Understanding the visual image of Kailash sacred landscape: a perspective from GIS and computer vision

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1 Introduction
1.1 Landscape —— a way of seeing

“A landscape is a cultural image, a pictorial way of representing, structuring or symbolizing surrounding.”
——Cosgrove (1998)

■ A way of seeing

“Landscape” can be considered as a skillful and cultivated way of visually forming and representing a physical environment (Urry & Larsen, 2011).

■ Spatial selection

People select a specific part of landscape to represent the information and characteristics of a whole region, using “difference” to create their own geography (Van Gorp & Béneker, 2007).

■ The image of Kailash (from internet)
1 Introduction
1.2 The image of Kailash

- The unique visual environment

  - A ‘pyramid’ like shape with four symmetric sides differs a lot from the nearby mountain peaks.

  - A all-year snow-capped peak looks magnificent mysterious under sunshine.

  - A highly ritualized terrain around Kailash is created by the surrounding peaks and valleys, which makes it a strong spiritual center full of centripetal force.
1 Introduction
1.3 Generation of Kailash cultural landscape

- Ancient belief
Since the ancient times, Kailash has been considered as a sacred site in four religions:
  • Tibetan Buddhism
  • Bön
  • Hinduism
  • Jainism
Modern times

The modern understanding of Kailash in the 20th century was a synthesis of many different world-view, which transformed this local sacred site into a world-famous mountain (McKay, 2015).

Further, a series of media like travel guides, movies, artworks in modern times depict their own understanding of this mountain, which in turn shapes the image of Kailash in people’s mind.

- The pilgrimage —— Sacred mountain and lake depicted by the modern artist (Socrates Geens)

- Paths of the Soul —— a Chinese film on eleven Tibetan’s pilgrim to Kailash (from internet)
1 Introduction

1.4 Kailash in a graph-reading era
2 Research content

2.1 Research question

- The visual construction of Kailash sacred landscape in a web-based context

This research includes two parts:

1. to explore the relation between the visualscape of Kailash and spatial distribution of photos;
2. to find the most representative elements of the landscape and the paradigms within the photos.
2 Research content

2.2 Research area

- the core research area
- the overall research area
- Two research areas
2 Research content

2.3 Research data

- **Virtual landscape data**
  - 90m digital elevation model (DEM)
  - 1:250,000 hydrological data
  - 1:250,000 road data

- **UGC geo-tagged photos**
  - Keywords "冈仁波齐(Kailash)" and "普兰县(Burang County)"
  - Two famous online tourist platforms in China (www.fooooot.com and www.2bulu.com)
  - **8,092 photos in total**
UGC (user-generated content) photo

- Users publish their original content through the network platform, and photos are among one of the main information carriers.
- Photos on social media accompanied with texts share a way for people to construct or reconstruct their experiences of the places (Lo & McKercher, 2015).

Geotagged photo

- Photos that contain latitude and longitude information.
- It is an independent and unique analysis data for obtaining spatial distributions characteristics of photos.
2 Research content

2.4 Research method

Viewshed analysis based on GIS

- Viewshed analysis

Viewshed analysis can help divide a certain area into those that can be seen and those cannot from a selected viewpoint based on DEM.

The result of viewshed analysis reveals the visible and invisible area of the Kailash-Manasarovar region.
2 Research content

2.4 Research method

Visual content analysis based on semantic segmentation

- Visual content analysis
  A attribute-based method helps identify the main items in the pictures and record their frequencies, co-occurrence, clustering, and other related issues in a quantitative way (Stepchenkova & Zhan, 2013)

- Semantic segmentation
  The DeepLabv3+ model with Xception as network backbone pretrained on ADE20k dataset provided by PixelLib in Python (PixelLib, 2021) is used to realize the semantic segmentation, which can identify at most 150 classes of objects from images.

- Examples of the outputs of the image semantic segmentation
3 Visual environment analysis

■ Introduction

The visual environment of Kailash is the basis of people’s perception of the landscape. To understand how people seek out views from the environment, the GIS spatial analysis is used to reveal the relationship between the geo-location of photos and the visualscape of Kailash.

■ Research framework for visual environment analysis
3 Visual environment analysis

3.1 Visualscape of Kailash

Total viewshed analysis

- Concept
  A first description of the visual structure of an entire terrain (Llobera, 2003).

Total viewshed 3D of the whole research area
3 Visual environment analysis

3.1 Visualscape of Kailash

Total viewshed analysis

- Analysis

Kailash as a lone mountain peak, compared with other mountain ranges with high visual prominence, stands out from its surrounding peaks.
3 Visual environment analysis

3.1 Visualscape of Kailash

Visual angle analysis

- Concept

Visual angles can be used to describe the visible portion of whatever concerned of the investigation. (Llobera, 2003)
3 Visual environment analysis

3.2 Spatial distribution of geo-tagged photos

- Photo distribution
  Photos are generally distributed along the route of kora, the outer path in particular.

- Relation with the visualscape

  - The relation between the change of photo density and the visual exposure of Kailash along the kora
  - The spatial distribution of photos
4 Visual content analysis

- Introduction

The content of images reflects what elements are spatially selected from the landscape to represent the whole region. The computer vision and statistics method are adopted to facilitate the information extraction from photos.
4 Visual content analysis

4.1 Image Content

■ Method
• image semantic segmentation
• compute the frequency for each of the recognized elements

■ Word cloud
• Natural elements: “sky”, “mountain”, “earth”
• Human-related elements: “person”, “building”, “signboard”

<table>
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<th>frequency</th>
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<th>frequency</th>
<th>name</th>
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<td>path</td>
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<td>land</td>
<td>598</td>
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<td>4773</td>
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<td>1117</td>
<td>river</td>
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<td>sand</td>
<td>1379</td>
<td>sea</td>
<td>745</td>
<td>pole</td>
<td>414</td>
</tr>
</tbody>
</table>

■ The frequency of top 30 elements

■ The word cloud depicts the relative frequency of elements appeared in the collected photos
4 Visual content analysis

4.1 Image Content

- **Perception type**
  - 8 kinds of visuals elements

- **Result**
  - The top 3 elements: “Mountain” (30.23%), “Sky” (28.00%), and “Land” (18.56%)
  - Other elements: less than 2%

<table>
<thead>
<tr>
<th>Visual element</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>building; tent; signboard; wall; house; fence</td>
</tr>
<tr>
<td>Creature</td>
<td>person; apparel; animal</td>
</tr>
<tr>
<td>Land</td>
<td>earth; field; sand; land</td>
</tr>
<tr>
<td>Mountain</td>
<td>mountain; rock; hill</td>
</tr>
<tr>
<td>Plant</td>
<td>grass; flower; tree; plant</td>
</tr>
<tr>
<td>Sky</td>
<td>sky</td>
</tr>
<tr>
<td>Traffic</td>
<td>car; dirt track; road; sidewalk; path</td>
</tr>
<tr>
<td>Water</td>
<td>water; sea; river</td>
</tr>
</tbody>
</table>

Eight visual elements developed from top 30 recognized attributes

The statistical differences in visual elements
4 Visual content analysis

4.1 Image Content

- **Content diversity**
  Diversity can reflect the number of elements people want to express in a single photo.

\[
D = 1 - \sum_{i=1}^{S} P_i^2
\]

Where \( D \) is the diversity of elements in the photo, \( S \) is the number of all perception types, \( P_i \) is the proportion of element \( i \)'s pixels in the photo.
4 Visual content analysis

4.1 Image Content

- Representative element
  The representative element refers to the most common element in a given area.
4 Visual content analysis

4.2 Paradigms of photos

- **Concept**

  When photos with similar elements accumulate, a “style” or *paradigm* will form to stress the unique points of the landscape (Dai & Chen, 2010).

- **Method**

  A *hierarchical clustering* algorithm is applied to divide the photos into eight major defined groups.

![Some typical images of Kailash](image)

![The dendrogram of hierarchical clustering](image)
4 Visual content analysis

4.2 Paradigms of photos

- Analysis
  - Focus on one kind of visual elements
    Type 1, type 5, type 7
  - As one falls, another rises
    Type 2, type 3, type 4, type 6
  - The human-related objects
    Type 8

- The average proportion of each element appeared in different paradigms

- The typical photo of each paradigm
4 Visual content analysis

4.2 Paradigms of photos

- Analysis
  - The distribution of paradigms
    Type 4 is the most common paradigm among most grids during the kora.

    Type 1 (land), type 7 (sky) and type 8 (building) occur mostly outside the valley.
Discussion and conclusion

- The visual image of Kailash sacred landscape in a web-based context

  - The high visibility of Kailash makes itself stands out from the surrounding mountains, and is selected by people to represent the whole region.

  - Most photos focus on depicting the landscape as “a high mountain under the sky”, which contributes to the generation of image of Kailash.
Discussion and conclusion

Future work

- Understanding the meanings of the visual images

Scoring different impressions of photos

- Kailash in Weibo —— a social media site like Twitter
Reference

THANK YOU.