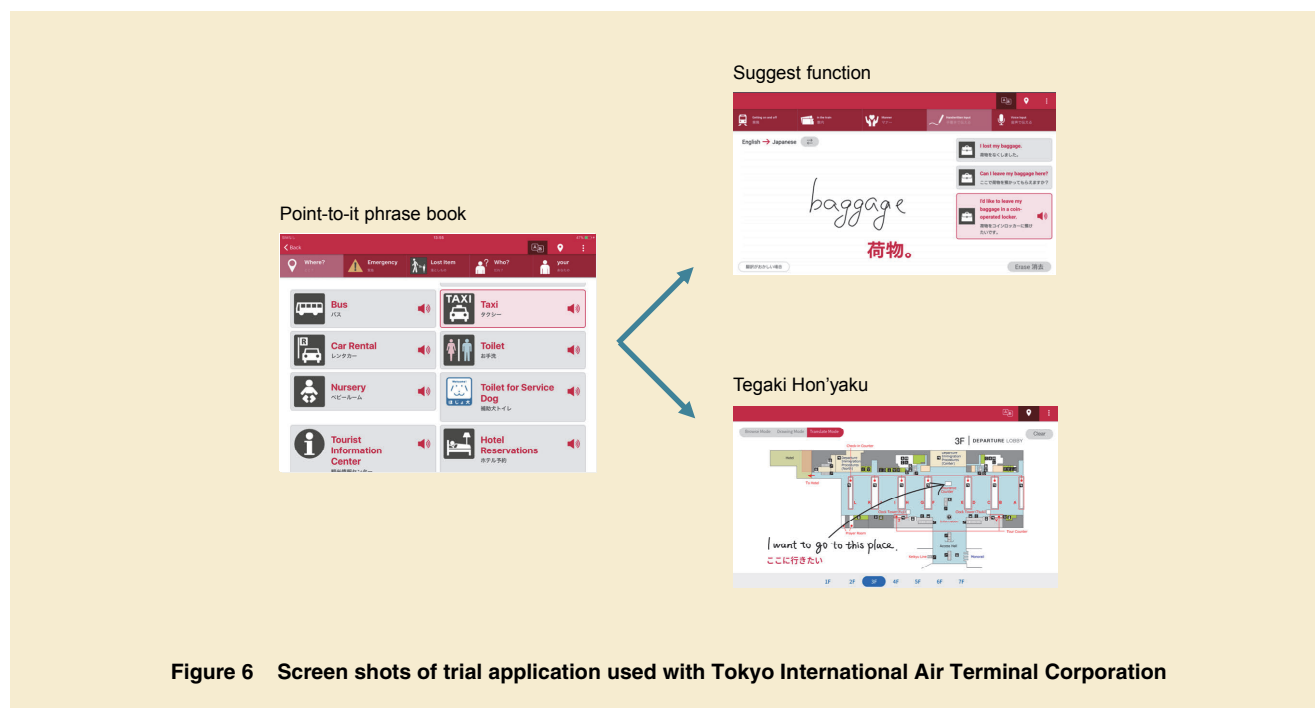

Figure 6   Screen shots of trial application used with Tokyo International Air Terminal Corporation

higher value for its customers.

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