

Experimental Release of “Japan Map in Multilingual Notation” Using Vector Tile Data

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Abstract

The Geospatial Information Authority of Japan-(GSI) defined the “Notation Rules of Geographical Names, etc. in English” and compiled geographical names and other data in English notation based on these Rules in 29 March 2016 for multilingual notation of geospatial information. In March 2019, GSI released on a trial basis a web map (“map in English notation”) using annotation vector tiles in which data in English notations are stored. Then, GSI configured a program for automatically converting annotations in different languages (French, Korean, simplified Chinese, traditional Chinese and Romanized Japanese) and displaying the results on the web browser. Finally, GSI published in 14 February 2020 a web map named “Japan Map in Multilingual Notation” implementing the program on a trial basis. This report describes our approach until the experimental release of the multilingual maps.

1. Introduction

Recently, facing a steep increase in number of people from foreign countries visiting Japan (Figure 1), administrative organizations and public transport have been promoting the multilingualization of their information and guidance materials, as part of creating environment for foreign visitors to travel smoothly and comfortably.

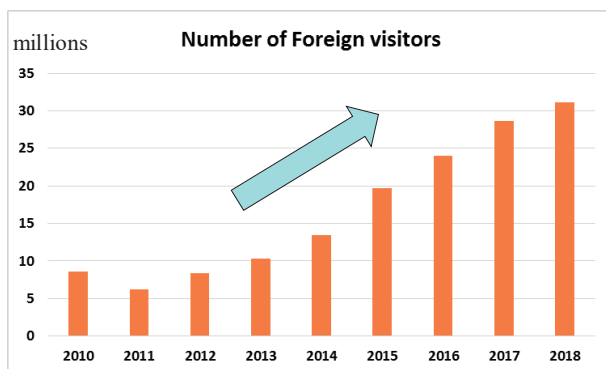


Fig.1 Numerical Trend of Visitors to Japan (source: Visitor Arrivals, Japan National Tourism Organization)

Maps are indispensable tools for tourists to travel smoothly along their itinerary, and so it is important to produce easy-to-understand maps for foreign tourists. Thus, GSI defined in 29 March 2016 the “Notation Rules of Geographical Names, etc. in English” (GSI, 2016b), which describes the processes for converting Japanese geographical names and other data into English notations and selected a set

of map symbols for people from foreign countries (GSI, 2016a).

We decided first to compile geographical names and other data in English notation in application of these rules and the new symbols set and then developed a web map in English notation. Moreover, based on the English-notation geographical name data and the existing Japanese-notation data, we have established a system for automatically converting notation for displaying them on the web browser, and it has been decided to expand into the following languages: French, Korean, simplified Chinese, traditional Chinese and Romanized Japanese.

2. Developing “map in English notation”


















2.1 Compilation of data related to English notation and map symbols

The English notation data was basically produced in accordance with the Notation Rules of Geographical Names, etc. in English. Administration names (prefecture, city, village, etc.), residential geographical names (*oaza* as a Japanese village section, etc.), and geographical names of natural features (mountain, river, etc.) were converted to English based on the rule. In the case of the names of public facility, when there are English names which are usually used by their administrators, that names were adopted. About the name of rivers, we contacted the competent authorities for river-related matters, including the Water and Disaster Management

Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), prefectural governments and municipalities to know their exact names. Moreover, we have been consulting with the Road Bureau of MLIT to avoid inconsistencies between the newly compiled data in English notation and their English notations on the road signs.

The data on geographic coordinates and other required data (e.g., category) were rearranged based on the “Digital Japan Basic Map (map information)” so that map symbols can correctly be displayed. Map symbols adopted in “map in English notation” are as follows. There are eight kinds of map symbols for people from foreign countries (GSI, 2016a): post office, police box, shrine, museum, hospital/infirmarary, hot spring, station and airport) and same several symbols as displayed on the GSI maps: prefectural office, city hall and national highway number (Table 1).

Table.1 Symbols adopted for "map in English notation"

Legend	
Symbol	Type
	Post Office
	Koban (Police Box)
	Shrine
	Museum
	Hospital
	Onsen (Hot Spring etc.)
	Station
	Airport
	Temple (The symbol derived from Buddhism)
	Prefectural Office
	Subprefectural Bureau Office
	City Hall
	Municipality Office
	National Highway Number
	Urban Expressway Number
	Expressway Number
	Michi-no-Eki (Roadside Rest Area)

2.2 Annotation Vector tiles

We compiled the data such as geographical names in English notation as annotation vector tiles in the GeoJSON format. Unlike image tiles, vector tiles are in machine-readable format and allow for an automatic conversion process of a program using stored attribute information. This

means that a multilingual map can easily be implemented even in not individually covered languages through automatic conversion of the annotation vector tiles which store the covered language as an attribute in accordance with definite conversion rules.

In preparation for implementing a multilingual map based on automatic conversion after releasing the “map in English notation”, we created fields for storing attributes of English notation, Japanese *kanji* notation and Japanese oral pronunciation in the specifications for annotation vector tiles. We also created fields for storing geographical names of natural features and residential geographical names for which Romanized Japanese notation data already exist.

Moreover, information for displaying map symbols were stored in the vector tiles.

2.3 Background tiles

Background tiles are required for displaying annotation vector tiles as a web map. Presently, four types of image tiles are available as base maps for GSI Maps: standard map, pale colour maps, outline maps and English maps. But every background tile contains annotations such as those about administrative names. If these background tiles are used as background for annotation vector tiles, the annotations of background tiles may overlap with those of annotation vector tile on the display. High-density brown contours on the background tiles will make it difficult to see the annotations of annotation vector tiles. Therefore, to ensure legibility of the annotation, we created new background tiles from pale colour map which do not interfere with the colour tone of annotation vector tiles and from which annotations and contours have been deleted. Moreover, these resulting tiles were combined with the appropriate shaded-relief maps which had already been released on GSI Maps to render the land features.

2.4 Experimental release of “map in English notation”

In March 2019, we released the “map in English notation” on a trial basis, using the annotation vector tiles storing the compiled English notation data on geographical names and other information and the newly created background tiles (Figure 2). The source codes of GSI Maps were used for developing the “map in English notation”. The superimposed information (such as aerial photos) displayed

on the GSI Maps was omitted to make it easier to use for visitors from foreign countries.



Fig.2 An example of “map in English notation”

3. Developing “Japan Map in Multilingual Notation”

3.1 Selecting languages to be displayed

As an extension version of the experimentally released “map in English notation”, we developed a web map called “Japan Map in Multilingual Notation” to serve more visitors from various regions of the world.

To create a map database with multilingual notations, the data could ideally be compiled by individually translating data in Japanese into every single language like in the case of creating “maps in English notation”. However, to make the development tasks more efficient, we decided to adopt the scheme of automatically converting data in English notation, data in Japanese notation, and data in Japanese oral pronunciation into data in other languages with a program running with the browser. Thus, it should be noted here that the resulting data may not always correspond to those created by individual translations into English.

The target languages were Korean, simplified Chinese, traditional Chinese in view of the majority of visitors to Japan, and French as the primary official language of the Olympic Games. According to 2019 Statistics compiled by the Japan National Tourism Organization show that tourists speaking/reading English, French, Korean or Chinese (simplified/traditional) as mother languages or national official languages who visited Japan in 2019 account for approximately 85 percent of all the visitors.

As an international framework for standardization of

geographical names, a resolution was adopted at the first session held in 1967 of the United Nations Conference on the Standardization of Geographical Names (UNCSGN) (currently “United Nations Group of Experts on Geographical Names” [UNGEGN]). The resolution recommended that each member nation should create and revise as required its national gazetteer, standardize its geographical name notations, and agree on establishment of a single Romanized Japanese notation system for geographical names for international use. In response to such resolutions, the government of Japan has published the “Gazetteer of Japan” and the “Toponymic guidelines for map editors and other editors, third edition” (2007). In line with this movement, we decided to include geographical names in Romanized Japanese notation in the multilingual map database.

3.2 Conversion rules for languages

3.2.1 Overview of conversion rules

First, we defined conversion rules for automatic conversion using a program. The rules were defined for the automatic conversion in directions from English notations into French and Romanized Japanese notations, from Japanese notations into simplified and traditional Chinese notations, and from Japanese notations and pronunciation into Korean notations. The rules follow the steps shown below. First, a geographical name in English notation, in Japanese notation or in Japanese phonetic character is divided into a “proper noun” term and a “general noun” term (e.g., the name of “*Fuji San*” (Mount Fuji) is divided into “*Fuji*” and “*San*” [Mount]). Then, the transcription for the “proper noun” term was combined with the result of conversion of the “general noun” term obtained under the conversion rules. However, the conversion rules for Korean language were defined in such a manner. First, a geographical name composed of a proper noun term of single *kanji* character and a general noun term such as “*San*” (means mountain), “*Kawa*” (river) or “*Ko*” (lake) is not divided into two terms but is transcribed as a whole name. Then, their resulting name in Korean notation is followed by a term translated the general noun term to Korean.

Under the entire conversion rules for the different languages, names of building and names indicating land use were excluded from the policies of multilingual representations since they are composed of a proper noun

term and an extremely wide range of general nouns.

3.2.2 Conversion rules for French notation

We defined rules on the conversion of names in English notation described in the “Notation Rules of Geographical Names, etc. in English” into French notation. In the French language, names of topographic feature and names of public facility (e.g., railway station) are always composed of a general noun term followed by a proper noun term, unlike in English. So, the rules were defined that their general noun term is located at the top of their names.

3.2.3 Conversion rules for Korean notation

We collated the English notation system described in “Toponymic Guidelines for Map and Other Editors for International Use, Second Edition” (“Guidelines for Korean Language Notations”) (National Geographic Information Institute [in Korea], 2015) with the correspondence table for English and Japanese notations shown in the Notation Rules of Geographical Names, etc. in English and defined the rules for converting the general noun term of a Japanese geographical name (oral pronunciation) into that of Korean geographical name. For the proper noun term of geographical name, we defined the conversion rules based on the “Foreign Language Notation System” (published by National Institute of Korean Language).

The Guidelines for Korean Language Notations describes the English notation system for Korean geographical names. It was accessible as of March 2019, but no longer accessible through the link as of March 6, 2020. Our list of references contains the link which was valid as of the date of the data acquisition.

3.2.4 Conversion rules for simplified Chinese notation

We defined the rules for converting Japanese notation into simplified Chinese notation based on a draft version of the “Transformation guidelines of geographical names from foreign language into Chinese – Part 10: Japanese” (Zhongguo Diming Yanjiusuo; institute of geographical name, a national organization of the People's Republic of China, as of 2018) (“Guidelines for Chinese Language Notations”) and the “Kanconvit”, a correspondence table for Japanese *Kanji* and simplified Chinese characters (Yamashita, 2009).

The conversion rules based on the Kanconvit was applied for converting names in Japanese *kanji* notation into simplified Chinese. We adopted the rule of not converting *kanji* characters originated in ancient Japan which have no corresponding characters in Chinese.

As for *hiragana* and *katakana* (types of Japanese language characters) notations of administrative name, we researched the official websites of the appropriate municipalities and geographical names in the surrounding areas. When *kanji* notations corresponding to such *hiragana* and *katakana* notations were found, they were converted into the corresponding simplified Chinese characters in accordance with the conversion rules.

-An example of conversion into simplified Chinese notation-
Tsukuba Shi (Tsukuba city); “つくば市” (the original *hiragana* notation in Japanese) → “筑波市” (in Japanese *kanji* notation) → “筑波市” (in simplified Chinese notation, same as Japanese *kanji* notation)

Uruma Shi (Uruma city “うるま市”), the name of city in Okinawa Prefecture, has no corresponding Japanese *kanji* character. So we converted in accordance with the rule for substituting simplified Chinese characters for *hiragana* in Japanese notation, using the simplified Chinese substitution table for Japanese pronunciations in the “Guidelines for Chinese Language Notations”.

The same conversion rule as for *Uruma Shi* was applied to *hiragana* or *katakana* notations of names other than those of administration.

We designed the program in such a manner that the simplified Chinese characters obtained in this rule are highlighted with an underline to be differentiated from the simplified Chinese characters converted from Japanese *kanji* characters.

3.2.5 Conversion rules for traditional Chinese notation

We created the rules for converting Japanese notation into traditional Chinese notation based on the Guidelines for Chinese Language Notations, as in case of simplified Chinese, and the “Traditional/Simplified Chinese and Japanese *Kanji* Correspondence Table” (Sato, 2007) (“Traditional Chinese Correspondence Table”). The Guidelines for Chinese Language Notations were originally designed for converting Japanese characters into simplified Chinese characters, but we

defined the conversion rules for traditional Chinese notation by combining the Guidelines with the Traditional Chinese Correspondence Table. The same rules as for simplified Chinese were applied to the handling of *hiragana* and *katakana* notations.

3.2.6 Conversion rules for Romanized Japanese notation

We established rules for converting English noun names into Romanized Japanese using the “Geospatial Information Authority of Japan’s Regulations for Romanized Japanese Notation” (GSI 1984, revised 2004). The rules allow spaces between proper noun terms and general noun terms of a name as well as long vowel sign in Japanese “—” to be described in accordance with the regulations. Names of public facilities (e.g., railway) were subjected to the automatic conversion process under the rules. On the other hand, we used already compiled Romanized Japanese notation data for geographical names of natural feature and residential geographical names.

3.3. Implementing the rules on the web map and experimental release

The rules described in Section 3.2 were implemented as JavaScript codes on the web map. Annotations in French, Korean, simplified Chinese, traditional Chinese, and Japanese (Romanized Japanese notation) were generated in the automatic conversion process on the web browser, using the annotation vector tiles described in Section 2.2. Using this annotation combined with the existing JavaScript libraries which control the display on the map, the web map “Japan Map in Multilingual Notation” was created. Figure 3 shows a part of the JavaScript codes in which the conversion rules have been implemented. This is a code to substitute the Korean noun “산” (means mountain) for Japanese noun “yama”, “san”, “zan”, “take” and “dake” (means mountain in oral pronunciation) from among the annotations to which the planimetric feature code for “山” has been assigned.

```
GSI.GLOBALS.toKr31X = function(word, sound){
    var es = sound.substr(sound.length - 2, 2);
    var esk = “야마스안단지다케”;
    if (esk.indexOf(es) >= 0){
        esk = “산”;
    }
    else{
        es = “”;
        esk = “”;
    }
}
```

Fig.3 A part of JavaScript code

Figure 4 shows an example of the Korean sheet of the web map in multilingual notations.

Users can switch the languages on the web map by clicking the [Language] button located upper left of the web map sheet. Since the information of the selected language is specified by the parameter described in the web map’s URL, accessing the URL enables users to link to the map sheet in the notation of their desired language.

Taking advantage of machine-readable vector tiles, we implemented functions to read out geographical name and to display pop-up by clicking on the annotation or symbol on the web map (Figure 5). These functions will help foreign visitors who are a little familiar with the Japanese language to understand maps easily.



Fig.4 An example of the Korean sheet of the web map in multilingual notations

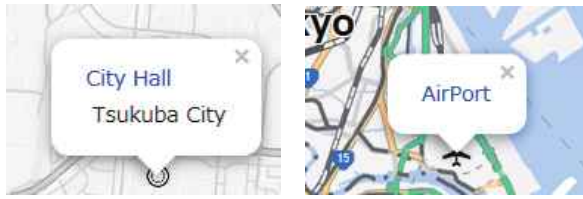


Fig.5 An example of pop-up indication
(left: type and name; right: only type)

Moreover, in simplified Chinese notation and traditional Chinese notation, we implemented a function of underlining that part when we converted from *hiragana* or *katakana* notations of names except the administrative names (Figure 6) as described in Sections 3.2.4 and 3.2.5. For example, “Tsukuba Station” (“つくば駅” [Japanese notation composed of *hiragana* and *kanji*]) is displayed in “兹库巴站” (simplified Chinese) and “茲庫巴站” (traditional Chinese).



Fig.6 Examples of underlining of terms after conversion from *kana* notations (left: simplified Chinese notation; right: traditional Chinese notation)

According to our rules, administrative name composed *kana* and *kanji* (“つくば市”) are represented in the corresponding *kanji* (e.g., “筑波市”) and then converted to simplified Chinese and traditional Chinese (e.g., “筑波市”). In the same way, railway station names composed *kana* and *kanji* (e.g., “つくば駅”), same as the administrative name should be converted to simplified Chinese and traditional Chinese (e.g., “筑波站”). But it is not realistic to assign appropriate notations on the program to many names in *hiragana* or *katakana* notations. Thus, we decided not to apply this processing rule to names other than those of administration.

One of the questions to be solved with the Japan Map in Multilingual Notation was to achieve a practical operating speed of the automatic conversion program executed before

the operation to display annotation vector tile. Thus, the operation test was carried out with the system and the set of annotation vector tiles and background tiles that were stored to an external server. As a result of the test operation, no sign or event of considerable slowdown of the operation that might cause users to feel stressed.

Following the test and the improvement, we renewed from the “map in English notation” to “Japan Map in Multilingual Notation” from following URL on February 14, 2020.

<https://www.gsi.go.jp/kihonjohochousa/multilingual.html>

Through this release, we would like to popularize the Notation Rules of Geographical Names, etc. in English and the map symbols designed for foreign visitors, and then to grasp the issues for creating maps that are more accessible to foreign visitors.

4. Conclusion

We created English notations of names on the web map in accordance with the “Notation Rules of Geographical Names, etc. in English” and map symbols for foreign visitors. We then developed a program for generating annotations-in multilingual notations through automatic conversion from annotation vector tiles and implemented it as a web map named “Japan Map in Multilingual Notation”. The application was experimentally released for tentative operation. The notations in different languages generated by automatic conversion may be not as accurate as those after separate translation in each of the languages, but we hope that they are useful for foreign visitors who are unfamiliar with the Japanese language to recognise their present location and destinations in understandable languages.

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