A Preliminary Study of Experiencing Chinese Heritage City using Map Street View during Pandemic COVID19

Yi Shi[a], Yong Adilah Shamsul Harumain[b], Hazrina Haja Bava Mohidin[c]

[a,b,c] *Faculty of Built Environment, University of Malaya, 59200, Kuala Lumpur, Malaysia*
[a] *E-mail: yshi8995@gmail.com*
[b] *E-mail: adilah_shamsul@um.edu.my*
[c] *E-mail: hazrinahaja@um.edu.my*

Abstract: Map Street View is a real-life map service. It mainly provides users with panoramic images of cities, streets, and other environments, and users can get an immersive browsing experience through Street View (Zhao, 2019). This paper analyses the urban planning elements and walkability characteristics of five Chinese heritage cities to use Map Street View. The Map Street View used in this article includes Baidu Maps, Google Maps, and other software. Walkability characteristics can be observed in traffic composition, historic buildings, and landscape features used on these maps. Street View can view actual images of the city, and this function can be used to analyze the walking characteristics of the city instead of observation. Due to Covid19, on-the-spot viewing of the heritage city's walkability characteristics becomes inconvenient in many places. Street View is a cost-saving method suitable for use in the preliminary study. Map Street View can be used as an alternative to on-the-spot viewing. Combined with literature and questionnaire, this study proves that Street View is reliable in walkability study. There are two kinds of questionnaires. The first questionnaire is to select respondents with on-site observation experience, and a total of 249 samples were collected. The second questionnaire is the respondents who choose to use Street View, with 268 samples collected. By observing Map Street View, the qualitative analysis shows that the urban design elements of Gulangyu are more conducive to walking. And the results of the questionnaire also prove this point.

Keywords: Walkability Characteristic, Chinese Heritage City, Urban Design Elements, Map Street View

1. INTRODUCTION

The rapid development of urbanization has brought about the unlimited expansion of motor vehicles. The construction of a non-motorized traffic system has been neglected in urban planning (Tian, 2010), leading to the emergence of road traffic that encourages motor vehicles and ignores the importance of non-motorized traffic. Non-motorized traffic is an independent mode of urban transportation and a non-indispensable link component of other motorized transport. Regardless of the city's social and economic development level, non-motorized traffic is encouraged by sustainable urban transportation development. More and more national governments, urban designers, traffic planners advocate environmental protection, health, and non-motorized travel safety. A basic form of non-motorized traffic, walking has a more in-depth perception of the environment than motor vehicles and public transport users. During walking, the environment can be felt by listening, seeing, and smelling (Handy, 1996). And walking can realize face-to-face physical and mental communication between people,

release life pressure, experience life, and other functions.

In the age of mobile and big data, it is possible to use web data to validate street features. Google Street View (GSV) images are taken on the street from a similar perspective to pedestrians, so the street's physical environment can be reflected from the Street View (X. Li et al., 2015). This paper mainly uses the Baidu map and Google map. Baidu Street View and Google Street View use different picture databases. The two maps of Street View images complement each other and make the street information more complete. China's Baidu launched its Street View service in August 2013, allowing users to view high-definition panoramic images through chosen city's streets. Click on the blue road on the Baidu map to enter Street View, similar to the Google Street View interface. Baidu Street View has covered more than 80 percent of Chinese cities, with more than 20 million users. Baidu Street View is widely used in China, with high coverage, clear pictures, and the Street View's convenient operation. Google Maps is one of the most commonly used mapping software in the world. It is used for some walking research, mainly to collect street environment data. Google Street View (GSV) images were used to measure street shape and greenery and explore the relationship between walking activity and the urban built environment (X. Li *et al*., 2018). Plascak uses GSV to assess the presence and quality of sidewalks (Plascak, 2019). GSV technology was used to extract and evaluate urban greening from Street View (Lu, 2018). The data such as floor height and road network are obtained by observing and collecting the Map Street View of historical and cultural blocks in Guangzhou. Simultaneously, based on the acquired street pictures, Guangzhou residents are asked to rate the images (Zhao, 2019).

There is a close relationship between heritage cities and walking, which has been proved in some studies. Using data analysis and field observations, a study on Venice's walkability evaluates the city's walkability level regarding practicality, comfort, safety, attractiveness, and readability (Gorrini *et al.*, 2018). By monitoring the number and density of tourists walking in significant festivals and ordinary times in Venice, especially in important scenic spots, tourists' comfort level and the perfection of pedestrian infrastructure in Venice are analyzed (Mamoli *et al.*, 2012). Zainol used GIS, questionnaires, and other methods to compare all transportation modes' total scores in Malacca, evaluating them from aspects of environmental protection and tourist experience, etc. They found that walking was the most suitable way to visit (Zainol *et al.*, 2013). In another study on Malacca, Zainol selected six streets to evaluate the users' satisfaction with pedestrian facilities from the pathway, zebra crossing, street furniture and signage, personal safety, adjacent traffic flow, aesthetics and amenities, and amenities (Zainol *et al.*, 2014). Five Chinese heritage sites were chosen as the case collection subjects to examine the study's importance of walking characteristics. The planning and implementation of the non-motorized road in many Chinese cities are backward, resulting in discontinuous non-motorized roads, poor safety, low comfort level, chronic road occupied by motor vehicles, and incomplete barrier-free facilities (Shen *et al.*, 2015).

Due to Covid19, there may be resistance to field investigations. Map Street View is a 360° panoramic image that offers multiple street views. This article tries to evaluate walkability features by browsing Map Street View to replace on-site observation. Street View is viewed as pictures, which can be hard to use for accurate data collection, such as green area, number of buildings, length of sidewalks, etc. However, urban design elements can be observed in Street View, including traffic composition, characteristics of historic buildings, sidewalks condition, squares and parks, landscape features, street furniture, etc. In the article, historic buildings' characteristics and landscape features are selected as study objects, and these two factors are most closely related to the walkability characteristics of heritage cities. Appreciating historic buildings is a significant factor for many tourists who choose to visit a heritage city. Environmental factors can influence people's comfort and satisfaction visiting

and living in a heritage city, which is essential for walking.

Research on walking started in the 1960s and 1970s and became popular in Europe around 2000 (Rahman et al., 2010). Cervero, the founder of the 3D model (density, diversity, and design), the earliest breakthrough research, proposed that the degree of the land mix is the main factor affecting walking choice (Ariffin et al., 2013; Cervero et al., 2003; Handy et al., 2005). Later, walking increased denser areas and was confirmed by other researchers (Forsyth et al., 2009; C. Lee et al., 2006a). Besides, walkers are classified into work purpose and non-public purpose, and the study shows that non-work purpose travel is more closely related to land use (Cervero & Duncan, 2003; Greenwald et al., 2001). Like the 3D model, Lee demonstrated the relationship between destination, distance, density, and route ('3D+R') and walking. Unlike Cervero's research conclusion, Lee concluded that the essential destinations affecting walking were grocery stores/markets, banks, eating places and schools (C. Lee & Moudon, 2006a). Another study by Lee also confirmed the relevance of walking destinations, providing further evidence that utilitarian destinations are more closely linked to walking than recreational ones (C. Lee et al., 2006b). In addition to the classic 3D and 3D+R models, walking and distance, density, and street patterns associated with walking have also been confirmed in other studies (Krizek et al., 2009).

Two basic urban morphology concepts affect travel's general choice: proximity and connectivity (Frank, 2000). Handy proposed that in addition to the actual distance, it should also be aware of walkers' perceived distance and the influence of urban morphological characteristics on perceived distance (Handy, 1996; McGinn et al., 2007). More subjective factors such as security and attractiveness are also important (Handy et al., 2006; Humpel et al., 2004). On the other hand, the impact of urban road connectivity on walking has also been reflected in many studies (Handy et al., 2005; Hankey et al., 2012; McGinn et al., 2007). As for other factors that affect walking, researchers recognize the importance of an integrated pedestrian system (Ariffin & Zahari, 2013; Lo, 2011). Small-scale streets with a complete sidewalk system are more conducive to inducing walking behavior (Clark et al., 2014; Hess et al., 1999; C. Lee & Moudon, 2006a). But other researchers argue that sidewalks do not matter (Forsyth et al., 2007).

1.1 Pedestrian Characteristic

Urban planning, including land use, urban type, landscape, climate, construction, etc., is closely related to walking. Walking is also more of a problem in heritage towns. The approach to walking encourages people to reflect on aspects of the heritage city and architectural specifics. Around the same time, most streets are small and not ideal for motor cars in historic cities. Like suburban communities and tourist attractions, China's heritage towns are the walking study subject.

The primary characteristics of walking can be summarized as follows(Yuan, 2020):

a. It runs through every corner of the urban public space to meet residents' needs for travel, shopping, and rest;
b. Short-distance travel has apparent advantages, generally less than 1 km. The walking speed is low, and the average walking speed is 1.2m/s-1;
c. Green environmental and healthy. It does not bring ecological pollution and has the role of physical exercise;
d. Pedestrians are in a weak position in traffic safety;
e. Walking takes up less space on urban roads than other transportation.

1.2 Built Environment and Walking in Heritage City

Heritage City is an urban-type World Heritage Site recognized by UNESCO. These historical cities are the cultural products of a particular historical period and need to be preserved entirely (Y. Li, 2010). The environment and architecture of a heritage city are traditional and local. The heritage city is an inheritance from the past to the future. It is an established commodity, deliberately created and influenced by consumer needs (Evans, 2002). A heritage city is a tourist destination, and tourist items have become important in its history, culture, architecture, transport, and urban climate. Since, before cars were widespread, heritage towns were built. Generally, their street patterns are narrow and crisscrossed, making them inadequate for motor vehicles. Therefore, researching the pedestrian ecosystem has particular significance in heritage cities.

Walking will ease the traffic jams in the heritage city and make it easier for visitors to explore the city's history, architecture, and climate more comprehensively to better experience the heritage city. Tourists drive more slowly than other street users, causing variables such as street textures and architectural details to have a larger effect on their journey (Vojnovic, 2006). Heritage towns are not only destinations for visitors but also suburban areas. Interpersonal contact between residents may be facilitated by a friendly walking atmosphere. Hui and Wang prove the walking characteristics of heritage cities are mainly evaluated from the aspects of accessibility (road length, intersection density), convenience (public facilities), comfort (street vision, street lighting), safety, rapidity, reliability, travel satisfaction, and travelers' behavioral intention(Hui, 2017; Q. Wang, 2020).

The relationship between the built environment and walking has been confirmed by many articles (Clifton et al., 2007; Orstad et al., 2017; Saelens et al., 2008; Yang et al., 2020). Many landscape environmental factors are associated with walkability. Safe and shaded built environment factors affect travel frequency, especially the departure environment (Cao *et al.*, 2006). Pedestrians who walk for health-related reasons consider aesthetic and phenomenological factors such as shade, water, noise, seating, lighting, well-defined spatial edges, and the place's reputation (Naderi et al., 2005). Goldsmith analyzed the influencing factors of walking from two aspects: individual factors and objective factors. The objective factors include environment (weather and terrain), facilities (traffic conditions, access, traffic signals, and pedestrian crossings, etc.)(Goldsmith, 1992). The main environmental factors affecting the satisfaction of walking are gentle slope, shade, sidewalk, crosswalk, and street lamp(G.-M. Lee *et al.*, 2016). The satisfaction scores of 14 walking environment items, such as footpath quality, continuity of footpath, shading/tree cover, etc., show that improving the environment can change pedestrian behavior (Nag *et al.*, 2020). However, some researchers have proposed that walking satisfaction with the environment is affected by the physical environment and affected by their own emotions (W. Wang *et al.*, 2012).

2. METHODOLOGY

2.1 Methodology Framework

In this study, five heritage cities, including Gulangyu, Hongcun, Lijiang, Pingyao, and Wuzhen, are listed as analysis and comparison objects. These five cities are influential historical villages and cities in China, representing China's heritage tourism. In 1997, Lijiang

and Pingyao were the first cities to be named World Heritage Sites, and Hongcun was added to the heritage list in 2000. These heritage cities have distinctive features and a long history. However, due to the early development of tourism, there are some problems in the cities' buildings, environment, and facilities. Gulangyu was listed as a world cultural heritage city in 2017. Gulangyu is a popular destination for heritage tourism, and there are many relevant literature studies. Wuzhen has been listed on the World Heritage Site Provisional List. Although Wuzhen is not officially a world cultural heritage site, it has ancient buildings and a unique environment. From 2015 to 2020, the World Internet Conference was held in Wuzhen. Concepts such as smart tourism have entered Wuzhen to promote the combination of traditional culture and modern technology.

Methods:

Baidu and Google Street View were used to simulate the browsing of heritage cities, observe the urban design characteristics, and qualitatively analyze the walkability characteristics of heritage cities. Walkability is assessed by traffic composition, architecture, and landscape. And supplementary information was collected through literature retrieval and questionnaire survey. This information verifies the feasibility of the results obtained from Map Street View. The questionnaire was divided into two items and distributed randomly through the online platform. The first questionnaire requires the respondents to have been to these heritage cities in recent years and fill in the questionnaire according to the respondents' real experience of visiting the heritage cities. A total of 249 valid questionnaires were collected. The second questionnaire requires that the respondents have not been to these heritage cities. In the questionnaire, the respondents are asked to rate the walking characteristics of the heritage cities based on the images of Street View, which can show the historical buildings and landscape characteristics of the heritage cities. A total of 268 valid questionnaires were collected. Finally, the data results of the two questionnaires were compared and analyzed.

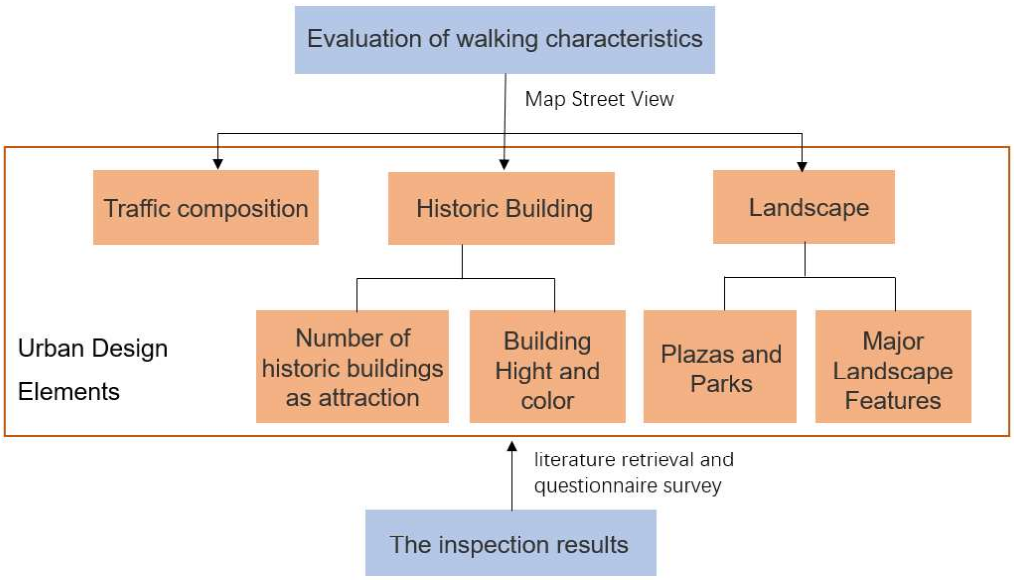


Figure 1. Methodology Framework

2.2 Street View Used in Heritage Cities

Street View is an easy way to view heritage cities. Taking Baidu Map as an example, select the destination city's panoramic mode and choose the blue road on the flat map -- the street covers the panoramic map (Figure 2). After entering panorama mode, the scene can be changed according to the direction arrow in the picture. After entering a certain scene, the panoramic map can simulate the pedestrian line of sight and rotate 360 degrees on the horizontal and vertical lines (Figure 3; Figure 4). In addition to selecting street scenes on the plane map, the main scenic spots in the heritage cities are listed below the app, and people can choose the location by clicking the scenic spots. Google maps are used in a similar way to Baidu Maps.

Figure 2. Baidu Street View in Lijiang's use

Figure 3. Street View's horizontal panoramic perspective rotates on Gulangyu

Figure 4. Street View's vertical panoramic view rotates on Gulangyu

3. RESULT AND DISCUSSIONS

3.1 Background Information on Case Studies

Table 1. Brief descriptions of the case studies

City	Population	Area	tourist amount (ten thousand)
Gulangyu	13108	1.87 km^2	818
Lijiang	32000	7.27 km^2	4600
Hongcun	1850	0.19km^2	275.9
Wuzhen	53988	2.5 km^2	915
Pingyao	20000	2.25 km^2	1765.04

Gulangyu is also known as Kulangsu and Gulang Island. Gulangyu is located in the southwest corner of Xiamen, surrounded by the sea. Due to its unique geographical location, Chinese and western cultures are mixed and fused here, gradually forming an international living community with multicultural fusion. Since the official definition of the development of the scenic area in 1988, the tourism development of Gulangyu has been increasingly prosperous.

Lijiang is located in the northwest of Yunnan province. Surrounded by mountains on three sides, the water system flows through the entire ancient city to form a waterway. Lijiang heritage areas include Dayan Town, Heilongtan Park, Shuhe Town, and Baisha Town. As Lijiang is an area inhabited by many ethnic minorities, architecture, handicrafts, clothing, and so on have been influenced by many ethnic groups and have a unique style.

Hongcun Village is located in Anhui province. The village was built 890 years ago, and the whole village has the same surname. It has Chinese traditional ancient buildings and a village layout. Architecture and artistic carving are of high conservation value. The water system runs through the village.

Wuzhen is located in Zhejiang province. The ancient town is a typical water city in China, with its buildings built on both sides of the river crisscrossed by rivers. The cross-shaped water system divides the city into four zones, with the leading architectural conservation and urban governance currently concentrated in the eastern district. This area

features artisanal workshops and traditional shops.

The ancient city of Pingyao is located in Shanxi Province, north China, with a history of 2,700 years. The building has the characteristics of cities and buildings in northern China. Both urban forms and historical buildings have precise axes and symmetrical left and right sides. The city walls and towers around the city were a defense system in ancient times, and the whole city retains the complete form of ancient Chinese cities.

3.2 Traffic Composition

Most heritage cities are not allowed to enter by cars and bicycles due to many narrow and tortuous streets, such as Gulangyu, Lijiang, and Wuzhen. Walking is the primary way of visiting and living in heritage cities. There are other transportation methods besides walking in some cities, which enriches visiting and facilitates residents' lives.

In Gulangyu, electric sightseeing cars are set up in major scenic spots with a total length of 6 km (Shan, 2016). Tourists and residents can get in and out of Gulangyu by ferry. The island is connected to Xiamen by four docks, one of which mainly serves tourists. Visitors can only travel on foot in Hongcun, but residents can use rickshaws, electric bicycles for transportations. Because of the rich system and broad surface of the water in Wuzhen, people can visit the whole town by boat. Boats and walking are the primary means of transportation in Wuzhen. Compared with the other four ancient cities, the ways of visiting Pingyao are more diverse. The core areas are off-limits to motor vehicles and walking, bicycles, electric sightseeing vehicles, and rickshaws can be used by visitors.

3.3 Characteristics of Historic Buildings

Historic buildings affect people's walking, mostly tourists, as historic buildings are the leading destinations for most tourists visiting heritage cities. Therefore, the characteristics of historic buildings affect walking time, satisfaction, and route, such as the height of the building affects pedestrian line of sight and the color of the building affects visual perception. These architectural features are critical criteria to measure the walking characteristics. Through Map Street View, obtain the building type of historical buildings in the heritage city, architectural attractions, historical building protection, building height, building color, and other information. In the Street View mode of Baidu map and Google map, the author chose architectural attractions and buildings on both sides of main streets as the main objects of observation. Based on the literature, this paper analyzes the architectural characteristics of the five heritage cities.

Gulangyu has the highest number of protected buildings. There are 466 buildings with historic features, most of which are located in Longtou Road and the Nei Cuoao area. Among them, 337 are under critical protection, and 129 are under general protection (Xi, 2020). The core building types in Gulangyu are mainly divided into six categories: ancestral temple and church, colonial government affairs, municipal services, residential villas, culture and education, and entertainment. But some privately residential villas and public buildings are not allowed to be visited. Visitors can only appreciate these buildings from the outside. In Gulangyu, there are ten buildings as attractions, most of which are historic buildings converted into museums. Pingyao has the most architectural attractions, with 22. There are 3,797 traditional dwellings in Pingyao, more than 400 of which are well preserved. Architectural attractions include city walls, dwellings, temples, ancient banks, and so on. Wuzhen has 13 architectural attractions. Most of these scenic spots are exhibition halls and shops transformed from residential buildings, while others are temples, post offices, and

academies. There are 134 existing ancient dwellings in Hongcun, most of which were built in the Qing Dynasty. Most historic buildings are residents, with a small number of public facilities, including academies and ancestral halls. At present, there are about eight ancient dwellings and public buildings open as scenic spots in Hongcun. The old buildings on both sides of the streets in Lijiang are mainly used for shops, restaurants, homestay, and bars. And there are 12 scenic spots to visit. Dwellings, exhibition halls, and temples dominate Lijiang's architectural attractions.

The buildings in Lijiang, Hongcun, Wuzhen, and Pingyao are mainly 1-2 floors. A few commercial and public buildings were built to three or higher floors. Pingyao has six high city gates and a 12 meters high wall. In Gulangyu, the low-rise buildings of 2 and 3 floors account for 56.8% and 27.4%, respectively. Followed by single-story buildings with 93 (11.0%) and 4-story buildings with 34 (4.0%); Six stories were the least numerous, with only two buildings (Zhang, 2018).

Due to the integration of various architectural styles in Gulangyu, the colors of traditional Chinese architecture, European architecture, American architecture, Southeast Asian architecture, and so on are also varied. White, brick, red, grey, and yellow are the primary architectural colors. Many ethnic groups influence Lijiang buildings, and the facades are rich in colors, mainly red, white, yellow, and grey. And areas near the town center have a higher color saturation than those far from the center (Liu, 2015). Other heritage cities are homogeneous in color. The buildings in Hongcun are typical of Hui-style architecture in China, and the architectural colors are grey, white, and black. The new building also maintains the architectural tone (Liu, 2015). The architecture colors of Wuzhen are similar to that of Hongcun. The architecture in Pingyao is uniformly brick grey, and the architectural details are dotted with red walls, lanterns, and couplets.

3.4 Major Landscape Features

Each city has its landscape characteristics, especially the historic cities. Many historic cities have been chosen to consider the surrounding natural environment and design it into the city. The landscape affects the ecological environment of the city and pedestrian satisfaction. Landscape factors, such as squares, parks, greenery, and facilities, affect pedestrian behavior. This study mainly observed the landscape environment characteristics, the main city square and the park around the city through the Map Street View. These factors bring the tourists and residents the functions of rest, communication, shopping, and entertainment.

Almost every heritage city has an activity area. Unlike modern cities, most of the squares in heritage cities are small, formed on several roads or in front of public buildings. These plazas are the main areas for residents' daily activities and tourists' rest and shopping. There are six public squares with a large area on Gulangyu. Public squares in Hongcun are mainly located at the village's entrance and center and in front of the temple buildings. The plazas in Lijiang, named Sifang Street, is a trapezoidal space. It is in the center of the town, and the streets are distributed outward from Sifang Street. It is an important place to celebrate the festival for residents and a commercial spot for tourists in Sifang Street. The Town God's Temple Square represents the public square of the ancient city of Pingyao, which is square and broad. It is built for festival activities and is now more tourism distribution and leisure functions. In addition to the same square space as other heritage cities, Wuzhen also has a particular form of the square -- water square, where the water surface is partially widened to provide places for ships to unload and trade(Zhou, 2003).

Only Gulangyu and Lijiang have parks. Yandang Mountain by the sea is a park on the Gulangyu island, overlooking the island's scenery. There are also three traditional Chinese

private gardens on Gulangyu. Heilongtan Park is within the heritage protection area of Lijiang. It gets its name because of the clear lake. It is a collection of mountains, water, ancient buildings as the park.

Each heritage city has its unique landscape features. Gulangyu has the geographical advantage of surrounded by the sea on all sides, and the scenic road and beach facing the ocean have a gorgeous view. At the same time, Gulangyu is located in the subtropical region. The island is rich in plant resources, including more than 200 ancient trees. The ecological environment of Gulangyu is excellent. As ethnic minorities inhabit Lijiang, the old city's spatial construction has been influenced by many ethnic groups such as Han, Yi, Naxi, and Bai. Various and high-density bridges on the river system are the landscape characteristics of Lijiang, which enrich the river system's landscape and facilitate the communication between the two sides. Because Lijiang is at a high altitude, the snow-capped mountains can be seen in the old city. Hongcun faces the lake and back to the hill, surrounded by farmland. The site selection and layout of Hongcun emphasizes the unity of nature and man, respect and utilization of nature. There is a water system throughout the city, and the water passes through every house and ends up in the lake at the village's entrance. The waterway of Wuzhen is its most prominent landscape feature. The whole town is built along the water. The ancient city of Pingyao is relatively flat, and there is no natural landscape such as a water system and mountains within the line of sight.

3.5 The summary of the urban design elements

Through the qualitative analysis of the heritage cities by Map Street View, the design elements that affect the walkability characteristics of the five cities are summarized. Overall, the historical buildings and landscape features of Gulangyu are better than those of the other four cities. The number of historic buildings in Gulangyu is higher than in other cities, and the grading standards for building protection are more precise. However, few architectural attractions are open to visitors. The building height in Gulangyu is generally higher than that in other cities, and the architecture is more colorful. The squares in cultural heritage cities have the characteristics of similarity, less quantity, and small scale. Only Gulangyu and Lijiang have parks, which is their unique advantage. In terms of major landscape features, almost every city has its characteristics. Gulangyu has sea views and sandy beaches; Lijiang and Hongcun have mountains and waters; Wuzhen has river views. As a northern city, Pingyao is weak in landscape characteristics.

Table 2. The summary of the urban design elements

Urban design elements		Gulangyu	Lijiang	Hongcun	Wuzhen	Pingyao
Historic buildings	Number of architectural attractions	10	12	8	13	22
	Types of main architectural attractions	Museums Residential villas Church	Dwellings Exhibition halls Temples	Dwellings Ancient academies Ancestral halls	Exhibition halls Temples, Ancestral halls Ancient academies	City walls Dwellings Temples Ancient banks Ancient government
	Main building	2-3	1-2	1-2	1-2	1-2

	height					
	Main building color	White Brick Red Grey Yellow	Red White Yellow Grey	Grey White Black	Grey White Black	Brick grey
Landscape features		Seaview Rich plant resources	Ethnic minority characteristics Bridges River system	Natural scenery River system	Waterway	No distinct features

3.6 The results of the questionnaire

The questionnaire is divided into two parts. In the first part, tourists who have been to Gulangyu, Lijiang, Pingyao, Wuzhen, Hongcun, and other places in recent years are selected to conduct the questionnaire survey. These questionnaires were distributed on the questionnaire platform on the Internet, and the respondents were randomly selected. A total of 249 samples were collected for the questionnaire survey. The respondents chose the cities they had visited to fill the questionnaire. Due to the differences in visibility and number of tourists among the five cities, the number of samples obtained in each city is different, including 66 in Gulangyu, 60 in Lijiang, 51 in Hongcun, 38 in Wuzhen, and 34 in Pingyao. Historical buildings, urban greenery, the surrounding environment, and street furniture were investigated. The questions were rated on a scale of one to five, with one being very poor and five being perfect. And calculate the score of each item and the average score (Table3).

Table 3. The average scores of environmental factors through observed on-site

City	Historic buildings' protection	The feeling of visiting historic buildings as attractions	Heritage city greening	Heritage city environment(surrounding environment)	General satisfaction of the street furniture	Total
Gulangyu	4.17	3.99	4.10	4.23	4.01	20.5
Lijiang	3.72	3.82	3.75	3.97	3.68	18.94
Hongcun	4.10	4.22	4.10	4.22	3.84	20.48
Wuzhen	3.71	4.10	3.86	3.92	3.92	19.51
Pingyao	3.82	3.88	3.44	3.76	3.65	18.55

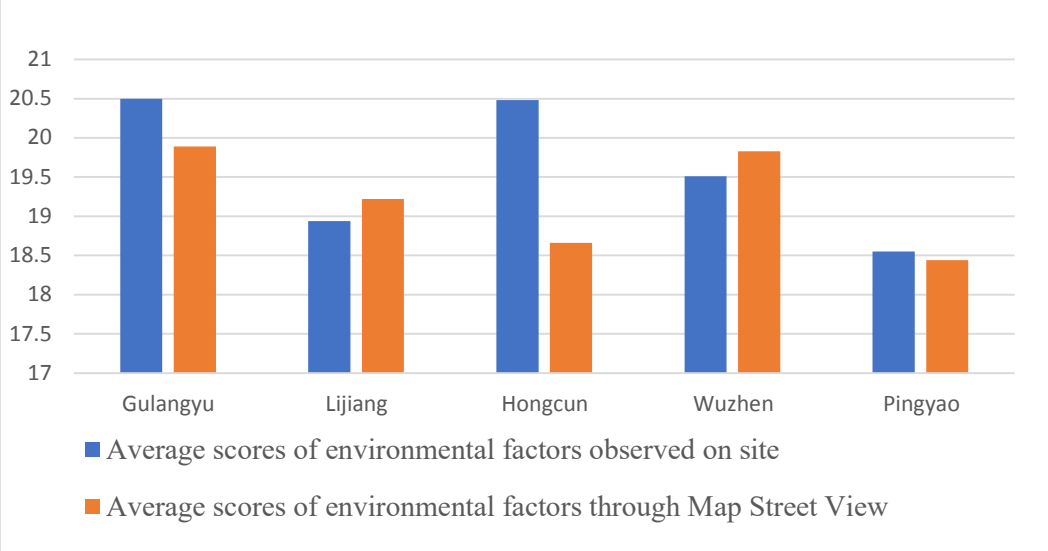
In the second part, respondents who have not been to Gulangyu, Lijiang, Pingyao, Wuzhen, and Hongcun in recent years. These questionnaires were distributed on the questionnaire platform on the Internet, and the respondents were randomly selected. A total of 268 samples were collected. In the survey, respondents chose cities they had not visited and rated them based on images taken from Map Street View. There were differences in the number of samples in each city, including 62 in Gulangyu, 64 in Lijiang, 48 in Hongcun, 44 in Wuzhen, and 50 in Pingyao. Historic buildings, urban greenery, surrounding environment, and street facilities were investigated. The questions were rated on a scale of one to five, with one being very poor and five being perfect. The average score for each item was calculated based on the survey results (Table 4).

Table 4. The average scores of environmental factors using Map Street View

City	Historic buildings' protection	The feeling of visiting historic buildings as attractions	Heritage city greening	Heritage city environment(surrounding environment)	General satisfaction of the street furniture	Total
Gulangyu	3.95	4	3.94	4.15	3.85	19.89
Lijiang	3.9	3.77	3.78	4	3.77	19.22
Hongcun	3.48	4	3.94	3.7	3.54	18.66
Wuzhen	4	4.14	4.07	3.82	3.8	19.83
Pingyao	3.82	3.82	3.52	3.7	3.58	18.44

By comparing the results of the two groups of questionnaires, except for Hongcun, the comprehensive scores of the other four cities have little difference (Table 5). Based on the two questionnaires, Gulangyu has the highest score, while Pingyao has the lowest score, which is similar to the results of the previous qualitative analysis. The result proves that it is reliable to study the walkability characteristics of heritage cities based on Street View.

Table 5 Compare the average score of observed on-site and Map Street View



The single score results of urban design elements showed differences in the scores of conservation of historic buildings and visiting experience of architectural attractions in the two questionnaires. Respondents who visited these cities rated buildings in Gulangyu and Hongcun as well protected, while Wuzhen was the least protected. But using Street View, respondents thought buildings in Wuzhen and Gulangyu were well protected, while those in Hongcun were poorly protected. Similar results were found for visits to architectural sites. This result may be that historical buildings, as three-dimensional spaces, interact with buildings more deeply than pictures. At the same time, the respondents who have visited the historic buildings may have a further understanding of the historical buildings through brochures, guides, and other means.

4. CONCLUSION

By comparing these five heritage cities, we can draw their respective urban design elements and walkability characteristics. By observing Map Street View, the qualitative analysis shows that the urban design elements of Gulangyu are more conducive to walking. Moreover,

according to the questionnaire results, the average scores of tourists' evaluation of Gulangyu in historic buildings' protection, heritage city environment, and general satisfaction of the street furniture are higher than in other cities. The result is the same as the process of observing Street Map.

The primary research based on Map Street View has many limitations, such as some of the branch streets do not have plans, Street View photos were taken several years ago. However, Street View provides a panoramic view similar to the human perspective, architecture, landscape, and other factors analyzed by Baidu and Google Maps. In addition, the results of the two questionnaires conducted in Hongcun are quite different, which is worthy of further research and discussion. According to the study of the method and process of using Street View in this paper, it is feasible to investigate walkability characteristics through Map Street View.

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