

# *Research on Information Visualization Based on User Experience (UX)*

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**Abstract:** With the vigorous development of digital information technology, more and more products and mobile applications have become more and more diversified in our daily life and product interaction. In the digital age and new media, most information transmission is done through images rather than text messages. Since images are expressed through visual symbols and expressions, the simplicity of information visualization is essential for effective information transmission. The main purpose of this research is to study the types of information acceptance through the basic research of user experience (UX) visualization theory, analyse how text information can be effectively visualized output, propose a visualization framework based on user experience, and transform text information visually through various interactive methods, bring new thinking and reference to visual design based on user experience.

## 1. Background

Information visualization first appeared in the 18th century, and it has been developed into today's visualization principles and methods by several researchers including Jacques Bertin and Edward Tufte. As a professional research field, data information visualization began in 1990. In recent years, it has been called data visualization, visual analysis, and information chart design. With the development of modern industry and technology, information design, as a mature expression carrier, from the 18th century to the beginning of the 20th century, charts, maps, pie charts, timetables, etc. appeared, laying the foundation for today's information design. With the emergence of charts based on objective scientific data, the importance of information visualization as a way of accurately grasping social phenomena and adopting visual presentation methods based on the phenomena is increasing.

As early as 22000 BC, the animal murals in the Lascaux Caves in France tried to express the information necessary for human survival in a visual form. The mural expresses how to visualize various situations, such as how to hunt, according to the size and position of the animals during hunting, so that they can be used as effective information.

## 1.1. The Concept of Information Visualization

At present, there is still no clear definition of information visualization in academia. In 1989, information visualization was proposed by Stuart K. Card, Jock D. Mackinlay, and George G. Robertson. It is a multidisciplinary field with the purpose of Study the visual presentation of large-scale non-numerical information resources. Information visualization is the conversion of textual information, data, knowledge, etc. into visual forms, making full use of the audience's natural ability to quickly recognize general education patterns. Specifically, it refers to the use of text, graphics, animation, film technology, as human-computer interaction technology to provide people with a means of information transmission.

As the visual form of text information, there are multiple forms such as graphics, illustrations, maps, charts, and physical images. Through the presentation of visual information, according to the purpose of delivery, image, printing, space and other media characteristics, it can be delivered to the audience in a planned way. When applying visual forms to information, the characteristics of the information content, the characteristics of the information delivery medium, and the characteristics of the information receiver should be considered.

The most representative information chart in history is the French engineer Charles Joseph Minard (Charles Joseph Minard) drawn Napoleon's crusade in 1861 (Figure 1), which described in detail the failure of Napoleon's crusade to Moscow in 1812. In the infographic, key events such as the size of the army, the number of casualties, the latitude and longitude position of the army march, temperature changes, and key battles are shown in detail. This information chart effectively displays the entire historical event, and is often used as a classic teaching case in statistics and design.

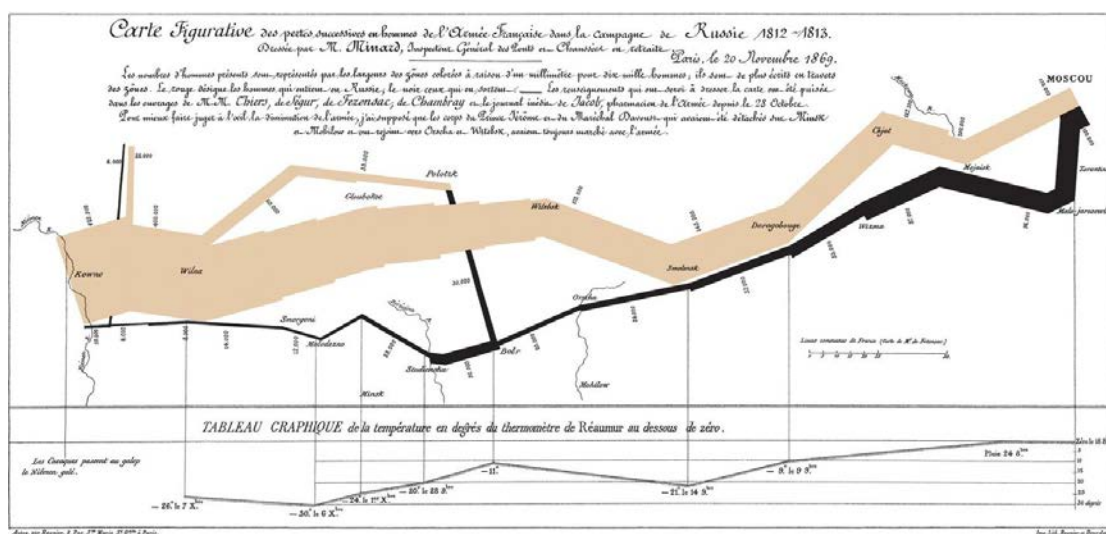


Figure 1: Napoleon's Crusade Infographic.

Information visualization transmits complex information to the audience simply and clearly through graphics, charts, digital styles, etc. After the designer fully analyses, organizes, categorizes, understands, and refines the information, he visualizes it to make the audience the most direct Way to get the information you need. Information visualization has been closely related to our lives. People receive thousands of information and data every day. The way of information visualization can help realize the indirectness and directness of information.

## 1.2. User Experience (UX) Concept

At present, mobile application devices have occupied most of our lives, and the concept of User Experience (UX) is receiving more and more attention in various fields. The user experience overview can be the actions, experience, and feelings of the operator when using a tool or a service, involving the dual interaction between people and products. The concept of "user experience" was first proposed and promoted by American cognitive psychologist Donald Arthur Norman in the mid-1990s. In his book "Emotional Design", he mentioned that there are three levels of design: instinct the design of levels, behaviour levels, and reflection levels. It refers to the higher level of spiritual and emotional feelings that can be brought about by product design from the surface impression and the experience of the product experience in the use process. These three levels can influence each other. [1] In 2014, Xin Xiangyang first put forward the academic viewpoints of paradigm shift of "experience as design object" and "from user experience to experience design" at IXDC (International Experience Design Conference) and UX Australia (User Experience Conference in Australia), and experience as a special group of people A special experience in a specific scene becomes the object of design. [2] In general, user experience focuses on the operations that occur between people and products in a certain context, which makes people do, think and feel. Then for different scenarios, different experience design thinking is required. The perspective focuses on the needs of people.

## 2. The Performance Type of Information Visualization

In the context of the era of big data, information visualization expresses more and more diverse elements and methods. According to the content and purpose of information performance, visual performance types can be divided into the following four types: spatial performance, time performance, attribute performance and narrative performance.

### 2.1. Space Performance

Spatial information visualization maps are divided into geographic knowledge explanations, spatial layout descriptions, etc. Spatial information views are widely used. Traffic route maps, visual guide views, and plane or three-dimensional maps belong to the application category of space. The space category mainly uses location marking symbols and line visual symbols for visual representation. The information view of the space category can vividly enable the audience to obtain a clear route, clarify their position in it, save the audience time, eliminate the audience's worries, and increase the audience's travel interest.

### 2.2. Time Performance

The scope of application of time-based information views refers to the development process of events, historical changes of events, and one Series plans, etc., the time-based information view is based on the time sequence of the information, movement changes, logical relationships, etc. [3]

The type of information view designed by clues is logical, continuous, and coherent. Time-based information. Images are often visually represented by oriented lines, allowing the audience's visual sight to move with the lines, allowing the viewer to the person understands the development process of things more intuitively.

### **2.3. Attribute Class Performance**

The attribute information view refers to the visual representation of the nature, composition, structure, and function of things. The attribute information visualization view usually adopts schematic diagrams, cross-sectional views, explanatory diagrams, etc.

Representation allows the audience to understand the phenomenon, attributes, structure and composition of objects in the most intuitive way non-representational information.

### **2.4. Narrative Performance**

The narrative information view is a graphic description of the story. The story can be fictitious or real. The narrative information view is based on the designer's full understanding of the story, and the key to extracting the story Plot, and then visually represent the plot of the story.

## **3. Starting from the User Experience (UX)-the Type of Information Recipient**

### **3.1. Cognitive Demand Type**

Cognitive needs refer to the need to transform cognition into intrinsic motivation in the cognitive refinement activities based on their engagement in stimulating information processing behaviour, and the frequency of individual thinking activities differs. In other words, information recipients with high cognitive needs essentially like to think and make the relationship between induction and events obtained through their own cognitive understanding, while information recipients with low cognitive needs are reluctant and avoid it. Circumstances that require recognition of needs or actions.

### **3.2. Emotional Intensity**

Emotional intensity is defined as "response to stimuli that cause emotions." [4] It is defined as "the intensity of emotions experienced by people" and is conceptualized as "the steady difference in the intensity of emotions experienced by individuals". Early empirical research on emotional intensity focused on the validity, reliability and conceptual independence of emotional intensity. Many studies have found individual differences in typical emotional intensity centred on personal emotional experience. Recipients with high emotional intensity will experience stronger positive reactions when they are stimulated by positive emotions, and stronger negative reactions when they are stimulated by negative emotions. In summary, recipients with higher emotional intensity are more social and active than recipients with lower emotional intensity, and they also show more emotional reactions.

## **4. User Experience Visualization Framework**

### **4.1. Theory of User Experience Design Process**

In order to propose a product visualization framework that reflects the concept of product user experience, it is necessary to define the design and planning process of the product user experience concept. In other words, you need to consider asking questions, defining questions, and proposing concepts throughout the design process. In 1994, K. Ulrich and S. D. Eppinger systematically proposed the methods of product planning and customer needs research and development processes. In 2005, the British Design Committee proposed the double diamond model and scientifically explained the model. In the book "IDEO, Design Changes Everything", Tim Brown starts from a

human-oriented design point of view, and uses creativity to solve problems in the design process, bringing life, organization, products and services into the society as a whole and enterprises to explore new alternatives [5].

## 4.2. Visual Framework Model of User Experience Design

Humans perceive external stimuli or the environment through five senses, and users make individual responses to external stimuli through body organs, and communicate through continuous connections and repetitions. This process can be described as a series of cyclical user experience flows. External stimuli (output) are input to humans, and humans respond (output) to external influences (inputs). Therefore, for a continuously connected user experience, the design of the product/system should allow users to select and realize a state that enables users to obtain and recognize information and communicate effectively by considering the characteristics of each interaction step. In this study, the visual, auditory, tactile, and motion, GUI (graphical user interface), AUI (auditory user interface), PUI (physical user interface), and TUI (contactless user interface) framework models presented in the interaction model (Figure 2: Human-system interaction framework model).

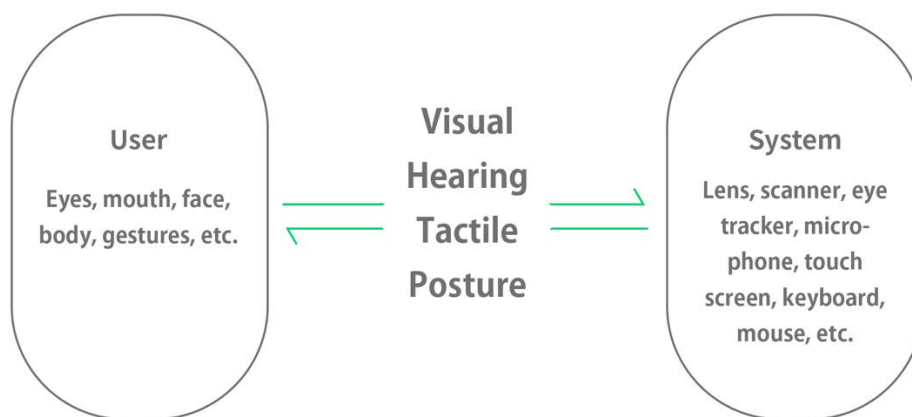


Figure 2: Human-system interaction framework model.

## 4.3. Visual Framework Design Method

According to the framework model, it is necessary to pay attention to the response between the user and the system. The system responds to changes in the user's thinking, actions, and behaviours, and the user needs to learn and understand the system.

### 4.3.1. Clearly Display Information and Data

First of all, in the process of information and data screening, it is necessary to clarify the ultimate purpose and audience group of information visualization, and select the appropriate information visualization performance type to carry out the design based on the acquisition of real and effective information and data. We can understand that the purpose of information visualization is to make information transformation simpler and easier for the audience to understand. The most important thing in information visualization design is to convey the theme of the information. Every information visualization expression method must be designed around the theme, which is required

in the design. Reasonable arrangement, reasonable simplification, highlighting the key points, and making it easier for the target audience to understand.

#### 4.3.2. Use Reasonable Graphics for Information Conversion

In today's information explosion, we are filtering useful or effective information for ourselves every day, and attractive information is the easiest to enter the public's field of vision. For example, information visualization can use histograms and pie charts to represent values. This is the conversion from numbers to geometric figures. These geometric figures can also be converted into specific figures in the design.

#### 4.3.3. Use General Knowledge to Make Connections

According to the audience's background, culture and understanding foundation, daily simultaneous vision can be used for visual transformation, which is convenient for the audience's understanding and cognition. At the same time, it can be combined with one's own understanding, allowing the audience to discover new information after relevance.

#### 4.3.4. Create Multi-Dimensional Dynamic Display

Information visualization is integrated into people's lives, and the way in which information is displayed is very important. The visual design must conform to the audience's reading habits, and the law of sight flow can show the effect of time and space. Compared with the static method, the dynamic display method is more vivid and can attract the attention of the audience, which is more conducive to the transmission of information.

### 5. Conclusion

In summary, with the development of interactive technology and smart devices, the way we interact with products in our daily lives is expanding in various ways. When more and more information is presented, textual information is gradually presented through visual information, and we need to consider the different responses of recipients. In such an environment, designers need to be able to visualize and present user experience (UX) concepts through various modal elements. The purpose of this research is to propose a model framework to help designers consider the "human-system" user experience model in an all-round way, and transform information visualization into specific interaction methods that can be correlated with actual implementation.

Through user analysis and research on the level of information recipients, try to explore how to deliver more accurate information in information transmission. Therefore, it is necessary to examine the research results through more case studies and practical project applications in the future, and the visual expression of applicable information in more diverse themes and situations. Through this theoretical basis, the information visualization framework can be further refined, objectively and quantitatively provide information visualization materials, and explore more ideas for the academic development of design, thinking, education and related fields.

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