Using Social Network Data for Subway Life Design: The Image-Need-Design Opportunity Model

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Abstract

Online social networks have permeated into people's daily lives. An increasing number of people from diverse backgrounds have expressed their viewpoints, feelings, and needs through the internet. Data from social network is widely used in every kind of academic social science. This study aims to apply data from online social networks into subway design work and promote a new way to discover design chance. By considering the Hong Kong, Shenzhen, and Tokyo subways as case studies, this study attempts to capture the images of subways. Through comparing the data from social network with users' needs level, an updated Image-Need-Design Opportunity model with a cyclical process is created at theoretical level. This research provides an insightful reference for future design work and aims to evoke in researchers a desire to excavate potential design information from online social networks.

Key words: case study, design model, design opportunity, design research, Social Network Service, Subway.

1 Introduction

Currently, social media is widely used by people of different education levels, cultural backgrounds, and ages to facilitate communications within social networks. A social network is a social structure comprising of persons or organizations with social relations (Yu & Kak, 2012). Social media is the sister of social networks; it comprises platforms that help users to create and exchange content, it is also widely called consumer-generated media (CGM). (Loader, 2008;

Reynolds et al., 2010; Romero et al., 2011). Online social networking services (SNSs) are a subset of social media (Yu & Kak, 2012). There are currently no reliable data regarding how many people use SNSs, but many people have integrated these sites into their daily practices (Ellison, 2008). Since there are many users sharing their opinions and experiences via social media and SNS, there exists therein an aggregation of personal wisdom and different viewpoints (Yu & Kak, 2012). The data available via social media can give us insights into the scale and extent of social networks and societies. This digital media can transcend the boundaries of geography to facilitate the study of human relationships (Lauw et al., 2010) and help measure popular social and political sentiments without the use of explicit surveys (Kumar et al., 2009; Ritterman et al., 2009; Ulicny et al., 2010). Thus, social network data is widely researched by scholars from disparate fields to understand the practices, implications, cultures, and meanings of the sites, as well as the users' engagement with them (Bothos, Apostolou & Mentzas, 2010). According to Yu and Kak (2012), network data can also be used to predict some human related events if the data is extracted and analysed properly. Nowadays, data from social networks are used to predict movie box-office results, disease, equity market,, tourism, and more (Asur & Huberman, 2010; Tse & Zhang, 2013). In Mayer Schoenberger and Cukier's (2013) book *Big Data: A Revolution That Will Transform How We Live, Work, and Think*, it is written that analysing "big data" from the internet would bring an unprecedented revolution of our future life. Many decisions could be made based on big data mining from the online social networks. The fact that participation on social network sites leaves online records offers unprecedented opportunities for researchers.

Considering the character of online social network data, we try to apply the data from the network to design work. In order to develop user centred design principles, we must discover design opportunities according to the users' opinions. Designers must recognize that they should not, and cannot, make decisions for users about their requirement and use method. This means that they should not impose their value judgments on users (Siu, 2003). Currently, there are a great many methods to obtain design opportunities. In his book *Design Investigation,* Li (2007) mentioned that there are 11 methods used to discover design requirements, including interview, observation, questionnaire, users' psychological experiments and so on. All these methods require direct communication with users. They are niche targeting and accurate methods, but they require a good deal of time and labour to perform.

This research hopes to predict users' needs for subway life design and find design opportunities by analysing big data. If big data can be applied to the design work, this will help to reduce costs associated with the labour and time required by the other discovery methods. As Yu and Kak (2012) identified, automatic prediction with machines has a much lower cost than human labour; furthermore, this method could process greater amounts of data and provide answers more quickly (Barbier & Liu, 2011).

In this research, by considering the Hong Kong, Shenzhen, and Tokyo subways as case studies, this paper attempts to capture the image and needs of subways. By comparing the data from social network with users' needs level, an updated Image-Need-Design Opportunity model with a cyclical process is created at the theoretical level. This model defined the subway images through the observation in the three case stations, by analysing the relationship between image and needs, the design opportunities are found. This research attempts to provide an insightful reference for future design work and aims to evoke in researchers a desire to excavate potential design information from online social networks.

2 Research Method

This study focuses on the city subway. City subway is the public transport which is shared and used by all the citizens. Almost every person has the experience of using a subway. There are two reasons of choosing the Subway as the research object. Firstly, the background of the users is rich. Public facilities are widely used by the citizens and the images from the users are colourful and representative. It is also easy to collect the users' images through internet. Secondly, it is easy to capture the images in the public environment. When people have the experience in the environment, they would obtain direct images and feelings in it. We don't need to arrange special usage scenario. By analysing the subway environment, we try to see how the design opportunity model is constructed.

As the object of this study is to determine the relationship between subway image and users' needs and develop a new method of discovering design opportunities, the research assesses the interaction between users and environment. A case study approach is adopted. Data are collected primarily through observation and interviews.

2.1 Case Study

Martyn (1998) stated that a case study research focuses on one instance (or a few instances) of a particular phenomenon with the goal of providing an in-depth account of events, relationships, experiences, or processes occurring in that particular instance. The purpose is to arrive at a comprehensive understanding of the groups under study. Siu (2001) mentions that case study has many advantages in urban research, particularly for the qualitative investigation of human behaviour. Some typical cities in Asia (Tokyo, Hong Kong, and Shenzhen) are selected as the cases studied in this research; observation and interviews are conducted in these city subways.

The Tokyo metro typifies what is meant by metro in a global context. As the first subway in Asia, it has an 86-year history. With the development of Tokyo's society and economy, the Tokyo metro experienced a complicated history of development. The abundant use of the Tokyo subway and the historical element of the subway's story endow the Tokyo metro with a unique but representative character.

Hong Kong's Mass Transit Railway (MTR) is also selected as a case. The city of Hong Kong is known for its combination of Eastern and Western culture through its accommodation of people from all over the world. Hong Kong MTR is the most important transport means in this city. It carries an average of 4 million passengers each day (MTR, 2012). It is famous worldwide for its security, stability, high quality of service, and use by other cities for subway research.

Shenzhen metro is the third selected case. As a Special Zone in China, Shenzhen is filled with young people from different provinces. It is a lively, multicultural city. Shenzhen Metro was constructed in 1999, which is very recent compared to Tokyo and Hong Kong. The different social environment and era of its production have created a modern subway that has benefited from the experiences of past metros and developed a unique style.

We conducted observations and interviews in typical cities and organized the results to obtain a comprehensive list of subway needs. The research results from these cities are comprehensive, as the Tokyo, Hong Kong, and Shenzhen city subways have very different cultural aspects. Besides this, these subways were constructed in different times and were developed at diverse prosperity levels. The subway images in these cities are typical and interesting.

2.2 Unstructured Interview

The image of the subway is not the subway itself but a subway that is experienced by its users.

To obtain accurate images of the subways, the study combines observation with unstructured interviews conducted among its users. Citizens' experience in the subway is very realizable and valuable for this research. We have interviewed several citizens from each city who have abundant subway experience, as well as persons who have experience using all three subways. We asked open ended questions that asked users to describe the city subway or their feelings when the city subway is mentioned. By analysing their feelings, we try to define different categories of subway image and determine how subway image corresponds to subway needs.

2.3 Observation

Observation of subjects can be performed to obtain a better understanding about people's behaviour in the environment as it is a method of looking at action between people and their environment and the result from observation is always reliable (Siu, 2007; Sanoff, 1992). In this research, cameras are used to record information about peoples' behaviours in the metro. This study observes two elements of the subway: (a) the static subway space and its facilities and (b) the dynamic subway life that occurs when the space is filled with people. These are the primary aspects affecting subway image.

3 Classification of Subway Images

Through interviews with 90 persons in Hong Kong, Shenzhen, and Tokyo about their subway impressions of these cities, we have obtained some key words which are provided in Table 1. The descriptions of subway image were organized into the categories described below.

Table 1 Description of each city subway

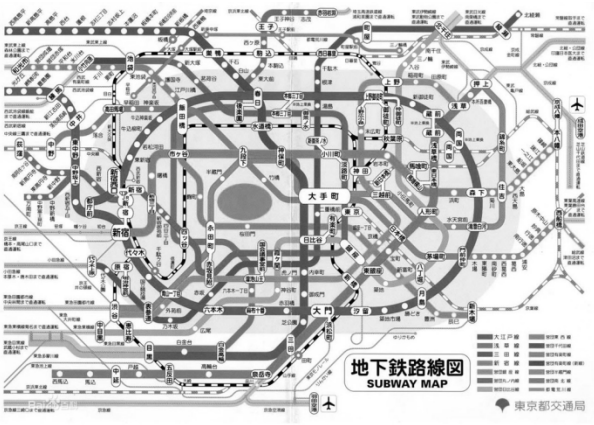
	Subway image
Tokyo metro	Silent, humanity, historical, fast rhythm, accessible, detailed, can buy food, enough toilets, old, indifferent, deep, convenient.
Hong Kong metro	Clean, low temperature, safe, convenient, frequency, punctual, chaos, orderly, flourishing, crowded, high priced, fast, humanized, civilized, global, multi-elements, callosity, MTR shop, unacquainted, flexible, artistic.
Shenzhen metro	New, reasonable price, crowd, chaos, fancy, emotional, clean, comfortable

	waiting environment, airtight, modernized, alive, novelty, unclear information, spacious.

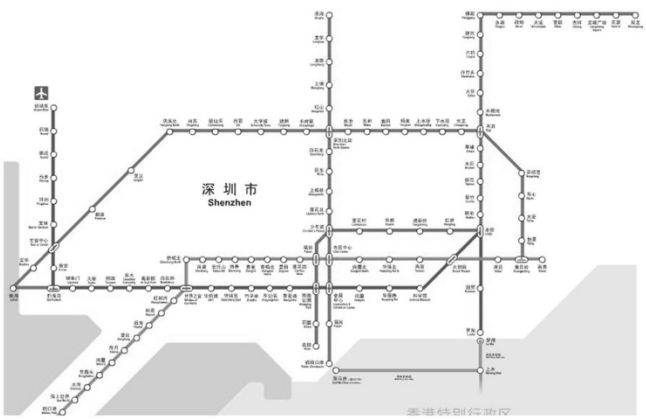
3.1 Function of the Railway

As one of the most basic forms of city transportation, the current functioning of the railway impressed people the most in all these three cities. Safe, frequency, punctual, and accessible were words used to describe the railways' functions. No matter whether the city subway is well-functioning or ill-functioning, functional feature is an obvious image. Although it cannot become a special label of the city subway, the functioning of the subway is the image that leaves the greatest impression. Figure 1 shows the map of Tokyo and Shenzhen subways to demonstrate the feature (image) of well-accessible and ill-accessible subways in these two cities.

Figure1 Tokyo Subway map and Shenzhen Subway map



Tokyo subway map



Shen Zhen subway map

3.2 Intuitive feelings of the environment

When people walk into a subway they immediately obtain an intuitive feeling about the environment. "New", "Historical", "Crowded", "Quick rhythm", "Capacious", and "Cleanness" were all representative words used to express the participants' images of the subways. Figure 2 shows the fast rhythm that is widely felt by passengers of the Tokyo subway.

Figure 2 People walk fast in the Tokyo Subway

3.3 Stimulates emotional feelings and sense of being respected

One of the most important feelings for passengers in the subway environment is a sense that they are respected and heard. “Humanity”, “comfortable”, and “kind” were all words used to describe passengers’ sense that they were respected. Some passengers also perceived emotion images such as “emotional”, “indifference”, and “no communication”. These emotion descriptions show users emotional needs in the subway. As Ho and Siu (2012) state, emotional design was not only communicated through the style of design, function, form and usability, but also built up experience for the user on their needs and demands. Figure 3 is an example that demonstrates the factor of humanity in the Tokyo metro. They provide compartment for women use only. Hong Kong MTR and Shen Zhen metro do not provide this service.

Figure 3 Women-only compartment

3.4 Self identity

A few of the interviewees mentioned that the subway included some special image of the city, such as a city card or reflection of city culture. In his book, *The Image of the City*, Lynch (1960) mentioned that clearly portraying a city image is one of the standards of an excellent city. A readable city may arouse citizens' senses of security, comfort, and freedom. The identity of a place can make it special and can create in users a feeling of self-actualization. Much like a city, the subway should portray a distinct identity to make it special and impressive. Figure 4.and Figure 5 shows some special design elements in Hong Kong and Tokyo subways that reflect the features of these subways' identities.

Figure 4 Distinctive design in the Hong Kong MTR station

Figure 5 The station seal for passengers in the Tokyo Subway

Among all the images, there are two main elements constructing these elements: the static environment (facilities, etc.) and the dynamic people (behaviour towards and interactions with

the environment).

When assessing participant responses, one must consider that passengers are both observers and the observed-target. Furthermore, their images of the subway will differ according to their backgrounds.

4 From Subway Images to Subway Needs

Based on the classification of the subway images provided by participants, we aim to gain insight into people's images of the subway and thereby ascertain users' needs inside the subway space, which will be divided into diverse categories. As images of the subway are the first-hand impressions of the users, they can reflect users' needs. We aim to discover the process that occurs inside the black box (figure 6) as we move from collecting the image to determining the subway needs.

Figure 6 The first black box

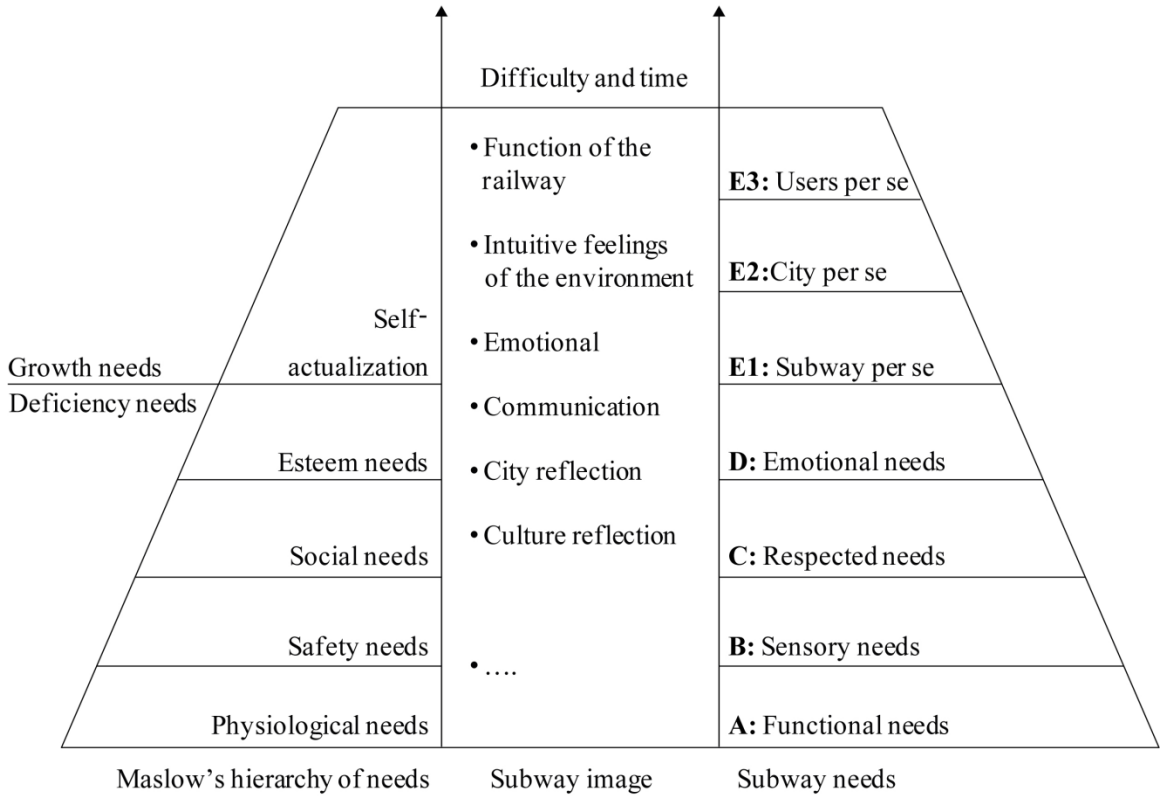
Many scholars have discussed the needs of design. According to Maslow's hierarchy of needs (1943), these needs can be assigned to five different levels, hierarchically organized as follows: physiological needs are on the bottom of the hierarchy, followed by safety needs, social needs, and esteem needs. The bottom four (physiological needs safety needs, social needs, and esteem needs) are deficiency needs (D-Needs). The top level self-actualization, also known as growth needs (G-Needs) (Maslow,1943). In the consumer marketing field, Maslow's hierarchy of needs corresponds to different requirements. These are needs of function, of the user's body, of social image, of the user's symbolic needs, and individual brand needs (in order from low level to high level needs) (Wu,2001).

As the subway is a special functional transport system in the city and is an independent underground facility, users' needs towards the subway space may not perfectly line up with Maslow's identified needs. But it is no doubt that the subway's needs are hierarchical in nature.

Based on the interview, these images will be divided into different levels by comparing

the subway images with the Maslow needs theory. Figure 7 shows the five levels of subway image categories, which are: function, sensory aspects, sense of being respected, emotional response, and identity. These images correspond to Maslow's needs. The highest image level, identity image, can be divided into three sub levels. The first level is the identity of the subway. Like the city in which it runs, a subway should possess its own special image. This image is not achieved by fulfilling the low level needs but by constructing a specific character to stimulate users' senses, memories, and souls. This identity is the visiting card of the subway. The second identity is that the city identity (culture, character, and image) should be reflected in subway. As an important element of the city, the subway plays the role of defining the city's borders, landmarks, and nodes, which are all elements of city image(Lynch, 1960). The third and highest level of the subway identity is its ability to express its users' identity. The subway experience should promote its users self-actualization and give them some inspiration about life. In this way, the role of the subway in people's lives becomes much more meaningful. These images correspond to their needs. Figure 7 shows the process of the analysis used to determine the levels of subway needs. Like Maslow's hierarchy of needs, the subway needs are also hierarchically organized.

Figure 7 The categorization of subway needs



Based on the interviews, the functional images emerged most frequently while the identity image emerged least often. Within the hierarchy, it is more difficult to realize higher levels than lower. But the higher the need satisfaction of the majority in a society, the greater the quality of life (QoL) of that society is (Sirgy, 1986). In each case, according to the result of the questionnaire, the research found that images from different levels exist together. The basic image does not disappear when the high level positive image emerges. This is congruent with Maslow's theory(1943), which notes that every person has needs. When the low level needs are fulfilled, the high level needs emerge. For each individual, when different needs exist together, the most basic levels of needs must be met before the individual will strongly desire (or focus motivation upon) the secondary or higher level needs. Needs in different levels depend on each other—low level needs do not disappear once they are fulfilled. Different people have diverse feelings towards the subway, which is why people's evaluations of the subway differ. For instance, we can see people describe Hong Kong MTR with both functional image (safe) and subway identity image (artistic). Some people are more sensitive to high level needs than others. Images can be both negative and positive; no matter what they are, they correspond to the same

needs.

As our research aim is to find a method for discovering design opportunities using the context of subways. In order to achieve this, a comprehensive understanding of subway needs should be generated. Our current subway needs pyramid combines all the images provided by subway users and distils the subway needs from these images. The elements of each level of needs and even the levels themselves will change with the development of technology and time. This subway needs level should be used in specific design contexts in future research.

5 The Application of an Online Social network System

After setting up an integral subway needs hierarchy, we try to construct the connection between design opportunity and subway needs. As mentioned before, needs emerge and are fulfilled from low level to high level. We should first identify what the needs are and then see what need levels have already been fulfilled. According to Maslow's theory (1943), when people's low level needs (such as function and sensory needs) are fulfilled, they pursue and focus on high level needs. Users' descriptions about the subway focus on high level needs, and the data available on social network systems provides an effective testing method for such needs. There are thousands of information points available from online social networks. In information driven design, the designer tries to define the design problem as strictly as possible (Kruger & Cross, 2006).The information from the users is quite valuable to this end. The big data from internet should be used appropriately. Figure 8 depicts another black box of this process: the transition that occurs from retrieving social network data to determining subway needs.

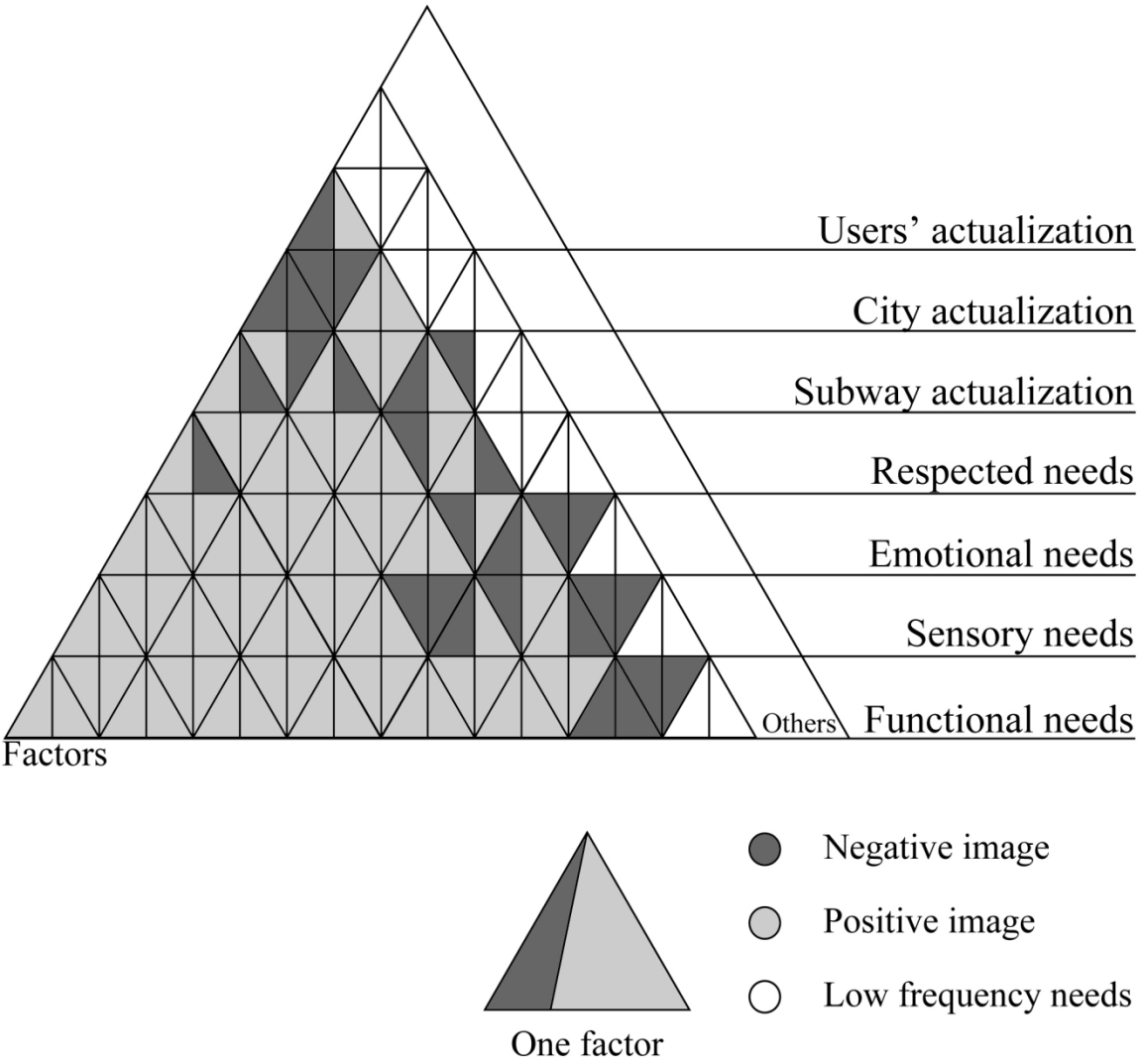
Figure 8 The second black box

In order to open this black box, we set Micro Blog and Hong Kong MTR as an example. When the big data from Micro Blog was obtained from the internet, content with the key words: "HK MTR", "Hong Kong Subway", and "subway life" was extracted from the large amount of Micro Blog data. By data mining towards these extracted descriptions, some high-frequency

words (emerged frequently in the extracted data) were gained with sequence. The amount determining what makes a word considered high-frequency depends on the amount of the basic data.

Most of these high frequency words can be categorized in the subway needs levels. Based on these high frequency words, the subway needs pyramid for Hong Kong MTR is as shown below.

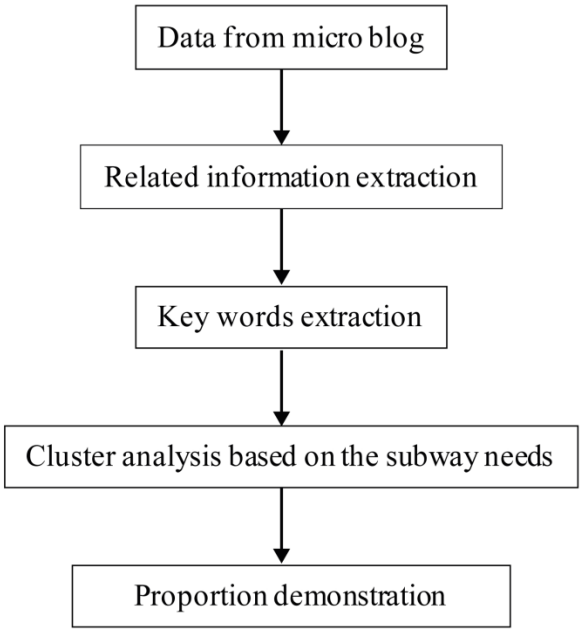
Figure 9 Proportion demonstration



Some aspects were described with both negative and positive images. Such as punctual and unpunctual. We then counted the scale of each part. The black part depicted in figure 9

represents the negative evaluations while the gray part represents the positive ones. The white part represents images that are just barely high-frequency words. For instance, “indifference” is one of the subway images that emerged only several times - it is sensed only by a few sensitive users. However, it could also be a key design need in the future. By analysing the context of the needs pyramid, including place and time, some design needs can be discovered. In the proportion demonstration shown in figure 9, the section in gray colour represents aspects of the subway that should not be paid attention to, the section in black colour represents aspects that should be improved, and the section in white represents potential design opportunities. Figure 9 not only demonstrates the current evaluation of the subway’s needs but also includes information about design direction. Based on the above discussion, the whole process that occurs within the black box is shown in Figure 10.

Figure 10 Process of data analysis

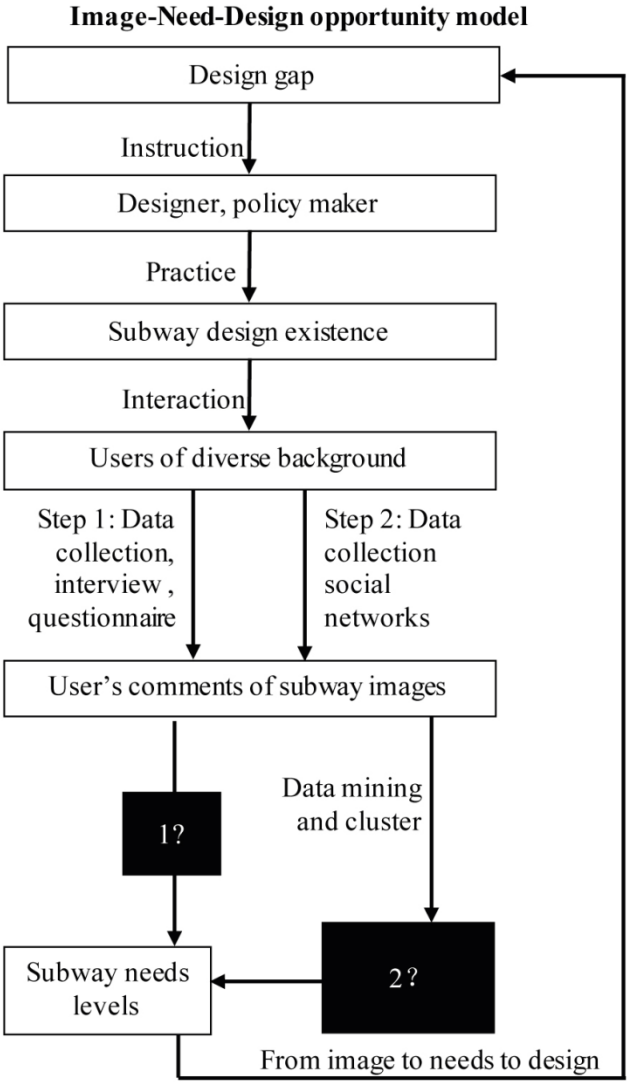


6 An Update System

The result of data mining demonstrates users’ current evaluations of and future needs for the subway. As data from online social networks is dynamic and unending, this method can be designed as an updated system that is sensitive and seasonable. This circulation system, with the

name image-need-design opportunity model, is depicted in Figure 11. The process described in Figure 11 starts from design opportunity, at the top. The designer and policy maker design the current subway space according to the initial design requirements. When users interact with the completed subway design, they have their own image about the subway. Through interviews and questionnaires, the subway's needs can be obtained by assessing and categorizing images of the subway and extrapolating needs. This step can be designed according to the requirements of the specific location and time in which it occurs.

Figure 11 Image-need-design opportunity model



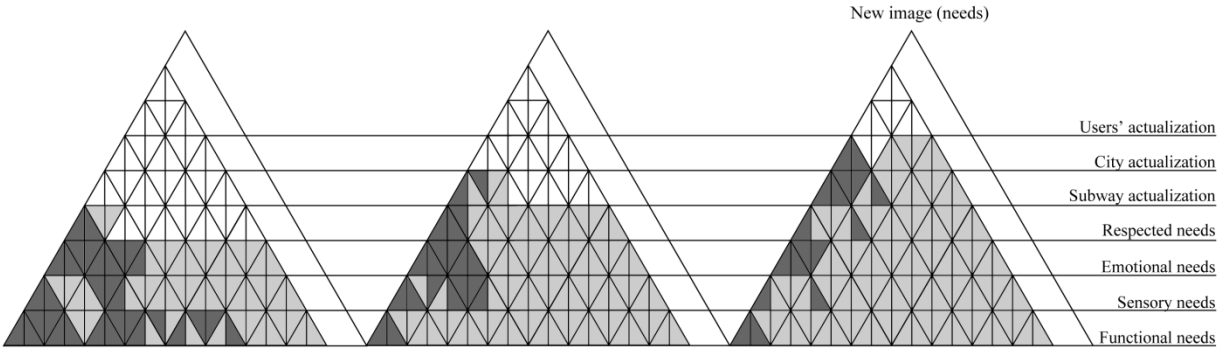
In Figure 11, black box 1 contains the process of transforming images to needs, as explained in the above discussion. Black box 2 (data mining) represents the transition that occurs from retrieving social network data to determining subway needs. The subway images retrieved from the social network can be used both to evaluate the current design and to reflect future design needs.

When social network users' subway descriptions and subway images are organized in the needs pyramid, we find the users' current focus and design opportunities. The new emerged requirements can then be used to instruct design work, and the cycle begins again from the top.

Figure 12 illustrates the predicted changing of subway needs as the process is implemented again and again, and shows how new design opportunities emerge in the updated system. At the beginning, most of the subway image is about the function and sensory needs. Only a few people can sense the high level image of the subway. When most of these low level needs are fulfilled, people are anticipated to begin to focus on higher level needs. White areas, which represent low frequency key words or newly emerged words, become green over time as design opportunities are fulfilled. Meanwhile, to avoid the confusion that current words of gray part became low frequency words in the future, once some of the factors emerged with almost full gray situation, it can be ignored in the future evaluation. The data analysis finds new needs and higher level needs as time passes.

Like described in Hauffe's design and society model (1998), design is changing from function-focused to consumer-focused to human-focused. Currently, design is no longer just a tool for the development of functional, innovative consumer products: it is increasingly seen as a process for radical change—for developing services, systems, and environments that support more sustainable lifestyles and consumption habits (Bjögvinsson & Hillgren,2012). For example, since the emergence of the smart phone, we seldom see people focused on the quality of connection during phone calls. When asking people their impressions about their mobile phones, they currently focus on the brand, interaction, or even the appearance instead of the basic functions. Sometimes, people also mention how the mobile phone affects their lifestyle. Users' needs of mobile phone are changing from low level to high level. The subway would also experience this process in the future. The development would always bring some surprises. There still thousands of subway needs to be excavated in the future.

Figure 12 Predicted change in subway needs



7 Problem Predictions

Until now, we have promoted a new method of applying social network data into design work at the theoretical level. More research is needed to supply and test this model with practice. Some of the difficulties and problems with this method can be predicted in the current stage, and future research should address these potential issues as described below.

We are far from knowing everything about social media. During data mining, it is difficult to avoid unpredictable problems, such as errors in semantic analysis (Yu & Kak, 2012).We don't know whether the selected data with the key words includes some unnecessary message (such as an advertisement) or even interference information. For example, Face book has a limit of 420 characters for status updates and Twitter has a 140-character limit. The shortness of the content affects the reliability of data analysis (Saif, He & Alani, 2011). What's more, users tend to use a large variety of short forms and irregular words, which also increases the difficulty of data analysis. These problems are common problems in the field of data mining, and the quality of the data mining directly affects the result of design instruction.

The subway needs obtained using the qualitative method change across different cities and eras. When applying this method to diverse cities, the subway needs should be designed accordingly. Targeted needs can help to find more suitable design opportunities.

Currently, we are just at the first step of data collection. Some detailed difficulties would be found in the practice. This model provides a basic frame for discovering design opportunities; this frame should be improved and supplemented in practice.

8 Conclusions

Big data from online social networking sites is widely used in diverse fields. The application of online social network data is an inexorable trend in the field of prediction and could bring great benefit to the future world. This paper has proposed a conceptual model for discovering design opportunities. This study utilizes a qualitative research method to hierarchically categorize subway images into five levels, and then constructs a subway needs pyramid to connect the subway image with design opportunities. This study also promoted an Image-Need-Design Opportunity model to evaluate the subway environment and discover subway needs by filling the subway needs pyramid with data from online social network. Compared with the traditional, interview method of determining design opportunities, this model provides a creative way to collect, extract, and utilize the wisdom of crowds in an objective manner with low costs and high efficiency. This method is also advanced in that it shows the updated dynamic result by time and location. It could not only be used to predict updated design needs but also bring a new era for the design process. It can be applied not only in subway space design but also in product design, city planning, policy formulation, urban design, and other design fields that conduct human-centred design work. The exploration and utilization of online social network data would begin a new stage for the design field and demonstrates unlimited potential in future research.

Now that the theoretical framework has been constructed, more practical work is needed. Relevant research should construct systematic correlations between object image and design needs, extract valuable design information from online social networks, and perform detailed data mining for design.

Acknowledgements

We thank The Hong Kong Polytechnic University for the research grants. We would also like to acknowledge Massachusetts Institute of Technology for Visiting Professor/Scholar support for the final analysis of the data and preparation of the paper.

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Figure Captions