Title:
Represent 3D cultural identity and property identity in a city

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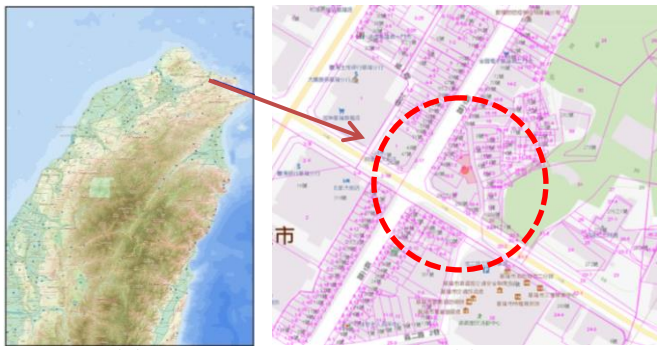
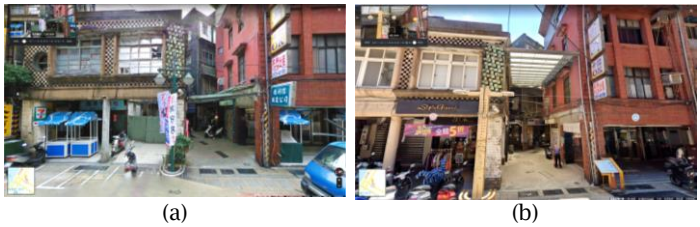
Introduction:
Keelung Port (Figure 1) was the most important sea freight center in northern Taiwan [1]. It was targeted as a container harbor for near-sea shipping and the main port for international cruises. The harbor has operated since 1863 and went through five phases of construction during the period of Japanese rule for over 44 years [2]. New constructions changed the waterfront and canals. After the main container port business was transferred to Taipei Port, landfill project started inside the harbor.



(A) (B)

Fig. 1: The location of alley on (A) Keelung, Taiwan, (B) cadastral map.

Research Goal:
This study aims to recreate a local identity by reconstructing the diversified urban fabric which fell behind regional evolvement. The study classified the diversity of local fabric by the combinations of type and configuration. One of the most diversified fabrics was located next to the landmark building at the corner of hill. A small alley was selected to exemplify the contrast made on the 2nd skin. This alley, which runs through street block diagonally, is located next to two main buildings, Tianliao River, and port front. A review of the Google® street scenes revealed the evolvement also occurred to the 2nd skins next to both entrance on either side (Figure 2). Question rose how the small alley identified itself from the old and the new cultural landscape in local area. Was any local effort involved to remodel it to be part of reactivated fabric?



(a) (b)

Fig. 2: Google® street view: (a) entrance, 2009.12; (b) entrance, 2022.08.

Related Studies:

The harbor region remained unchanged in Qing Dynasty. New urbanization process and initially developed identity represented a combinative evolving process of fabric. The streets on east and south are parallel to the coastline. The street block, which was in a module of 109 m long (60 bays) and 72.7 m wide (40 bays) [2], maximized the number of street-facing shops and the size of open space in the center. In total, there are 2,176 retail stores and 878 lodging accommodations and food services [3].

The scales of a city and an alley are interrelated. Light detection and ranging (LiDAR) studies have been conducted regarding city reconstruction [5], physical cultural heritage [6], and augmented reality (AR) applications [7-11] in real environments. Moreover, unmanned aerial vehicle (UAV) has been applied to city reconstruction [12] over a large area. The former fabric approach, which provided comparisons in different format of sections [13], can be applied to study the contrast made on the two types of scale, as a reversed study of construction [14].

Methods:

This study consists of three main tasks in recreating local identity: 3D reconstruction of fabric, historical map inspection, and AR simulation (Figure 3). Both UAV and smartphones were applied to retrieve urban data, in order to integrate a city between a small and a large scale. For the scale of a handheld device and a small alley, iPhone® was applied as a combination of the smartphone functions and LiDAR.

The reconstruction process collected data related to physical elements, such as 2D map, 3D context, and 3D virtual context. This alley was first recorded on 1907 map. It was not shown on Japanese renovation plan. Depending on the availability of GIS data, historical maps were selected in the four years of 1907, 1937, 1971, and 1974. With Google® maps, it covers near 115 years of geo-data from 1907 to 2022.

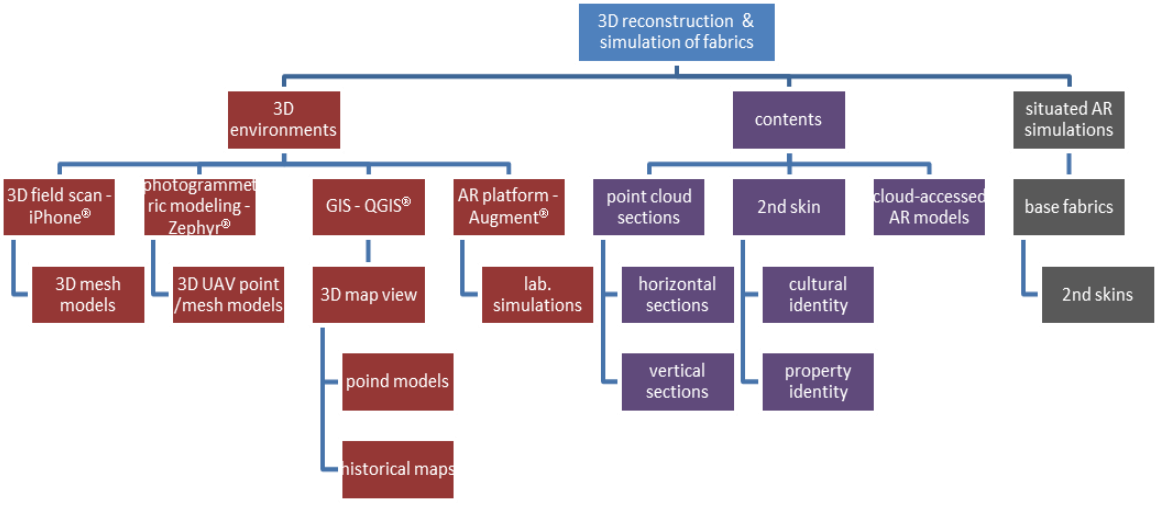


Fig. 3: 3D reconstruction and simulation of fabrics.

Existing reactivated instrumentation was examined by government intention and private response, based on the nature of properties and the highly contrasted appearance. A typical architectural approach was applied by creating sections of horizontal and vertical fabric to highlight the chronological difference over hundred years. The sections also differentiated the variations of skyline and 2nd skin of public and private properties. The difference illustrated the relative scale of change, in contrast to the current configuration. Alley, defined within these historical maps, was compared with the newly reconstructed fabric and nearby circulation infrastructure using 3D urban model created by UAV imagery (Figure 4).

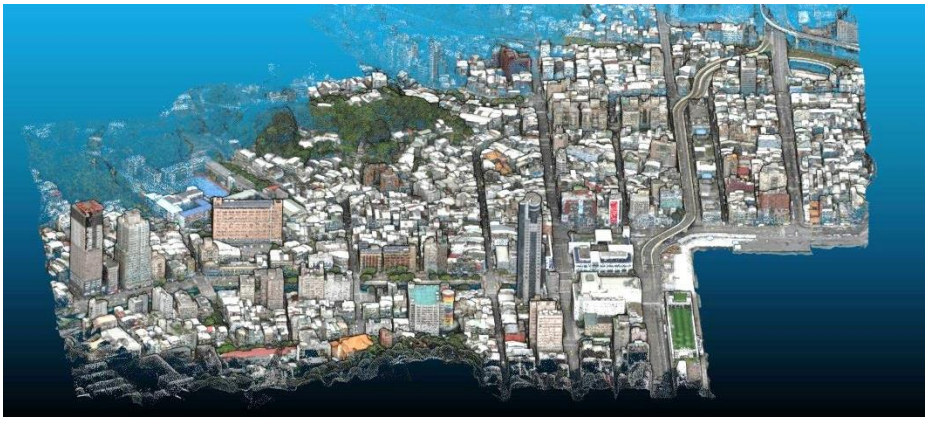


Fig. 4: 3D urban model created from UAV imagery.

Results:
The final results presented a detailed 3D visual and structural description of the scenes in the alley, including cultural identity and property identity (Figure 5). Although they were displayed in a linear fabric arrangement, the associated vocabularies were very rich. Historical photography, cultural artifacts, tourism introductions, and free-hand chalk-like sketches were arranged on walls or in picture frames. Visitors can easily relate the artifacts with Keelung's history in different periods of the past. Most important of all, the situated arrangement encapsulated the temporal-spatial evolvement of the alley at the same location. Unfortunately, the sky can hardly be seen under weather shelters. It would provide more direct connection to urban context if the landmark building could have seen from inside and created divergent urban scale of the past and nowadays.

Fig. 5: Alley landscape of cultural and property identity.

The final results are represented by the interaction made to physical and virtual context, in terms of section model and AR models. The former was made of 3D sections of point cloud model through (a) river, landmark building, alley, and hill; (b) harbor, apartments, alley, and hill (Figure 6). Sections were

purposely arranged in radial cuts from the center of the alley. Hill was illustrated either in the section or as a background. With the landmark building removed, chronological physical context was simulated as from early stage to now. Virtual context and identity were interacted using AR models made by (a) alley, landmark building, river, and hill; (b) low-rise apartments, cultural center, and landmark building. As a result, the AR definition was also extended to 2nd skins.

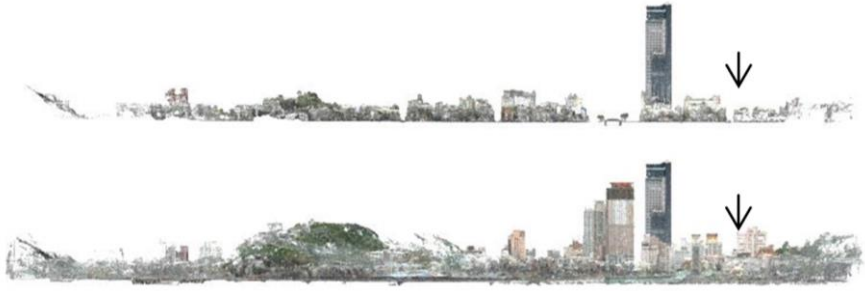


Fig. 6: Section with the alley indicated by arrows in the downtown area.

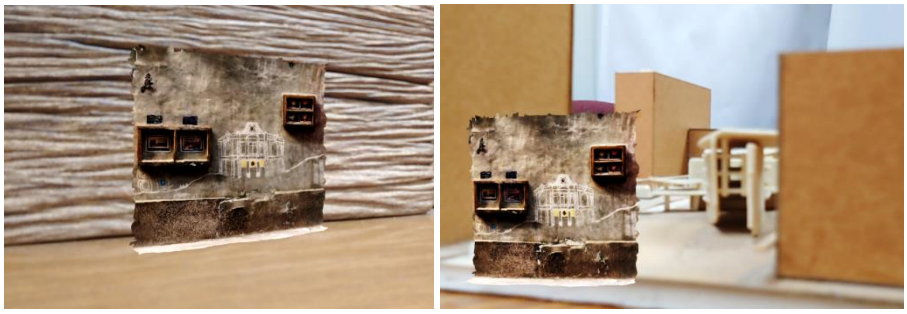


Fig. 7: AR models on different backgrounds.

AR intersections were applied to be a feasible instrumentation to enhance the understanding of the diversified fabric patterns. The highly elevated skyline configurations actually can hardly be seen from ground level. The individual urban elements, which were created in 3D mesh models, were converted into AR model and simulated under different combinations and various backgrounds. The simulation started from proportion in relatively correct size, and then adjusted to relate the scale in an alternative scene. The result was a situated interaction which can be conducted anytime in anyplace (Figure 7).

Conclusion:

Cultural identity and property identity are both parts of local identity. The alley presented an accidental and purposely made cultural landscape by residents, tourists, and cultural workers. The encapsulated space of identity is a very valuable part of context contrast to the symbolic landmark building of new construction located in next block.

Vocabulary, identity, cultural landscape, and property are cross related. Cultural identity and property identity contribute to cultural landscape. The relationship between both can be exemplified from the walls differentiated by vocabulary and household identity. As a result, cross-referred alley space creates a straightforward connection to a cultural landscape.

Shift from physical context to virtual context enabled the comprehension of historical evolvement from Japanese colonial era to nowadays. After identity being interacted in AR, we found identity can be represented in different forms of virtual space. The situated simulations in AR proven both

identities are parts of culture. Their interactions contribute to the sustainable evolvement of local landscape.

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