Title:
Railroad as a Digital Icon of Local Culture

Authors:
Naai-Jung Shih, shihnj@mail.ntust.edu.tw, National Taiwan University of Science and Technology
Pei-Huang Diao, diaoph@msn.cn, National Taiwan University of Science and Technology

Keywords:
Railroad, Old Streets, Urban Fabric, 3D Scan

DOI: 10.14733/cadconfP.2017.217-221

Introduction - the image of a railroad:
The purpose of this study is to retrieve icon-centered activities in Pingxi and Jingtong (Fig. 1.), Taiwan, and re-interprets them through a railroad peripheral of the old streets in a digital form. Traditional 3D scans have a greater emphasis on technology. In contrast, this study would like to emphasize preserved cultural subjects and their relationship to different 3D data retrieval approaches. The purpose of this study is to interpret local culture in terms of the digital icon of railroads in Pingxi and Jingtong, New Taipei City. Railroads often were recognized as an icon of industry in the past. An iconic image and train station are usually located at the center of a city. In both of these towns, the icon has a new cultural meaning and has been transferred into a new illustration arena of cultural activities: flying lanterns and hanging bamboo tubes. The activities also give new meaning to the urban fabric with casual additions by local shops, residences, and tourists, especially around New Year's Day and the Lantern Festival.

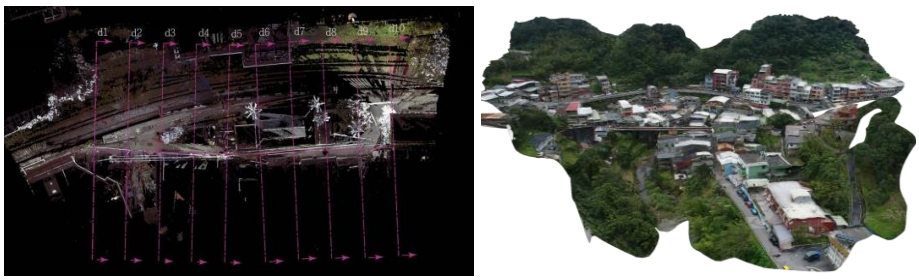

Fig. 1: Railroad scenes of Jingtong in point clouds (left) and of Pingxi made by UAV images (right).

The Pingxi and Jingtong Districts, located at the north-east corner of Taiwan, have many unique local characteristics which attract tourists each year especially to the Lantern Festival during holidays around the Chinese New Year. Both places are connected by railroads. Pingxi is also one of the four Slow Cities which are famous for cultural sight-seeing activities. It tops the priority for development. Proper sight-seeing-oriented environment management has been applied to issues related to cultural fairs, traffic, tourists, and neighborhood cities. Pingxi's old streets are under the jurisdiction of the Urban Plan issued by New Taipei City, based on the National Regional Planning Guideline issued by the Construction and Planning Agency, Ministry of the Interior. The evolution of a city space is often influenced by government policy. In a small town like Pingxi, the effect is subtle but important. In order to control the traffic flow, signs are installed at several gateways to the city. The control is

© 2017 CAD Solutions, LLC, http://www.cad-conference.net

strictly executed on New Year's day, when the number of cars that flood into the old streets used to stop traffic for hours.

Modeling Plans - the method used to retrieve an urban image:

Urban fabrics usually feature a consistent appearance and structure for years under a space framework that can achieve and interpret the cross-relationship and identity between buildings and streets [5, 7, 11]. The representation of urban fabrics requires as-built data to verify the relationship between space and tourists' behavior.

Virtual 3D city models are becoming more widely implemented by governments and city planning services [2, 10]. The detailed 3D models reflect the complexity of city objects and their interrelationships. In order to capture realistic data from streets, city modeling has reached a new standard in which 3D point cloud models have been treated with rich geometric properties and rich details, which enable the point cloud models to be integrated with other city model types [13]. Unmanned Aerial Vehicles (UAVs) or aerial LIDAR (Light Detection and Ranging) methods add a more detailed description of as-built geometric information [3] with different levels of accuracy. The vast amount of data opens up opportunities in various fields of study [11], especially when showing the complexity of city objects and their interrelationships.

The 3D models created in this study come from a combination of approaches called multiple sources modeling, in which a 3D ground scan and 3D photogrammetry are applied.

- 3D scans (Fig. 1. left): This process was conducted by on-site observation, scan planning, scan location selection, scan registration, and as-built cultural feature abstraction. The scans were made on ground level as the main subjects scanned were street scenes and the environment around the railroad.
- Photogrammetry: This approach was conducted from two different altitudes.
  - In the air (Fig. 1. right): A UAV system was applied by airborne path planning, cloud-computing, 3D model editing, and 3D publishing in VR and AR. A Dji Phantom 4 Pro® and Autodesk Remake® were used, especially for the entire site with an elevated mountain scene. The north side of the model has better details by flying at a 9 m altitude than that of the south part at a 40 m altitude in a more elevated mountain area.
  - On the ground: The process included multiple photo-taking, cloud-computing, 3D model editing, publishing in VR and AR. Both Autodesk 123Dcatch® and Remake® were used especially for individual scenes and subjects.

A Faro Focus 3D® laser scanner was applied to retrieve as-built urban data. In total, 14 locations were selected for scanning, based on the availability of cultural subjects, clear views, and the importance of urban fabrics. The final information reached about 4.5 billion points. Files were about 26.9 GB. They were still 20.4 GB after scan noises were removed. Due to the size of data, the scans were divided into 8 segments for the ease of file handling and a clear illustration without mutual interference. The result is an as-built scan of the railroad and surrounding environment. The different sections of point cloud and the interrelationship between the infrastructure and residence are well-defined.

Railroad - an elevated axis in the air:

A railroad, which is considered one of the local icons, goes through the entire downtown area of Pingxi. This mountain city and residences divides this railroad into three segments (Fig. 2, left). The sections of each segment can clarify the interrelationships between the old streets and this railroad. The segments from east to west are railroad on ground level, railroad on the bridge, and railroad on the hillside. The railroad not only crosses the streets overhead, but also presents the images accessed from a distance, like over a river. To mimic a visual experience similar to normal perception, photogrammetry was applied to allow a view that follows the river from one end toward the center of the point of interest (Fig. 2, right). Although modeling by UAV had better geometric definition of the roofs, the view accessed on ground level still required photos taken from a lower viewpoint to create a much better description.

© 2017 CAD Solutions, LLC, http://www.cad-conference.net

Fig. 2: The railroad over the bridge and street in Pingxi (left) and visual access of the residences, the bridge, and the railroad along the river by photogrammetric modeling (right).

Fig. 3: The relationship among railroads, residences, and landscape in terms of skyline (left) and overlapped point sections along the railroad's centerline (right).

This iconic railroad features distinctive characteristics by segments, in terms of layers of objects, viewpoints, and cultural intensities. The interrelationships among railroads, residences, and landscape are represented in the skylines. In contrast to a photo-based profile, the skyline is created based on as-built scans which have retrieved many real 3D subjects that are also of interest. As the original scans show, the city's elevation has been divided into the levels of river, street, residence roof, and railroad. A closer look into the data in the vertical orientation would add complexity to it, such as infrastructure, illegal construction, and landscape (Fig. 3, left). Infrastructures, like lamp poles and electrical wires, have reached a certain width that can hardly be ignored. As a result, the real skyline has become more diversified as various subjects are included. For the first time, town-wide sections (Fig. 3, right) have been created based on real objects from a main point cloud database.

Railroad-centered culture activities:
Lantern shops sell different types of merchandise and use various space management methods (Fig.4, left). The sites for flying lanterns are allocated at the peripheral open spaces around the railroad. The green zone shows an elementary school with a larger area for preparing the Lantern Festival during the Lunar New Year. Many temporary lantern booths appear during this period of time. The red zones designate shops and temporary booths during weekends and holidays. After greetings are written on the lanterns, customers are led to blue zones to release the lanterns after taking photos. The blue zones show where the railroad is located. In order to present cultural activities, this study tried to include the presence of events as part of the scenes. Although moving objects are difficult to capture in time by a 3D scanner, the scans in this study have caught trains and flying lanterns (Fig. 4, right). The data have a close connection to the environment. The result is a realistic scene showing cultural activities, in terms of the dynamic interaction between tourists and residents in open spaces. The sites for hanging bamboo tubes are allocated at the peripheral open space around the railroad and old streets (Fig. 5, left). Individual shed frames or fences next to the railroad are filled with the tubes, even on the ceilings, beams, or columns of the abandoned living quarters used by miners in the past. Tubes also appear on the trees on the hillside next to the railroad in Jingtong and on the art sculptures next to a coffee shop. Lines for hanging tubes swing in the air. Now the icon of tubes and legend-pursuing behaviors has raised a concern for environmental protection and a question regarding the commercialized cultural activity.

© 2017 CAD Solutions, LLC, http://www.cad-conference.net

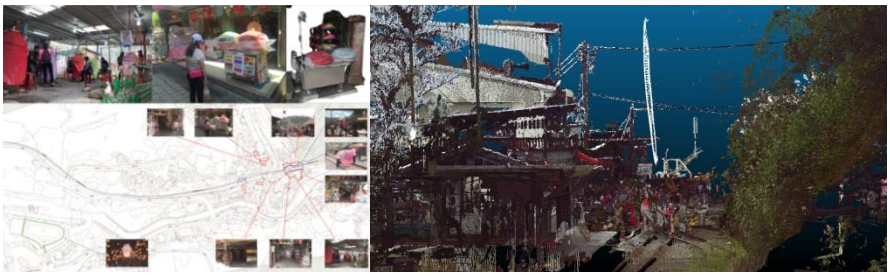

Fig. 4: A caught lantern flying above the railroad in Pingxi (left) and the lantern shops and flying sites around the railroad in Pingxi (right).

Local Cultural Identities and Corresponding 3D Models:
The complex relationship between tourism and heritage is revealed in the tensions between tradition and modernity [8]. A holistic view, which combines a distinctive environment with many different interrelated elements of a community [9], is a promising approach. In order to prevent the reduction of vitality, personality, and humane aspects in city renewal [6], Pingxi is going through a slow evolving process which incorporates tourists and local people. In addition to the flying lanterns, shopping and associated booths or carts also contribute a great deal to the tourist experience, as an intimate shopping experience can enhance a place's friendliness and character [9].

Street art has become a global phenomenon that incorporates physical and visual forms of expression [1]. In contrast to graffiti, street installations are also part of the art. In Pingxi or Jingtong, the entire mountain towns are made up of a collection of street art. This is "co-authored" by local people and the government. The streets feature a pedestrian-oriented environment [4] which becomes a perfect illustration of local cultural characters. In addition, the integration of users and roadway treatments creates an image of a slow town [12].

The symbol of local cultural identity is the result of a series of resource management. In order to support the large demand of tourists, flying lanterns has been developed by local shops as an efficient wish-noting process, starting with selecting lanterns from piles of inventory, framing lanterns for notes on both sides, approaching open spaces like railroads, posing for photos, and culminating with the release of wishes. Shop owners usually lead the customers to their domains with a picture-taking service. Since this small town does not provide sufficient open space for this during the lantern festival, the railroad and streets are used temporarily. The two orthogonal planes, horizontal railroad and the multiple vertical rising lantern paths above it, have become typical images of local identity. For the active part of culture creation, the lantern business has effectively integrated the shop, the open space, and a tourist need. The identities, no matter whether iconic or casual, were captured by photogrammetry application (Fig. 5, left), as a reference for local culture in VR (in Sketchfab®) or AR mode (Fig. 5, right). In AR, the system allows a variety of media or texts to meet different presentation needs. For example, a paragraph of text description is used to introduce the history of that railroad.

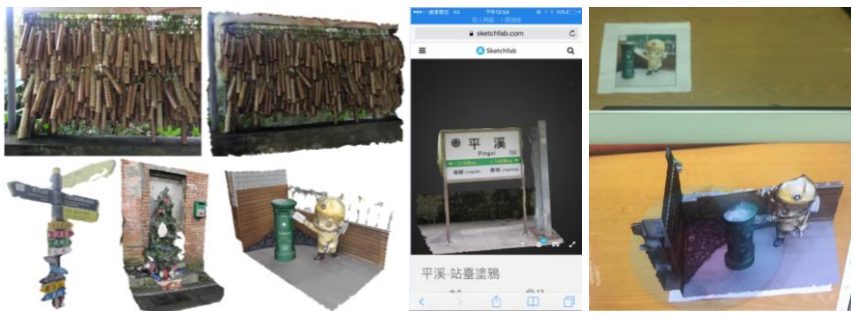

Fig. 5: Photogrammetry models, Sketchfab® model browsing, and AR interaction.

© 2017 CAD Solutions, LLC, http://www.cad-conference.net

Conclusions:

The Pingxi and Jingtong railroads have become local icons of industrialization in coal mining days and a symbol of culture in the 21st century. The achievement was made by a long term development effort by the government and local cultural industries. The railroad has created a distinctive axis on ground level, on the bridge, and on the hillside.

The scan data have been very useful to interconnect the relationships among old streets, residences, rivers, and the railroad in 3D. The integrated environmental data also connects the two parts of the railroad separated by a bridge in Pingxi. As a result, the entire tourist experience can be well-presented from the pedestrian bridge as an entrance to the old street, from the railroad on the bridge, and from the railroad station. The railroad, a cultural icon, is now part of a geo-information system with great detail and will also serve as a cultural reference for the interaction between tourism and heritage.

Acknowledgements:

This research is sponsored by the Ministry of Science and Technology of Taiwan. The involved project number is MOST 105-2221-E-011-014-MY2. The authors express sincere appreciation for this support.

References:

[1] Borghini, S.; Visconti, L.M.; Anderson, L.; Sherry, J.F..Jr.: Symbiotic postures of commercial advertising and street art - rhetoric for creativity, Journal of Advertising, 39(3), 2010, 113-126, http://dx.doi.org/10.2753/JOA0091-3367390308

[2] Chen, B.; Huang, F.; Fang, Y.: Integrating virtual environment and GIS for 3D virtual city development and urban planning, International Geoscience and Remote Sensing Symposium 2011, Vancouver, Canada, 4200-4203, 2011. https://doi.org/10.1109/IGARSS.2011.6050156

[3] Czyńska, K.: Application of LIDRA data and 3D-city models in visual impact simulations of tall buildings, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-7/W3, 2015, 36th International Symposium on Remote Sensing of Environment, Berlin, Germany, 11–15, 2015. http://dx.doi.org/10.5194/isprsarchives-XL-7-W3-1359-2015

[4] European Commission, Reclaiming city streets for people - chaos or quality of life? http://ec.europa.eu/environment/pubs/pdf/streets_people.pdf , 2004.

[5] Hull, R. B.; Lamb, M.; Vigo, G.: Place identity: symbols of self in the urban fabric, Landscape and Urban Planning, 28, pp.109-I 20, 1994. http://dx.doi.org/10.1016/0169-2046(94)90001-9

[6] Luo, W.; Liu, Y.; Jiang, Y.: Living Heritage Protection in China Urban Renewal Planning: A Case Study of Quanzhou West Street, Proceedings REAL CORP 2015, 5-7 May 2015,Ghent, Belgium, 401-9. http://www.corp.at/archive/CORP2015_52.pdf

[7] Nüchter, A.; Gutev, S.; Borrmann, D.; Elseberg, J.: Skyline-based registration of 3D laser scans, Geo-spatial Information Science, 14(2), 85-90, 2011. http://dx.doi.org/10.1007/S11806-011-0449-4

[8] Nuryanti, W., Heritage and postmodern tourism, Annals of Tourism Research, 23(2), 1996, 249-260, http://dx.doi.org/10.1016/0160-7383(95)00062-3

[9] Project for Public Spaces, Streets as places – using streets to build communities, Project for Public Spaces, Inc., 2008. https://www.pps.org/pdf/bookstore/Using_Streets_to_Rebuild_Communities.pdf

[10] Sadek, E.S.S.B.; Ali, S. J. B. S.; Kadzim, M. R.B.Md.: The Design and Development of a Virtual 3D City Model http://www.hitl.washington.edu/people/bdc/virtualcities.pdf, 2015. http://www.hitl.washington.edu/people/bdc/virtualcities.pdf

[11] Shih, N.J.; Tzen, S.C.; Chan, T.Y.; Lee, C.Y.: Cross-Verification of As-Built Point Cloud and GIS-Related Map Data, Open Journal of Civil Engineering, 3, 219-227, 2013. http://dx.doi.org/10.4236/ojce.2013.34026

[12] Witte, A.; Meisel, D.: Shared Streets and Alleyways – White Paper, Alta Planning + Design, 2011. http://nacto.org/wp-content/uploads/2015/04/shared_streets_and_alley_ways_witte.pdf

© 2017 CAD Solutions, LLC, http://www.cad-conference.net