



3D ARCHIVING OF ARCHITECTURAL HERITAGE IN SHRINKING TOWNS CASE OF YOICHI, HOKKAIDO

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Abstract: *This study will focus on creating 3D archives of architectural heritage in Yoichi, Hokkaido. In many rural areas of Japan, population is decreasing, vacant house rate is increasing, and existing architectural heritage has become a victim of demolition. Preserving all historic buildings is impossible, but there is a chance to create 3D archives for heritage buildings before demolition. Until now, it has been common to create 2D data, but with the development of low-cost devices and technology, it has become easier to create 3D data. The 3D architectural archive has been made mainly by architectural students using low-cost devices.*

Keywords: *Yoichi, Hokkaido, shrinking towns, depopulation, vacant house rate, architectural heritage, 3D archive*

Introduction

Yoichi, a town in Hokkaido with a population of 18,000 (according to the 2020 census). The population decreased significantly by 3,258 persons or 15.3% from 2010 to 2020.

The vacancy house rate is 17.1%, higher than the national and Hokkaido averages.

[Table 1] Comparison of vacant house rate

Area	vacant house rate
Japan	13.6%
Hokkaido	13.5%
Yoichi	17.1%

Yoichi has architectural heritage buildings from the Edo period to the present, some of which are registered as important cultural properties and historic sites. Many prominent buildings were built when

the town prospered from herring fishing, but in recent years, they have been in danger of being demolished due to deterioration of buildings and the high rate of vacant houses.

The research team has been conducting a survey of architectural heritage in Yoichi Town since 2020, and has identified existing architectural heritage while conducting research on urban and architectural history.

In this study, we selected four buildings from the architectural heritage list [Table 2] that were particularly important and for which we had permission to conduct research, and attempted to create a digital archive while conducting a detailed survey of the buildings. These buildings include some that are not well known to the townspeople. By creating and visualizing an archive, we aim to make the architectural heritage widely known to the public and to communicate the situation of these buildings, which are facing the danger of demolition.

[Table 2] Overview of the selected buildings

Name of building	Constructed year	Reason for selection
Former Nisshinkan school	Early Meiji period	It was used as a school for the Aizu clan during the Meiji period (1868-1912) and still retains its original components.
Former Kon's residence	c. Taisho 8	Residence owned by a former prominent fishery entrepreneur in Yoichi Town
Former Inomata agricultural office	Mid Taisho	The only existing agricultural office and was owned by the Inomata family, a Yoichi businessman
Former Araki family's masonry warehouse	Early Showa	The only remaining masonry warehouse used for fishing.

*Meiji era: 1868-1912, Taisho era: 1912-1926, Showa era: 1926-1989

Method

In conducting the architectural heritage survey, we made measurements and drawings, interview, photography, 3D modeling by photogrammetry using drones, SLR cameras, and action cameras, 3D and 360-degree camera shooting. In particular, for the survey in Hokkaido, shooting dates were selected to avoid the snow season (October-April). In cases where it was difficult to fly a drone over densely populated areas, the exterior of the building was photographed using a long stick.

Weeds around the buildings, beehives, wild animals entering the buildings, deterioration of the buildings, and a large number of objects inside the buildings were factors that hampered the survey and these factors were avoided as much as possible.

The 3D models of the four selected buildings are shown in [Figs. 1-4]. 3D models are adequate for recording the deterioration status and characteristics of building materials because they can record the texture of the building. For example, among the buildings targeted in this study, the texture data of the masonry warehouse helped to understand the characteristics of the local stone. In addition, the 3D model

was used to accurately record the damage to the roof of the former Ima Residence, which partially collapsed due to snow in the previous season.



Left: [Fig. 1] 3D model, Former Nisshinkan school

Right: [Fig. 2] 3D model, Former Kon's residence



Left: [Fig. 3] 3D model, Former Inomata agricultural office

Right: [Fig. 4] 3D model, Former Araki family's masonry warehouse

Creating drawings from 3D models

Elevation and roof plan drawings were created from 3D models of buildings created by photogrammetry using photos from the drone. Since the building had a complex roof and was difficult to make measurements from the ground, the 3D model helped to create accurate measurements. By using the 3D model, working time at the site was significantly reduced. An example of the created drawing is shown in [Fig. 5-6].



[Fig. 5] Elevation created from a 3D model, Former Kon's residence



[Fig. 6] Elevation drawing created by tracing the 3D model, Former Kon's residence

Creating a floor plan using a 3D camera

A 3D camera was used to create a walk-through image of the building interior [Fig. 7], and the data was used to automatically generate a floor plan via the Matterport service [Fig. 8]. Although the automatically generated drawings differed in some respects from the actual space, such as the number of sliding doors not matching, we were able to create a rough drawing. When compared to the actual measured dimensions, some areas showed deviations of several centimeters, and it became clear that the drawing was not suitable for creating drawings that require millimeter-level accuracy.



[Fig. 7] interior view captured by 3D camera Former Kon's residence

[Fig. 8] automatically generated plan, Former Kon's residence

Uploading the 3D data to an online platform

The 3D models of the four selected buildings were uploaded to Comony, an online platform for architectural space. Based on the uploaded data, we verified the effectiveness and issues related to the utilization of the 3D archives [Fig. 10]. A questionnaire survey was conducted among building owners and related parties regarding the current status of preservation and utilization, the representation and reproducibility of spatial data, and the scope of information disclosure. A summary of the results is shown in [Table 3].



[Fig. 9] Comony interface showing the 3D model of the Former Araki family's masonry warehouse

[Table 3] Overview of the results of the questionnaire

1. Current status and intentions for preservation and utilization of buildings
<ul style="list-style-type: none"> - Many respondents said that it is difficult to maintain and manage the buildings due to the economic situation and lack of manpower. - The respondents were of the opinion that the historical value of each structure is generally high. All of the owners and related parties were of the opinion that the buildings should not be demolished and that they would like to continue to inherit and maintain them.
2. Reproducibility and representation of spatial data
<ul style="list-style-type: none"> - Many respondents commented that the reproduction of the buildings was very good. - Some respondents suggested that it would be better to include the surrounding plantings and monuments, as well as the historical and cultural aspects of the area in the data.
3. Information dissemination and publication of 3D archives
<ul style="list-style-type: none"> - The overall opinion was that the significance of disseminating information on the value and current status of buildings is generally high. - On the other hand, some pointed out the privacy issue of not being able to disclose drawings or other information that could identify the location of privately owned buildings.

Discussions

Demolition of architectural heritage is common not only in areas with declining populations, but also in urban areas with growing populations. In Tokyo, there are many cases of demolition at the city block level for large-scale redevelopment projects. Until now, records of architectural heritage have been created mainly by professionals in order to carry out professional duties. In the future, the rise of various

technologies will make it possible for many people to create archives, and the use of data will diversify. In the future, it will be necessary to consider how to create and publish 3D digital archives, especially with regard to privacy and copyright.

As the percentage of vacant houses in Japan increases, measures are being taken to address vacant houses, many of which are valuable as architectural heritage. It is desirable to consider how to digitally record, preserve, and make use of them.

References:

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