Visual Design of Smartphone APP Interface Based on User Experience

Weiqi Qi[1] and Jing Xue[2]

[1]Sichuan University of Media and Communications, Chengdu, China, qiweiqi123@163.com
[2]Southwest Jiaotong University, China, joyxuejing@sohu.com

Corresponding author: Jing Xue, joyxuejing@sohu.com

Abstract. This research uses the interview method to further investigate and verify the user's cognition of the good user experience structure and its influencing factors, and qualitative analysis of interview data to obtain the key characteristics of user experience by scientific method. Finally, with the questionnaire survey, different types of smartphone APP pay more attention to the features of the experience level, emphasize the different experience created by each interaction period between the user and the smartphone APP, and create a smart phone APP interface design process centered on the user experience. So the APP interface designs a more comprehensive and consistent with the target user's operating habits and improves user experience when operating smart phone APP emotional experience. The research of smart phone APP interface design centering on user experience has very important practicality and can guide the theoretical guidance and practice basis in the actual product development process.

Keywords: Visual Design, Smartphone APP Interface, User Experience.
DOI: https://doi.org/10.14733/cadaps.2020.S2.89-99

1 INTRODUCTION

The interface design of the APP is also called UI design, that is, the human-machine interface. Broadly speaking, there is a medium of interaction between the user and the terminal. The user receives the information of the terminal through the sensory and responds to it after self-processing to realize information transformation between people and products. To design a product that meets the needs of the user, it is necessary to understand the user's desired and potential needs in advance. User requirements at different stages will evolve, such as the beginning of the phone is just the function, then the performance, and finally the value and brand. Different users have different pain points, the pain point of the income earners is low price, the demand of high-income users is the experience, and the demand of the mass users for the products is cost-effective and stable. Compared with the current research situation in China, the overseas research results have formed a relatively mature theoretical system. Research on user interface design has summed up the basic theoretical knowledge of user interface design, and has practical value for reference, relevant results proposed by Bhandari et al. [1]. The research topics cover basic theoretical discussions, user interface interaction design, user experience implementation methods,

and visual design rules and so on. JefPaskin's "Human-based Interface" systematically outlines the research results in the field of human-machine interface design. It puts forward that "people-oriented" is the core content of the interface design idea, which is proposed by Feller et al. [2]. Different from the traditional human-computer interaction design, its limitation is only based on the human-oriented interaction design, which emphasizes the user's core position in the interface interaction, the psychological characteristics and needs of the user as the guiding ideology and superstructure of the design [3].

To sum up, the research thinks that the research field of user experience design in our country is still in the initial stage, mainly focusing on the Internet, the development of hand-held mobile terminal and the usability testing stage of the product, which lacks of user experience as the center of the mobile phone APP interface designed for systematic research of the editorial. In addition, its research content is only for graphic, color, text, layout and other elements of a simple exposition. For the smart phone APP interface design and comprehensive research results for the time being in the initial research, Jung et al. introduced that it is necessary from a psychological point of view of the user experience structure and interface design process to explore for the smart phone APP to provide practical value and guiding significance [4, 5].

2 THEORETICAL ANALYSIS OF INTELLIGENT APP USER EXPERIENCE AND INFLUENCING FACTORS OF SMARTPHONE APPLICATION INTERFACE DESIGN

2.1 Smartphone APP and User Experience

1) Smartphone APP

The smartphone has a relatively independent operating system, and the user can selectively install the program APP provided by a third party. A certain number of APP clients use a humanized form of social interaction to connect product designers, developers, operators and users, and optimize products based on user feedback. The current smartphone apps are mostly based on ISO, Android, Windows Phone and other operating systems. App stores can search for various APP apps in the app store corresponding to each operating system. The proportion of applications of various functions in the mobile phone is shown in Figure 1.

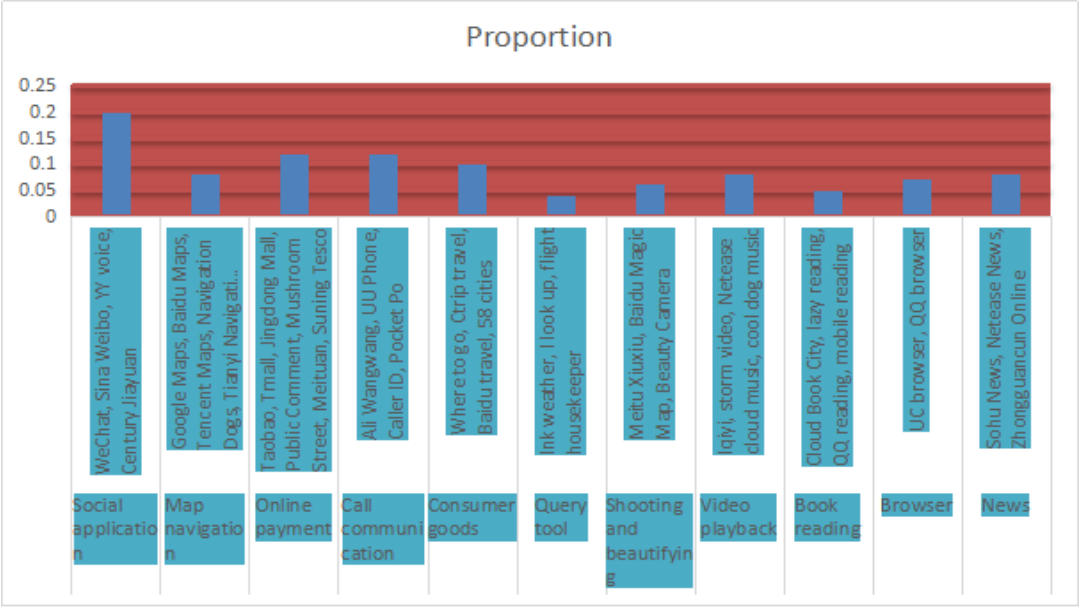

Figure 1: The proportion of the application of various functions in the mobile phone.

These apps are related to all aspects of our lives and can be roughly divided into : comprehensive information, instant messaging, Weibo social, comprehensive shopping, webcast, etc. APP application classification sub-table is shown in Table 1.

Classification	Application
Social application	WeChat, Sina Weibo, YY voice, Century Jiayuan
Map navigation	Google Maps, Baidu Maps, Tencent Maps, Navigation Dogs, Tianyi Navigation, Sogou Maps, Car Network
Online payment	Taobao, Tmall, Jingdong Mall, Public Comment, Mushroom Street, Meituan, Suning Tesco
Call communication	Ali Wangwang, UU Phone, Caller ID, Pocket Po
Consumer goods	Where to go, Ctrip travel, Baidu travel, 58 cities
Query tool	Ink weather, I look up, flight housekeeper
Shooting and beautifying	Meitu Xiuxiu, Baidu Magic Map, Beauty Camera
Video playback	Iqiyi, storm video, Netease cloud music, cool dog music
Book reading	Cloud Book City, lazy reading, QQ reading, mobile reading
Browser	UC browser, QQ browser
News	Sohu News, Netease News, Zhongguancun Online

Table 1: APP application classification breakdown table.

2) User experience

The user experience is generally speaking, the user subjectively feels that this product is not good. This requires the designer to fully consider the user when designing the product, giving the user a comfortable experience. User experience, usually refers to how users feel when they use a product. The user experience can be expressed in another way, namely user experience research. When optimizing a product, the process can be understood as: by observing the user's behavior, analyzing the behavioral data to design a behavioral interaction model. If you want to design a good user experience, you should start with the sensory experience, interactive experience, browsing experience, emotional experience and trust experience.

The sensory experience is the user's experience on the visual elements of the interface. The sensory experience is obviously reflected in the browsing interface. The content (content, navigation information) that the user cares about is opened first, and then the content such as advertisements is opened, thereby reducing the user's waiting anxiety and improving the user experience.

The interactive experience refers to the user's experience when operating the product. Nowadays, large-screen mobile phones are more popular, and designers must design for the interactive way of clicking on the screen. Due to the limitation of the size of the human palm, the finger touch range is limited when the mobile phone is operated by one hand, so the touch range and comfort should be balanced when designing the application function.

The browsing experience is the experience of the user when browsing the interface, including visual hierarchy, content classification, text arrangement, and the like. There are two main modes of browsing: the Z mode for the horizontal F mode and the axis, and the F mode. The initial paragraph, subtitles and points are kept conspicuous. The Z mode has a very good effect on simplifying the layout.

Emotional experience refers to the emotional experience that the interface brings to the user, such as interface color and icon changes with the holiday.

Trust experience, emphasizing reliability, generally includes security, privacy terms, article sources, and detailed information. Emotional experience and trust experience are issues that are considered after the product's basic experience, interactive experience, and browsing experience are designed.

2.2 Mobile Interface Visual Design Based on User Experience

1) Interface design

Interface design involves design art, ergonomics, psychology and computer science. It is a medium for transferring and exchanging information between people and machines. It requires comprehensive consideration based on user's cognition, needs, pain points, background and other factors. An easy-to-understand interface optimizes user operations and facilitates communication with users. User interface design has a very important position in product development. Successful interface design can greatly improve user's use efficiency. Interface design is divided into web design and mobile interface design. Both are in interaction mode, interface layout and operation mode. Greatly different, this article mainly introduces the mobile interface design.

The mobile application interface is the user interface (GUI or UI), and the UI design refers to the overall design of the interface aesthetics and interaction behavior. The standard for verifying the quality of an interface is the user's feelings, so the interface design must be combined with the user at all times, starting from the user experience. The interface design is divided into two directions: interface visual design and interface interaction design. Interface visual design uses visual elements to convey a variety of application information to the user. Interaction design is human-centered, enabling applications to be used simply. Interaction design focuses on the relationship between people and products, focusing on user needs and user experience.

2) Interface visual style

More striking fonts can attract users' attention. Now APP applications are becoming more popular. The use of large fonts can help applications stand out. On the other hand, large fonts are presented on the mobile side, which can give the interface a layered feel and improve the visual weight of text elements. Secondly, the font is large enough and unique enough to enhance the characteristics of the page.

Through subtle dynamic effects or interactions, users can be reminded of the completion of operations and tasks. Dynamic effects can express some functions more naturally, and sometimes more interesting effects can attract users' attention.

The combination of graphic and text design often appeared in news and reading applications. Now, as long as the image is involved in the layout of the app, the designers like the combination of graphic and text. The combination of graphic and textual text fills the picture. The gaps in the hierarchy also make the interface richer.

The blurry background is very similar to the IOS Frosted Glass effect, and it works well with ghost buttons and popular elements to enhance the user experience. A blurred background can only focus on one main color, especially a white-based design, which looks absolutely brilliant and clean under a blurred background. Secondly, you can use face or line graphics more casually. These graphics can respond well to the background, and the fonts are not affected by them, even the ultra-narrow fonts will be clear and easy to read.

The flat design is to remove a complex layer pattern, achieve flattening, and pay more attention to information communication. Flat design for the product, can simplify the interface function layout, highlight the information level, and increase the information transmission rate. Cards often provide users with relevant information quickly in a rectangular manner. Cards are functional, versatile, independent, and interactive. They not only provide information to users, but also interact with users.

2.3 Influencing Factors of Smartphone Application Interface Design

1) Interface Design Overview

Qu et al. introduced that User Interface is a user interaction with the machine and information transmission interface, he user and the machine input and output information, information exchange medium, is a human and a support level in the system interaction [6]. Excellent user interface not only has the interface is simple and beautiful, and it is easy to understand the operation of the guide function. you can also improve the emotional and emotional experience of users to meet the user's level of individual needs and actively participate effectively in the information services and the entire.

2) The physical characteristics of smartphones
There are two types of touch screens used in smartphones, that is, resistive touch screens and capacitive touch screens. Different types of touch screens have different interactive design experiences. The resistive touch screen is made up of two layers of ITO conductive sheets (as shown in Figure 2). When the finger touches and presses the outer panel, the two conductive sheets contact with each other to generate current to complete a touch operation. Resistive touch screen requires a hard touch, which will produce a response with high cost. However, it is easy to be scratched sharp weapon. When the finger touches and presses the screen, the peripheral current is collected at the contact point to complete a touch action [7]. Capacitive touch screen touch experience is very fast, with the characteristics of sensitivity, fluency, but the capacitive touch screen is more costly.

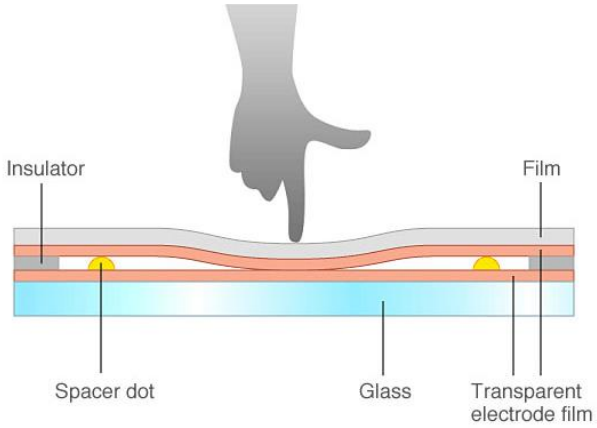

Figure 2: Touch screen of smartphones.

Studies have shown that most users are more appropriate to touch the smallest touch area is 10mm × 10mm area, this valuation is suitable for all touch screen design. The majority of users with one hand holding a mobile phone and interacting on a smart phone mainly depend on human hands to control the touch screen. The layout of the touch screen interface is not only beautiful, but also requires the operation habit of touching the finger and thumb of an object to conform to ergonomic principles as shown in Figure 3.

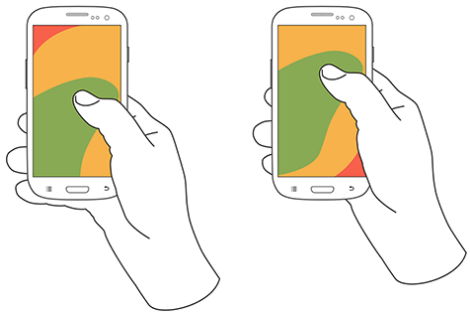

Figure 3: Horizontal and vertical thumb control area.

A gesture is a specific way of expressing and transmitting information. Based on the prompt information on the GUI interface element, for example, a button can be clicked or the scroll bar can be moved. It is concluded that gesture operations of a smartphone can be roughly classified into clicks, hold down and drag, zoom out, stretch, press, pinch, rotate, shake, bump, invert these

11 most common movement gestures (as shown in Figure 4). This is based on the experience of familiar gestures and is user-friendly to grasp, but its low accuracy of operation and poor visibility make it a weak point in its design.

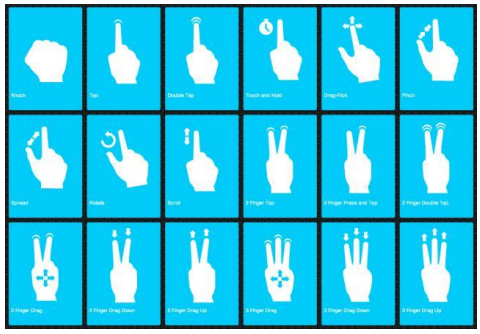

Figure 4: Moving gestures.

3) User factor
Smartphone body smaller, user-friendly, users can operate the phone anytime, anywhere, are free to choose the time and place. From home to the office, the subway to the bus, shopping malls to restaurants, we have been using the phone, and the use of the scene has undergone great changes, before we are sitting in a comfortable chair, lying in bed watching TV talk QQ, browse the web, brush microblogging, and now we often clutch a hand ring on the bus, a hand brush in the Weibo, chat WeChat. Walking along the street while searching the map with a mobile phone, micro channel in the bustling shopping mall, while browsing the bus and waiting for the news, the use of fragmented time to use mobile phones become an important factor affecting the interface design. As shown in Table 2, smartphone users age survey is given in details.

Item	Category	Ratio
Gender	Male	54.4%
	Female	45.6%
Age	less than 18 years	5.80%
	18-24 years	43.3%
	25-29 years	25.1%
	30~49 years	24.2%
	larger than 50 years	1.6%

Table 2: Smartphone users age survey.

4) Technical factors
Human-computer interaction system, the impact of the interface design is the biggest external factors, technology, screen material, hardware performance and operating system and other technical factors directly affect the design of the APP interface. In the practical work, the application of the current technical conditions is very important to the design of the interface. First of all, smartphones have a smaller screen size and lower information capacity than their computer counterparts, and they are larger and can hold more information than regular phones.
5) Envirnmental factor
Environmental factors compared to traditional PCs, smartphones are more portable, which allowing you to interact better with your users' products in any situation. From the previous survey we can see that the use of smart phone APP scenarios mainly include work on the road, subway, quiet classrooms, sunny outdoor venues, before going to sleep at night, and others, the car spare time.

You can always change the phone's use of the scene. The popularity of the usage scenario has also become one of the design factors that affect the smartphone APP interface. The user needs to move in different scenarios and does not feel any inconvenience caused by the application.

$$P(X_t) = \sum_t w_k \eta_k (X_t) \tag{1}$$

3 USER-EXPERIENCE LEVEL MODE-ORIENTED AMART PHONE APP INTERFACE DESING

3.1 Through Competing Product Analysis, User Interviews to Determine the Interface Design Goals

Commodity analysis is a method of comparing several similar products through comprehensive comparison and is widely used in the field of economic research and practice. In the user experience of competing products analysis, more is the same type of products for visual, efficacy and other aspects of design elements are compared, analyzed, which is based on the results of the comparison summarized meaningful design. On the one hand, the purpose of competitive product analysis is to refer to the function and content of the same type of products, to collect and compare the characteristics of the same type of products, and to find out the users' best expected products through effective feedback information.

$$X_1(t) = \begin{cases} 1, \text{if obtain high scores} \\ 0, \text{ otherwise} \end{cases} \tag{2}$$

3.2 Through User Segmentation, the Persona Makes the Result Concrete

Due to the difference of users, they can be divided into different groups according to different user needs. For the lifestyle service APP, user experience assessment questionnaire can be through the early target users to determine further user information collected from the demographic indicators to be divided, such as age, gender, work, education. To develop subdivision criteria, we can determine the specific characteristics of the description through the subdivision of the user description, relevant results proposed by Saiprasert et al. [8]. Characters are prototypical characters with distinctive personality traits formed by the common characteristics of the target customer groups, and are widely used in the design field.

$$X_2(t) = \begin{cases} \dfrac{1}{a}, \text{if it is specific} \\ 0, \text{ otherwise} \end{cases} \tag{3}$$

3.3 Determine Design Direction and Product Characteristics Based on User Experience Level Model

To determine the product features, you can keep the final product close to the design goal, closer to the user's expectations. According to the user experience level model, the characteristics of the product can be determined. Specifically the implementation process is used to determine the smartphone APP in the user experience level model category and product features. In the design goal determination stage, positioning the final experience level of the product can make the positioning of the product more accurate and make the final designed smart phone interface effect closer to the initial goal.

$$X_3(t) = \begin{cases} \beta^2, \text{if it follow the direction} \\ 0, \text{ otherwise} \end{cases} \tag{4}$$

It can be seen from Figure 5 that although the running time of the model is slower than that of the classical PM model and wavelet depreciation, the running time of the NLM method, BM3D method, Non-iterative method and Iterative method is faster. In this paper, the second-order micro-component curvature modulus is used to detect the operator, and the least-squares algorithm is used for closed-value optimization.

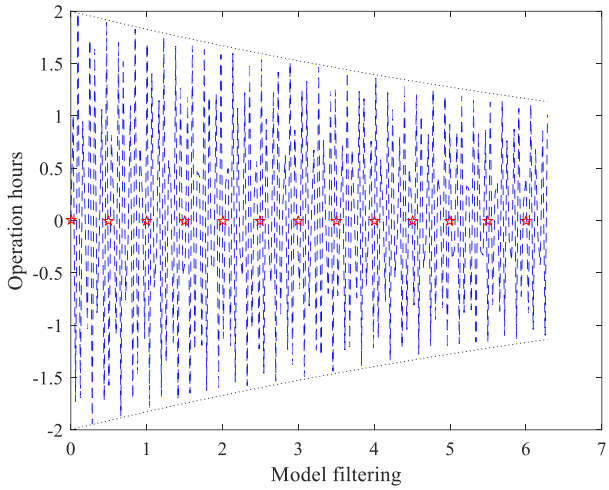

Figure 5: Run time of the Smartphone APP Interface.

3.4 Visualization Design Method of Smartphone APP Interface Based on User Experience

The user's cognition is influenced by factors such as education level, life experience and cultural background [9,10]. When the user operates the app, interacting with the APP can generate a certain emotional resonance. Therefore, in the design of the intelligent public transport APP, it is necessary to meet the cognitive characteristics of users with lower cognition among such users. By creating a certain situation, the user is given an immersive feeling and brings a certain emotional resonance to the user.

In the APP design process, it is also necessary to experience the user's experience of using the APP, observe the user's operational behavior habits from a practical point of view, tap the user's pain points and needs, and design a product that conforms to the user's behavior habits [11]. The design method that conforms to the user's behavior habits is mainly reflected in the product interaction. When designing the product, it should always be user-centered and convenient for users to operate. The APP operation should be simple and fast, the interaction and information level are clear and easy to understand, and the steps of the user operation should be minimized. The products that meet the target user behavior habits can be closer to the user's needs and improve the user experience.

3.5 The process of Interface Design and Wireframe Design

Interface design flow chart is a graphical representation of the user interface to build the image of the basic process of design can be seen as a guide to the design process (as shown in Figure 6). The diagram is conducive for designers to step by step organized design, but also conducive to effective communication between different design departments. And new users and complex processes have a good logical guidance [12]. Wireframe is a graphical representation of the design of the mobile phone APP based on the flow chart and the center. It shows the basic structure of the page and the basic relationship between the pages. Wire-frame diagram in accordance with

the priority of information on the logical relationship between a good description of the interface design provides a graphical blueprint.

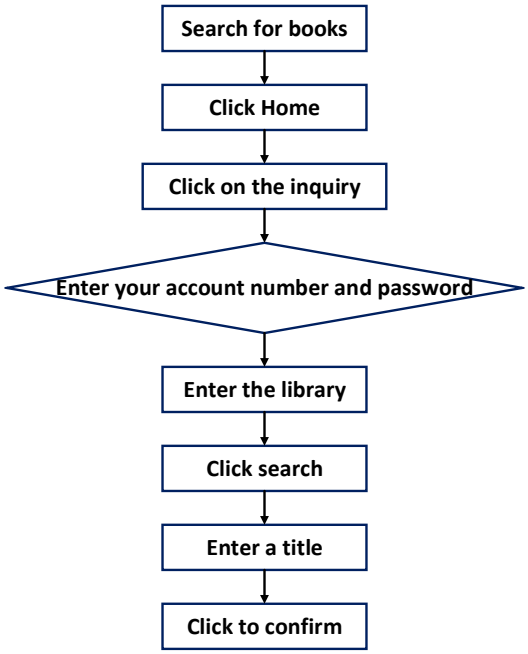

Figure 6: Flowchart of APP design.

3.6 Design Example

During the design process, the user needs are taken into account. The strength of the user's needs can increase the viscosity of the product, but also invite users to join the design process. Users not only in the early design process put forward needs, but also in the process of testing the interface plays an important role in the positive feedback, which can be made to provide the basis for the final assessment experience [13]. Because this article mainly discusses the information interface, interactive mode, psychological cognitive habits and behavior-related factors in the interface design of smartphone APP, and does not make any further research on the user's physiological characteristics, emotion and ergonomics. As shown Figure 7, we give an example of the visual design of smart phone APP interface based on user experience.

Figure 7: Example of APP design.

4 CONCLUSIONS

This research uses the interview method to further investigate and verify the user's cognition of the good user experience structure and its influencing factors, and qualitative analysis of interview data to obtain the key characteristics of user experience by scientific method. Finally, with the questionnaire survey, different types of smartphone APP pay more attention to the features of the experience level, emphasize the different experience created by each interaction period between the user and the smartphone APP, and create a smart phone APP interface design process centered on the user experience. So the APP interface designs a more comprehensive and consistent with the target user's operating habits and improves user experience when operating smart phone APP emotional experience. The research of smart phone APP interface design centering on user experience has very important practicality and can guide the theoretical guidance and practice basis in the actual product development process.

ACKNOWLEDGEMENT

This work is supported by the Research center for reform and development of newly-built universities in Sichuan province in 2019 (No. XJYX2019B08); Special project of Sichuan University of Media and Communications in 2017 (No. CM17C018); Comprehensive reform project of Sichuan University of Media and Communications in 2018 (No. CM18C012).

Weiqi Qi, https://orcid.org/0000-0002-4914-510X
Jing Xue, https://orcid.org/0000-0001-8569-2349

REFERENCES

[1] Bhandari, U.; Neben, T.; Chang, K.: Effects of interface design factors on affective responses and quality evaluations in mobile applications, Computers in Human Behavior, 72(6), 2017, 525-534. https://doi.org/10.1016/j.chb.2017.02.044.
[2] Feller, N.; Amann, A.; Müller, U.; Application of a simulation-based software tool for the prospective design of it work places, Advances in Neuroergonomics and Cognitive Engineering, 89(1), 2017, 87-96. https://doi.org/10.1007/978-3-319-41691-5_8.
[3] Hsiao, S. W.; Lee, C. H.; Yang, M. H.: User interface based on natural interaction design for seniors, Computers in Human Behavior, 75(9), 2017, 147-159. https://doi.org/10.1016/j.chb.2017.05.011.
[4] Jung, W.; Yim, H. R.: An empirical study on the relationship between user interface design attributes in smartphone applications and intention to use, Advanced Multimedia and Ubiquitous Engineering, 76(2), 2017, 81-84. https://doi.org/10.1007/978-981-10-5041-1_14.
[5] Liu, N.; Yu, R.: Identifying design feature factors critical to acceptance and usage behavior of smartphones, Computers in Human Behavior, 70(2), 2017, 131-142. https://doi.org/10.1016/j.chb.2016.12.073.
[6] Qu, Q. X.; Zhang, L.; Chao, W. Y.: User experience design based on eye-tracking technology: a case study on smartphone APPs, Advances in Applied Digital Human Modeling and Simulation, Springer International Publishing, 2017, 34(4), 303-315. https://doi.org/10.1007/978-3-319-41627-4_27.
[7] Wei, Y. L.; Qian, C. Y.; Jun, Li, J.: Modular design of mobile APP interface based on the visual flow, Automatic Control and Computer Sciences, 53(1), 2019, 56-62. https://doi.org/10.3103/S0146411619010127.
[8] Saiprasert, C.; Pholprasit, T.; Thajchayapong, S.: Detection of driving events using sensory data on smartphone, International Journal of Intelligent Transportation Systems Research, 15(1), 2017, 17-28. https://doi.org/10.1007/s13177-015-0116-5.

[9] Hussain, J.; et al: Model-based adaptive user interface based on context and user experience evaluation, Journal on Multimodal User Interfaces, 12(10), 2018, 1-16. https://doi.org/10.1007/s12193-018-0258-2.
[10] Hussain, M. J.; Lu, L.; Gao, S.: An RFID based smartphone proximity absence alert system, IEEE Transactions on Mobile Computing, 16(5), 2017, 1246-1257. https://doi.org/10.1109/TMC.2016.2591524.
[11] Shaheen, S.; Cohen, A.: Martin, E.: Smartphone app evolution and early understanding from a multimodal app user survey. disrupting mobility, Distributed Mobility, 67(6), 2017, 149-164. https://doi.org/10.1007/978-3-319-51602-8_10.
[12] Tan, W.K.: The relationship between smartphone usage, tourist experience and trip satisfaction in the context of a nature-based destination, Telematics & Informatics, 34(2), 2017, 614-627. https://doi.org/10.1016/j.tele.2016.10.004.
[13] Javadi, E.; Gebauer, J.; Mahoney, J. T.: The impact of user interface design on idea integration in electronic brainstorming: an attention− based view, Working Papers, 14(1), 2019, 1-21. https://doi.org/10.1155/2013/107975.