Research on Improved Design of Bus Stops in Xiamen

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Abstract. The design of bus stops can be vital for urban image building and the happiness of citizens. Xiamen, a city with various combinations of public transport preferred by a large number of people, was studied in this paper. To be specific, the advantages and existing problems of the guide system of the bus stop system in Xiamen were researched and analyzed, and then the significance and value of the "user-friendly" design in the guide system were explored. Based on these investigations, a specific design for the bus stop system was proposed to better serve the public and improve the service quality of the bus system.

Keywords: Bus stop · guide system design · user-friendly · innovative design

1 Introduction

With rapid urbanization, it is quite important to upgrade the transport network. In particular, the construction of the "sustainable" green transport system is now at the top of the agenda to relieve the serious traffic congestion and environmental pollution. As one of the most popular tourist cities, Xiamen enjoys a developed and comprehensive transport system. Nevertheless, the bus stops in Xiamen cannot serve the public well. The preliminary investigation on the setting of bus stops in Xiamen reveals that the city only keeps increasing the number of stops to enhance the transport system yet neglects the upgrading and construction of the bus stop guide system, which fails to ease the public transport congestion but, on the contrary, makes it difficult for passengers to locate the stops. The contradiction between the outdated guide system and the passengers' poor riding experience becomes apparent these days, resulting in a dip in people's happiness. In light of this problem, a specific design for the guide system of the bus stops is proposed with the combination of the actual situation of Xiamen and the guiding theory.

2 Status of Bus Stop System in Xiamen

The bus stops function in many practical ways. Basically, they are used by people from all walks of life to wait for buses (The stops are reasonable in size to hold a certain

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number of people). Most importantly, the bus stop boards can serve as reminders (The boards often provide bus information, route number, and destination, and may be used for illumination at night). Furthermore, the stops offer shelter from the sun, rain, and snow, especially in Xiamen which has a varied climate. Besides, riders can have a rest at the bus stops (the seats are arranged for people to sit and wait, and the people in need can get help there). Therefore, starting from these four aspects, namely the sign of the bus shelter, the bus stop boards, the queue signage, and the reminder of the bus, this paper aims to improve the design of the guide system of Xiamen bus stops. And the research and analysis are mainly carried out from two dimensions as follows.

2.1 Investigation and Analysis of Existing Facilities in Bus Stops in Xiamen

2.1.1 Status of Xiamen Bus Stops

According to Xiamen Public Transport Group of China Transportation Network, the coverage rate of "stops with a spacing of about 500 m" in the whole city reaches 83% while that in the downtown area is 100%. There are around 3400 bus stops, which are huge in number and densely distributed, in the city, making it convenient for citizens to travel or transit by bus [1].

2.1.2 Problem Analysis

The large quantity and density of bus stop in Xiamen ensure travel efficiency. Theoretically, the bus system in Xiamen has made great progress and guaranteed that everyone has easy access to the transit service, which should have boosted people's happiness and eased their life stress. However, the research shows that the satisfaction and happiness of the commuters are never directly proportional to the increasing number of bus stops but drop on the contrary [2].

2.1.3 Varied Bus Stop Size

The bus stops can work as guidance to passengers to show them specific driving directions of buses and the relevant details of the stop itself. The performance of the guidance function depends on the following aspects: the size of the stops, the contrast to the surrounding environment, and the fonts written on the bus stop boards. As for Wucun Stop, its platform is unreasonable in size, and its layout cannot relate to or coordinate with the surrounding environment, affecting the passenger's riding experience and causing spatial confusion.

The design, including the size and layout, of the bus stop board, fails to factor the focus of people's attention and meet the psychological needs of people, tough to be identified as shown in Fig. 1. 70% of the riders think it is necessary to transform all bus stop signs into a uniform style. The guide system should take the passengers' riding experience as well as the coordination with the environment as the top priority to maximize resource utilization and maintain the information architecture of the bus system [3].

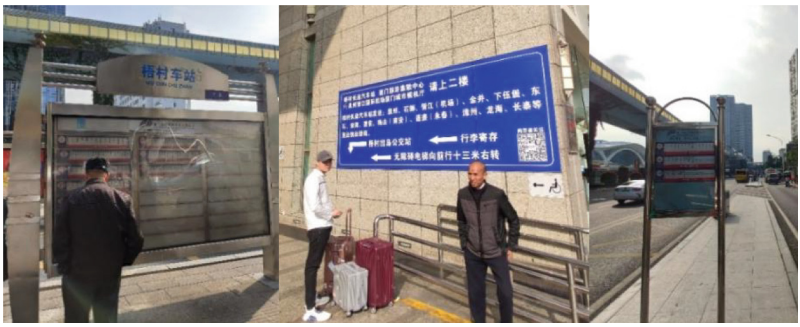

Fig. 1. Bus Stop Boards of Various Shapes [owner-draw]

2.1.4 Dense and Complex Route Information

The information on the Wucun Stop board is mainly in the form of written words. The same is true for most of the other boards in Xiamen. The research data shows that 90% of passengers demand to readjust the design of the board information while 55% of them feel that the route information is not clear enough, and 85% of them claim that they cannot recognize the bus stop information as quickly as possible. The root cause is that the print on the board is too small to be read clearly and the route information is too dense with no regular pattern. The on-site observation and investigation reveal that for some buses running a long distance with too many stops on the route, the board doesn't have enough space to display the information properly. Moreover, it is particularly difficult for the elderly, who, with poor vision, need to take twice or even thrice as long as a normal person does to read the information. In addition, the board only indicates the approximate departure time of the first and last buses while their arrival time during the day is left out. Furthermore, the Chinese characters and phonetic transcription cannot be recognized by the foreign riders, who are commonly seen in Xiamen, a tourist city. What makes Wucun stops difficult to be spotted by people is that it has one major platform and two sub-platforms, one of which is 20 m on the left side and the other is located under the ground. As there are no obvious signs to disclose the connections between the two sub-platforms, people may find it hard to spot the right one [4]. In this sense, the scientific and reasonable set of text information on the bus stop boards directly determines travel convenience (Fig. 2).

2.1.5 Image Signs Deficiency

According to the on-site research, the guide system of the bus stops barely has information in the form of images. And the on-site, as well as online questionnaire, manifests that the passengers are well aware of the meaning of image signs on the platform and can identify the bus stops and information with the help of these signs. 75% of the riders regard that it is necessary to add the image signs of the route to all bus stop boards while 44% of them expect that the Wucun Stop can be equipped with a map guide and the exact locations of the two adjacent platforms can be marked out in an image.

Fig. 2. Information on Bus Stop Board [owner-draw]

The collected and organized data shows that the current bus stop guide system lacks image signs and neglects the actual needs of passengers, impairing the waiting experience and the effectiveness of information transmission at bus stops.

2.1.6 Interference by Color Chaos

The guide color design of all bus stops in Xiamen doesn't take the influence of the surrounding environment on board. And commercial advertising takes the largest colored area, having an impact on the display of the information on boards. When the question, namely "What do you think blocks your access to information and what is the biggest problem of the identification system of bus stops?" was asked in the questionnaire, 60% of the passengers chose commercial advertising. For all bus stops, commercial advertising occupies the largest space since there are several of them displayed at the same time. With all these advertisements superimposed on top of one another, the color level is in chaos with poor visual effects. Consequently, the guide system should be designed with the color influence on passengers in mind to maximize the information transmission efficiency and bring color guidance into the design.

2.1.7 Single Materials

The guidance effect can be greatly impacted by the materials used at bus stops. The color, texture, and reflections of different materials may produce different visual effects. However, the field investigation shows that most of the materials used in the bus stops in Xiamen are basically stainless steel, PVC, and aluminum alloy, none of which are appropriate due to Xiamen's location and climate. More specifically, Xiamen enjoys long hours of hot sunshine and short winter. It rains so much and the temperature can be too high in summer. The overused metal materials in the bus stops may gleam too much as they catch the light, impeding the information transmission. In addition, the bus platforms don't perform well in illumination. People can only recognize the information on the board with the help of the shimmering street light. Therefore, the light may be included in the design (Fig. 3).

Fig. 3. Competitive Analysis [owner-draw]

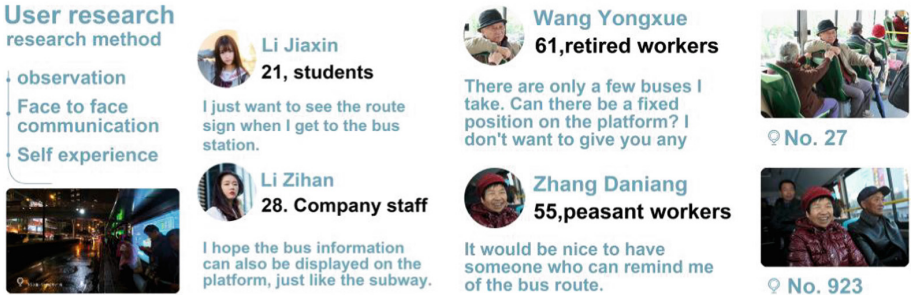

Fig. 4. User Research and Analysis [owner-draw]

2.2 Passenger Research and Analysis

To better understand the honest feedback of passengers, online questionnaires and offline interviews were adopted. The research, analysis, and on-the-spot photographs were carried out on the following aspects, such as the facilities of bus stops along 20 main roads in the six districts of Xiamen, the relationship between bus stops and environmental pollution, spaces, habits of passengers, and the situation of peak hours. The methods, including photographing, video shooting, sketching, and measurements were used to spot and discover the problems that existed in the current design (Fig. 4).

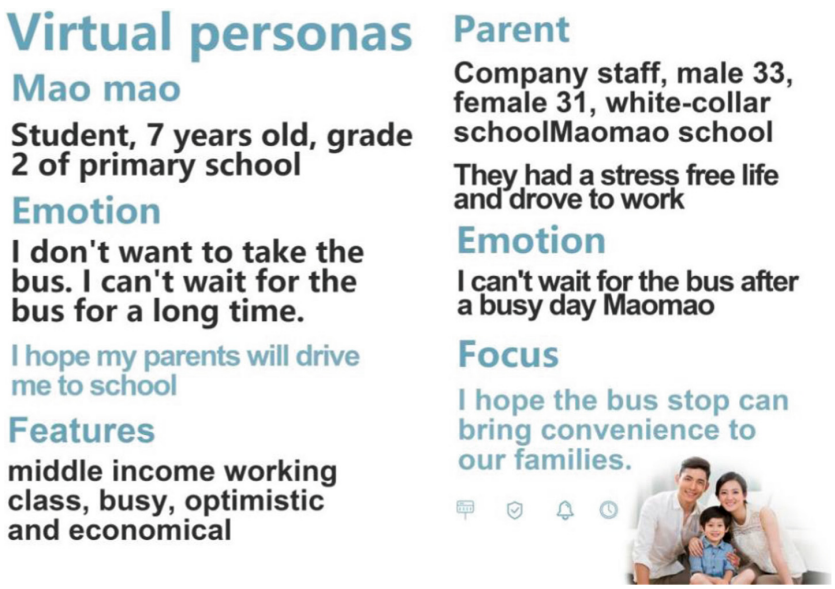

Fig. 5. Information about a virtual character [owner-draw]

2.2.1 Virtual Character

On the basis of the on-the-spot interview of the passengers in Xiamen, a virtual character is set according to the online questionnaire. According to the feedback, the several reasons that make the passengers feel depressed are as follows. Firstly, they wait too long for a bus after a busy day and there are even times that the buses never turn up (delayed information feedback). Secondly, they can't spot some of the bus stops (unclear route information on the bus stop boards. Thirdly, they tend to get wet by the rain or be blown hard by the wind (poor shielding function). Fourthly, some people might jump a queue and while others can't even get on the bus (unreasonable design of boarding and alighting areas). Fifthly, passengers may not locate the bus stops when they come to an unfamiliar place (poor guide effect) (Fig. 5).

Therefore, the bus stops need to be designed to avoid affecting riders' life and work but satisfy their emotional needs.

3 Design Modification of Guide System of Bus Stops in Xiamen

The problems that existed in bus stops in Xiamen as illustrated in Sects. 1.1 and 1.2 impede the network upgrading and fail to meet the riders' demands.

3.1 Breakthrough Points of Design

The bus stops need to be designed to be user-friendly on the foundation of the relatively perfect public transport network in Xiamen. Firstly, the bus stops should be made easier to be located by the passengers to save their time. Secondly, the information should be

made readily accessible to riders to spare them from waiting for buses at the wrong stops when there are multiple sub-stops. Thirdly, the route information should be clear enough and updated timely to remain consistent with the real-time position of the riding vehicles. Lastly, the boarding and alighting areas can be marked with different colors to signal the riders to wait at the right place. The above four points listed can be the breakthrough in design to improve the guide system of the bus stops in Xiamen. The design can be carried out according to the statuses of passengers (locating the bus stop- ensuring to wait at the right stop- obtaining the route information - waiting for buses- queuing position), and the guide system can be developed to solve all problems.

3.2 Static Identification

The professional static signboard design can improve people's travel efficiency. The modifications can be made in the following aspects.

3.2.1 Form Design

Although the bus stops are simple in design, they are not unique enough to be distinguished by people. The bus stop needs to be identified as an integral space, whose size and shape may coordinate with the urban landscape of Xiamen. The spatial layout relationship between the bus stops and the street landscape is supposed to be taken into consideration to maintain the spatial order.

Given the geographical location and climate conditions of Xiamen, which has an annual average temperature of around 18 °C in the hot and long summer, the bus stops are mainly L-shaped with an open-plan design. Besides, the platforms and boards are floor-standing. In combination with the living habits of the current users, the guidance information can roll across the main frame of L. And more stop graphics and boarding information can be embedded in a three-dimensional form to facilitate passengers to look up information at close range.

3.2.2 Material Selection

The sunlight condition of Xiamen determines that the materials used in the bus stops may better be the matt ones to avoid the influences of light. With the strong sun rays, a 200 W photovoltaic panel can be installed on the top of the shelter to collect the solar energy to supply power for the lighting system of the bus stops at night to further enhance information transmission [5], conserve energy, and protect the environment. The outer surface of the materials can have a matte finish to be similar to the texture of wood, and more compatible with the surrounding environment.

3.2.3 Visual Information Design

Any information in the public transport system network is transmitted to users visually, the same is especially true for bus stops. It is critical to outstand the information symbols of bus stops and ensure that the buses pause smoothly to enable the passengers to board them. Therefore, the hierarchical relationship of visual information such as board

Fig. 6. Design Display [owner-draw]

graphic identification, route code, route information, and route map should be arranged scientifically and reasonably for the purpose of accurate information convey.

3.3 Dynamic Identification

With the characteristics of route number as a reference, the standard color map of the bus route is generated while the route numbers are classified according to different colors. The colors of the platforms, stop boards, and advertisements are designed uniformly. The bus stops are equipped with many intelligent facilities, including the LED electronic screen, route number, alarming signs, and pulling-in reminders through modern technology, which greatly enhances the waiting experience of travelers (Fig. 6).

4 Improved Design Display

5 Conclusion

The maturity and perfection of the bus system and the upgrading of the bus network can't be measured by the increasing number of bus stops but by the "new" materials

used, the unique design, the reasonable size, and the comprehensive functions. As the modern age witnesses highly developed science and technology, what people really yearn for is emotional satisfaction. Maybe the bus stops are not big enough to satisfy the demands of all people, but with a good design, the information can be conveyed clearly to passengers, making them feel happy and comfortable [6]. Starting from the most basic needs of people, the design of bus stops becomes more user-friendly to perform their function of information carrier of public transport and emotional and communication media between humans and the environment. The new design enables people to better understand the functions and operate through the shape, color, texture, quality, characteristics, and other information of the bus stop facilities while continuing to create new facilities and civilization forms, which shows the vitality of the city and refreshes the feelings of the riders.

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