Research on the design method of user interface for mobile Internet based on data mining

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Abstract

In order to improve the interactive and artistic of user interface of APP for mobile Internet, the design method based on data mining is proposed in this paper. This paper takes the interface design of smartphone mobile Internet application as the research object, adopts a collection of literature investigation, applies interdisciplinary research method, and combines practical case analysis to reconstruct interface design knowledge system, namely SUIG interface design knowledge system, with big-picture thinking of smartphone mobile Internet application from four aspects such as design strategy, user model and its task analysis, interaction of interface, and visual design. Besides, on this basis of the study, by taking the interface design process of smartphone mobile Internet application as the research content, the paper analyses the principle and method of the interface design of smartphone mobile Internet application, emphasizes the user-centred ideas figuring out the whole process of interface design of application would require around the user and task model implementation and development. The experiment result shows the proposed method can improve the overall performance for the design of user interface for mobile Internet.

Keywords: Design method, user interface, mobile Internet, data mining, the interactive visual technology

1. INTRODUCTION

In recent years, with the gradual maturity of mobile Internet and mobile equipment technology, mobile Internet application based on smart phone is deeply influencing all aspects of people’s basic necessities of life. Due to its features such as easy operation, portability, and sound interaction experience, smartphone mobile Internet application plays multiple roles of “assistant”, “playmate”, “teacher”, etc. in people’s daily life. However, with the rapid growth of the market of mobile Internet application, the homogenization phenomenon of smartphone mobile Internet application becomes increasingly serious. In the meantime, as a part of application R&D teams overlook the experience of application when they deliberately pursue the progress of application R&D, a great deal of low-level smartphone mobile Internet application starts appearing in the market (Johnson, 2014), which forms into sharp contrast with the trend of consumers (users)’s gradually increasing demand for application experience and requirement degree. As the most important part of smartphone mobile Internet application, interface design directly determines users’ experience effect of the application and it is the key factor to win the market, which enables the research of interface design to become one of the core problems concerned by the research field of smartphone mobile Internet application. However, most of the related research only focuses on the interaction and visual design of the interface design, and discipline limitation also exists in related research (Page, 2014; Ahmad, 2014).

Touch-screen era is coming, merchants should pay more attention to the visual unity of the mobile phone’s interface design, different brands should have their own distinctive visual style, constructed unique commodity image. Visual unity can enhance product awareness. For example, Nokia windows phone, breaking the conventional mobile phone interface design layout patterned way, has a distinctive visual style, very different from other brand of mobile phones, with a strong identification, has its own unique visual language. With the IOS7 of Apple systems appears, the transition of design style from materialized to flat, flat interface design is simple, fresh and still able to seize the consumer, Apple’s corporate image has deeply rooted in the hearts of the people, the product itself is a fashion symbol. Today, the Android-based Samsung, HTC, MI, Huawei have followed the Android kernel, only has its own design on the icon of style and the background image, the interface design is still an icon of the arrangement monotony multiplied by 5, homogenization is serious. With the development of science and technology, the mobile phone market has focus on product innovation, visual and user experience instead of product quality from the past. In the highly competitive market environment, the
phenomenon of Android-base phone’s visual homogenization is a very serious problem, which is a potential problem in the future development of the enterprise in the invisible. This situation prompted the mobile Internet companies must pay attention to the visual design of the product and the brand, only create differentiated brand visual identity will allow enterprises to achieve better development in the competition. Mobile phone as a personal media terminals compared with other media, is more convenience than other media unparalleled, the service form of mobile phone has brings efficient, convenient and enjoyable in human life. Thus, in the experience economy era, mobile phone interface requires not only beautiful, understand and operate easily, user also want to be able to process operations reached a multiplier effect, allowing user to experience the new procedure in the fun (Macik et al., 2015; Gutenberg, 2015).

2.MATERIALS AND METHODS

The mobile internet is the emerging industry with quickest development, greatest market potential and most attractive prospect in the world today. Mobile device like smart phone as the terminal of personal information and media under the background of mobile internet, its UI is the direct channel and the only medium for man-machine interaction between users and mobile devices. Therefore, the design of UI has unique significance and occupies an important position under the background of mobile internet, and its advantages and disadvantages not only directly affect the success or failure of its own products, but also indirectly affect the future development of mobile internet.China has the largest mobile internet market in the world as well as many outstanding products of mobile internet (Reimer, 2014). However, some companies don’t pay much attention on UI design, and the study of UI by related practitioners is relatively lagged. The UI designs of many products fail to meet the standards and are lack of originality with rough creation, which severely weaken its own market competitiveness. The UI with low quality and homogenization is not able to meet user requirement which is increasingly rising, and the products which are lack of market competitiveness will be eliminated by market soon. Figure 1 shows a case for the UI design for mobile Internet.

The method of user interface design of mobile phone is the research theme of this paper. Along with the info-tech coming into the post-pc time, user interface design of mobile phone has gradually become the key factor of design evaluation for mobile phone. But only a few mobile phones on market can claim to be satisfied. The reason is that two objects emphasized by user interface design of mobile phone — the usability object and user experience object — can seldom be reached at the same time. To ameliorate the user interface design of mobile phone, mobile phone user is chosen as the cut-in point of this research. Some important elements which can greatly affect interface design of mobile phone and user are analyzed and explained in details, such as the definition of user, the cognition process of user, the human-machine interface(HMI) of mobile phone and the way that HMI influencing user, etc. (Rosa et al.,2014; Guler et al.,2014). On the basis of analysis, some aspects which designers should pay more attention to during the user interface design process and some awaiting problems are given. Further, combining the research on objects and fundamental process of user interface design of cell phone, and the analysis and comparison on the main-stream design methods, an ameliorated method called User Participation and Iterative Design which focuses on users is introduced. This method focuses on addressing user demand and task target at the initial stage of the design process, and requires users participate in every stage of design. During the whole design process, iterative cycle should be taken as much as possible. After several cycles of design-evaluation-redesign, the interface design of mobile phone will tend to optimization. By this user interface design method which emphasizes users’ participation and iteration, problems consisting in products on market will be avoided. Moreover, the usability object and user experience object will be fulfilled at the same time, which means basing on the easiness to learn, efficiency and credibility, the user interface of mobile phone will also present affinity and be easily accepted by users, offering them the happiest experience (Kwon and Giang, 2016).
With the emergence and development of the computer technology and new media network, interface design has become a new and important member in the field of art design. The design can be broadly divided into three parts: structural design, interaction design and visual design. The graphical user interface studied in this article belongs to the visual design of the interface design, which is the most intuitive part that digital products present to the user and also the interface between users and digital products to operate each other. When the art design develops into a deep level, it not only has a further contact with science and technology, but also surely happens to cross with some branches of culture, such as history, folklore, study of human culture, social psychology, and social ethics. Implementation through the design is not just commercial purposes, but also the reflection of politics, economy, culture, philosophy, aesthetics and social psychology in a certain period. As a product of modern-advanced science and technology and rapidly-developed cultural media industry, graphical user interface which is a new and special media, carries abundant but complex cultural information. One important aim of interface design is to convey information, which itself is just a phenomenon of information dissemination. Graphical user interface design is not only an act of information dissemination, but also an act of cultural symbol; its process can be seen as a cultural process of information dissemination. Therefore, graphical user interface and cultural transmission are two concepts of two completely different areas, but this article will still link the two closely. Figure 2 shows the ways of collecting data.

The basic algorithm for data disposal is shown in the following equations [10]:

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Methods of Data Collection

Secondary
Document

Government publications, earlier research, Census, Personal

Primary Sources

Observation, Interviewing, Questionnaire

Participatory, Structured, Unstructured, Unstructured

Source: Kumar (2005:118)
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\[ \varphi_j(\mu_i) = \exp\left(-\frac{(\mu_i - C_j)^2}{b_j^2}\right) \text{, for } i = 1, 2, \ldots, H \]  

In this space, the \textit{mth} multidimensional receptive-field function is defined as

\[ \Phi_m(\mu) = \prod_{j=1}^{L} \varphi_j(\mu_j), \text{ for } m = 1, 2, \ldots, N \]  

The function can be written in a vector notation as

\[ \Phi(\mu, C, b) = [\Phi_1, \Phi_m, \ldots, \Phi_N]^T \]  

where \( C = [C_{11}, \ldots, C_{L1}, C_{i1}, \ldots, C_{iL}, \ldots, C_{iL}, \ldots, C_{iL}]^T \).

The weight memory space with \( N \) components can be expressed in a vector as

\[ W = [W_1, W_m, \ldots, W_N]^T \]  

The activated weights in weight memory space, which can be written in a vector form as

\[ y = W^T \Phi(\mu) \]  

The state variables and the desired values can be defined as follows:

\[ z_1 = x_1 - y_d \]  

and

\[ z_2 = x_2 - \alpha_1 \]  

The following tracking error dynamics is shown as:

\[ \dot{z}_1 = \dot{x}_1 - \dot{y}_d = x_2 - \dot{y}_d = z_2 + \alpha_1 - \dot{y}_d \]  

The first derivative of the Lyapunov function can be written as

\[ \dot{V}_1 = z_1^T \dot{z}_1 = z_1^T (\dot{x}_1 - \dot{y}_d) \\
= z_1^T (\dot{\hat{x}}_1 - \dot{\hat{y}}_d) = z_1^T (x_2 - \hat{y}_d) \]  

\[ = z_1^T (z_2 + \alpha_1 - \hat{y}_d) = -\lambda_1 z_1^T z_1 + z_1^T z_2 \]  

From (2) and (6), it can be obtained:

\[ \dot{z}_2 = \dot{x}_2 - \dot{\alpha}_1 = -M^{-1}Cz_2 - M^{-1}(G_s + d) + M^{-1} \tau - \dot{\alpha}_1 \]  

\( \tau \) is selected as
\( \tau = -\lambda_z z_2 - z_i - F \) (11)

Then we can get:

\[
V_2 = V_1 + \frac{1}{2} z_i^T M z_i \tag{12}
\]

\[
\tilde{V}_2 = \tilde{V}_1 + \frac{1}{2} z_i^T M z_i + \frac{1}{2} z_i^T M z_i + \frac{1}{2} z_i^T M z_i
\]

\[
= -\lambda_i z_i + z_i + z_i^T M (\lambda_i - \lambda) + z_i^T C z_i
\]

\[
= -\lambda_i z_i + z_i + z_i^T (Cz_i + r - M \lambda_i - (G_i + d))
\]

\[
= -\lambda_i z_i + z_i + z_i^T (f + r) - z_i^T (G_i + d) \tag{13}
\]

\[
\tilde{V}_2 = -\lambda_i z_i + z_i + z_i^T (f - F) - z_i^T (G_i + d) \tag{14}
\]

The ideal weight \( W \) from (10) and expressed as

\[
F = W^T \Phi(\mu) \tag{15}
\]

Define the estimate of the value of (11) as

\[
\hat{F} = \hat{W}^T \Phi(\mu) \tag{16}
\]

By analysing the typically representative works, it also deeply explores the modern cultural environment and traditional cultural resources involved in development process of graphical user interface design, mining the theory of value in graphical user interface design, in order to better grasp the development trend after the integration of graphical user interface design and new technologies. This trend has a far-reaching significance to enrich our theoretical research of graphical user interface design, promote the creation of the design of graphical user interface, help our graphical user interface design accurately to position itself to the track of international development of graphical user interface design and benefit the development of our digital products and prosperity of traditional culture.

3. RESULTS AND DISCUSSION

Datasets: We run experiments on the CUB-BIRD dataset, one of the most extensive datasets in the fine-grained literature which is composed of 200 sub-species of birds, several of whom bear tremendous similarities, especially under common image transformations. We use the standard training/test split provided by the authors. Following the standard evaluation protocol, we use the bounding boxes to normalize the images. We use the ground truth part annotations only during learning, unless stated otherwise. We use their standard evaluation metrics that is the category normalized mean accuracy.

Networks: For the constrain of training time, we resize the image size to 39x39, and convert to the grey level images. At the TCNNs layer of the first stage, receptive field size is 4x4, convolution step is 2, tiled size is 2, map numbers is 12, and pool size is equal to tiled size; At the LCN layer, gauss filter size is 3x3, gamma value is 2. The parameters setting differences between Stage 1 and Stage 2 are the receptive field size which is 3x3 and the maps numbers in which is 60.

Implementation details in recognition algorithm. We extract SIFT descriptors at every parts. We sample densely every 3 pixels and at multiple scales (16x16, 24x24, 32x32 and 40x40 windows) for all experiments, unless stated otherwise. After extracting the SIFT descriptors we reduce dimensionality to 64 by applying a PCA transformation. For Fisher vectors we use a Gaussian mixture model with 256 components. We apply power- and \( l_2 \)-normalization on Fisher vectors. We use a linear SVM classifier with the fixed parameter \( C=10 \).
Although computer support of form design will be rather moderate in the near future, especially when fast representation and alteration of early shape concepts are considered. The diverse tools, including freehand sketch, 2D digital images, and 3D modeling, applied by designers in the design process have been investigated separately. As input, design activity requires designer's observations. The importance of the sketches from nature has been addressed from many aspects such as visual thinking. It goes without saying that visual perception is the prime channel and the human being to get in touch with the external world. In terms of cognitive psychology, all mental operations involve the receiving, storing and processing of information are sensory perception, memory, thinking and learning. Surrounding by design fields, sketches have been used as a research medium for visual perception. Though these studies belong to different domains, they focus on the conceptual development stage. The conceptual design process itself can be considered as the one in which the designer navigates through an observation nature domain and employs various sketch images to elaborate the conceptual description. Figure 3 shows the design process for UI design system.

![Figure 3. A design process for UI design system](image)

Both theories and practical application have proved that the knowledge system and method model of smartphone mobile Internet application interface design can effectively instruct the application R&D teams for organizational planning and specific implementation of the interface design task, to enable the results of application R&D to correspond with the targeted goal of the interface application and help users to enjoy sound product experience and service when meeting target users’ demand. By analyzing the typically representative works, it also deeply explores the modern cultural environment and traditional cultural resources involved in development process of graphical user interface design, mining the theory of value in graphical user interface design, in order to better grasp the development trend after the integration of graphical user interface design and new technologies. Figure 4 shows a case for UI design.

To facilitate the users finding the most similar colour in standard colour database, the measurement of colour similarity was studied and the methods of judging colour similarity in different colour models and precision were constructed. The relationship between colour harmony and colour attributes was studied and the methods of colour harmony in single attribute, double attributes and triple attributes were built. Colour harmony can be gotten through hue, brightness, Chroma, tone and colour solid. Single attribute colour harmony includes hue harmony, brightness harmony and Chroma harmony. Double attributes harmony was realized by colour tone design through synthesizing brightness with Chroma.

It researched teaching present situation of vocational school colour design course and analyse problems, expounds the significance of colour design teaching assistant system development background and development. According to the management information system demand analysis research method has carried on the demand analysis, function characteristics combined with the development of software for planning the teaching assistant system to achieve the function of. The outline design, and draw out the system structure chart of the teaching assistant system. In the implement phase system, the application of flash the technology is introduced, the module introduces the implementation process of the interactive function. Technical aspects of the main features of FLASH are introduced methods and principles of interaction design, the method call external files in FLASH. Figure 5 shows the colour capture chart.
System and scientific character means exact, sensible, effective and distinctive teaching system. There exist isolated parts which combine to produce different levels, thus interweave to an organic whole. To judge and weigh the system’s standard needs to be effective. The powerful system needs operational mechanism to regulate and control, for it involves two aspects: static and dynamic state. Without good operational mechanism, system’s superiority can’t be brought into full play. Moreover, because of UI design systems different subjective and objective factors, it has vivid individuality (Macik et al, 2015). The figure 6 shows the UI design after optimization based on the interactive visual technology.

![Figure 4. A case for UI design](image1.png)

![Figure 5. The color capture chart](image2.png)
After the training of the initial deep network (3 stages TCNN+LCN) in a greedy stage-wise fashion, we get the top layer neuronal populations’ activations of train set and test set, which is a 540 dimensions vector for each images. In order to visualization these activations, Spectral Multi-Dimensional Scaling which provides a visual representation of the original distances of any pairs of samples is used to reduce the dimensions of the activations to 2 dimensions. It can be found that most adjacent points have the same orientations, as shown in Fig. 7. This can be seen as a validation for our approximately modelling to topological property.

![Figure 7. The visualization of the approximately topological properties of partial samples points](image)

In the up figure, total sample numbers is 3605, the sample numbers in dash rectangle b, c are 724 and 172, respectively. And the red, blue points represent train set and test set samples respectively. The middle and down figures are the corresponding input images of random selected samples.

4. CONCLUSION

In order to improve the interactive and artistic of user interface of APP for mobile Internet, the design method based on data mining is proposed in this paper. In this paper, the author researches on the interface design of mobile device based on the theory of colour semantics. Thinking from the view of the lifecycle development of application, applying the research method of logical reasoning to summarize and conclude the key points and mutual relations of all parts of the knowledge system of application interface design, to form into a complete
method model suitable for the interface design of smartphone mobile Internet application. This paper takes the interface design of smartphone mobile Internet application as the research object, adopts a collection of literature investigation, applies interdisciplinary research method, and combines practical case analysis to reconstruct interface design knowledge system, namely SUIG interface design knowledge system, with big-picture thinking of smartphone mobile Internet application from four aspects such as design strategy, user model and its task analysis, interaction of interface, and visual design. The graphical user interface studied in this article belongs to the visual design of the interface design, which is the most intuitive part that digital products present to the user and also the interface between users and digital products to operate each other. Besides, on this basis of the study, by taking the interface design process of smartphone mobile Internet application as the research content, the paper analyses the principle and method of the interface design of smartphone mobile Internet application, emphasizes the user-centred ideas figuring out the whole process of interface design of application would require around the user and task model implementation and development. When the art design develops into a deep level, it not only has a further contact with science and technology, but also surely happens to cross with some branches of culture, such as history, folklore, study of human culture, social psychology, and social ethics. The experiment result shows the proposed method can improve the overall performance for the design of user interface for mobile Internet.

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