



Research on Innovative Application Mode of Human-Computer Interaction Design in Data Journalism

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Abstract. In the context of intelligent communication, with the advancement of artificial intelligence technology, technologies such as voice interaction, image recognition, gesture recognition, and brain-computer interface have been further developed and used, and interactive data news is also considered to be the development of data news trends and directions. However, the current human-computer interaction technology used in data journalism is relatively simple. And it still has some problems. In the future, interactive visualization needs to improve its interactive operation and immersive experience. At the same time, it needs to update data in real time and achieve advanced interaction, encourage crowdsourcing production, and combine VR technology to give users a stronger sense of “presence”.

Keywords: Human-computer interaction design · Data news · Application model

1 Introduction

Intelligent technology is changing the form of communication, and intelligent communication with human-computer interaction as the core is beginning to emerge. In the context of intelligent communication, as computer technology is increasingly integrated into all areas of human life, human-computer interaction is with us anywhere, anytime. Human-computer interaction design has gradually expanded from primitive graphical interface interaction to voice interaction, gesture recognition, and brain-computer interface. At the same time, with the advent of the era of big data, data journalism based on massive amounts of data has become a new force and entered the journalism industry in the third wave of revolution. Contemporary data journalism is part of the digital journalism industry. One of its characteristics is the use of interactive technology, which gave birth to interactive narratives. Data journalism on the new media platform also innovates the expression of news narrative with the help of interactive narrative. Data shows that two-thirds of the “Best Visualization” works in the Data Journalism Award

use interactive visualization to varying degrees [1]. This has transformed the form of data news from a single static information chart into an interactive data visualization work. Interactive data journalism is also considered the trend and direction of data journalism development. However, there are still a lot of problems in the design of human-computer interaction in current data journalism. Human-computer interaction technology has not been developed simultaneously because of the achievements of information technology. The current human-computer interaction method used in data journalism is still based on the traditional one-handed one-eye mode [2]. This article will first briefly introduce the design of human-computer interaction. Then sort out the current status and shortcomings of human-computer interaction design in data journalism under the background of intelligent communication. In the last part, this article will explore new models of innovative applications of human-computer interaction design in data journalism.

2 Advantages of Human-Computer Interaction Design

Human-computer interaction is a technology that studies people, computers and their mutual influence. Human-computer interaction is the communication between humans and computer systems. It is a two-way information exchange of various symbols and actions between humans and computer systems. Here “interaction” is defined as a kind of communication, that is, information exchange, and it is a two-way information exchange. The user can input information to the computer, and the computer can feed back information to the user. This form of information exchange can appear in many ways. For example, the keystrokes on the keyboard, the movement of the mouse, the symbols and graphics on the display screen, etc. It can also exchange information with sounds, gestures or body movements. First of all, human-computer interaction design has a wealth of interactive means. It can be human body parts, such as human body, hands, feet, head, eyeballs, expressions, postures, etc. Through these means, users can perform various interactive behaviors such as voice interaction, motion recognition interaction, and eye tracking. In addition, interactive devices can also be used as a means of human-computer interaction. Such as common interactive devices such as mouse, keyboard, interactive handle, etc. The user can select a certain point or area in the image through the mouse or keyboard, and complete operations such as zooming and dragging the virtual object at that point or area. This type of method is simple and easy to operate, but requires the support of external input devices.

Secondly, the human-computer interaction design has a direct and efficient operation mode. Machines are an extension of human functions. If humans can control machines as easily as their own bodies, the gap between humans and machines can be completely eliminated. Human-computer interaction design can enable humans and computers to achieve as efficient and natural interaction as between humans. Artificial intelligence technologies such as speech recognition, image analysis, gesture recognition, semantic understanding, and big data analysis can help computers better perceive human intentions. This makes the user's operation more direct and efficient. At the same time, the humanization of human-computer interaction is also improved. It also eliminates tedious commands or menu operations. Humans can control machines more easily, and machines have become an extension of humans.

Finally, the human-computer interaction design enables users to have a more realistic experience. One of the main characteristics of virtual reality technology in human-computer interaction technology is “immersion.” Virtual reality technology presents users with more realistic visual images by constructing three-dimensional virtual scenes. At the same time, it provides functions such as experience interaction, cultural guidance and interactive communication, allowing users to interact with the elements of the three-dimensional scene through the participation of multiple dimensions such as sight, hearing, touch, and smell. So that the user can be immersed in the virtual scene. It guides users to a sense of immersion from both physical and psychological aspects, and gives users a more realistic experience.

3 Current Status and Shortcomings of Human-Computer Interaction Design in Data Journalism

Thomas Rollins believes: “News organizations must realize that news is pushed through computers, and the essence of computers is interaction. The notion that news organizations rely on static and non-interactive ways to attract audiences is outdated [3]”. Therefore, the use of human-computer interaction technology in data journalism can provide a large amount of valuable data to users in a personalized way to achieve accurate information dissemination. In addition, a good interactive experience can attract more users, guide more users to participate, and achieve deeper communication effects.

Current data journalism uses multiple dimensions and highly expressive interactive visualization works to present news events. At the same time, it is supplemented by text explanations, showing a new reporting mode. Through interactive visualization works, users can obtain news content by clicking on the mouse, moving interactive elements and so on. The use of human-computer interaction design has changed the linear reading mode of traditional news, and greatly stimulated users’ desire to explore. And to some extent, it also gives users greater autonomy. At the same time, the use of interactive data tools has gradually become a trend. When users use interactive data tools while reading, the background will collect the audience’s behavior and the data that users generated in real time according to the interactive instructions that have been set. Then the background will analyze the collected data. In the end, the background will push personalized information to the audience. We often see the emergence of data tools in interactive data news, such as calculators for calculating numbers, geographic data tools for positioning, etc. The “New York Times” data news section once posted an interactive data news called “Is It Better to Rent or Buy?”. Through this work, users can calculate the cost of renting a house and buying a house. It can help users to judge whether renting a house or buying a house is cost-effective. It is precisely because of the use of these interactive data tools that data journalism is more functional.

Although the application of human-computer interaction design in data journalism has made great progress compared with before. However, the advantages of human-computer interaction design are not perfectly reflected in the current data news creation.

First of all, the current data journalism using human-computer interaction technology is relatively small, and the interaction method is relatively single. Although voice interaction, gesture recognition, and somatosensory technology have made great progress at

the application level, they are still less used in data journalism. Most of the interactive technology in data journalism is graphical interface interaction. However, most graphical interface interactions are done through mouse clicks, keyboard input and touch controls. On the surface, touch seems to liberate the mouse and keyboard. But in essence, it is no different from a mouse click. This single repetitive operation will bring fatigue to the user [4]. In addition, this type of interaction that requires clicks or touches has certain operating difficulties for some disabled people. What's more, when users are immersed in virtual environments such as AR or VR, frequent mouse clicks or touches will reduce the user's experience.

The next, there is a lack of two-way interaction settings in interaction design. At present, the two-way interaction is not strong in most data news works. Most of the data journalism works are simply listings of data and charts. And lack of two-way interaction with the audience. However, the interaction of data news cannot be limited to one-way content delivery, but to supplement and update the data through interaction with users to enrich the content of the news. In the socialized communication pattern of the mobile Internet and media, news is not only for people to "see", but also for people to "use". Technology has turned traditional audiences into users and changed their media behavior. Users become a "combination" of consumers and producers of news content, which is not in the traditional media era.

Then, some interactive data journalism products lack post-maintenance and fail to update the old data and replace the correct data in time. The most important point that interactive data journalism is different from static information schema data journalism and traditional journalism is that it changes the argument that journalism is "fragile". Interactive data news is no longer a one-time display of information. It surpasses the news content itself to a certain extent and becomes an application product with a tool nature. If this kind of non-one-off display is to be realized, the editing team needs to maintain the database continuously, add the latest data provided by the reader, and correct errors in the data. In addition, openness and sharing are not only the basic concepts of data journalism, but also the communication characteristics of the Mobile Internet era. In order to maintain the vitality of news reports, news reports need to continuously update and maintain their core data and news stories. In December 2015, The Washington Post produced a data journalism titled "Investigation: People Shot and Killed by Police This Year". However, after entering 2016, there have been more shooting incidents that caused casualties in the United States. The Washington Post continued to pay attention to this, and on July 27, the journalism was updated. Until 2020, the data is still being updated. This approach effectively extends the communication value of data news products. However, only a small number of interactive data journalism will periodically update the data and perform post-maintenance of the data, which also greatly reduces the effectiveness of some data journalism [5].

4 The Emergence of New Technologies Promotes Continuous Upgrading of Human-Computer Interaction Technology

The development of human-computer interaction is a process from people adapting to machines to machines adapting to people. Summarizing the development history of

human-computer interaction, it can be roughly divided into the following stages. The first stage: the manual operation stage, represented by punched paper. The second stage: the interactive command language stage, where the user operates the computer through a programming language; The third stage: the graphical user interface stage, the Windows operating system is the representative of this stage. The fourth stage: the emergence of intelligent human-computer interaction such as voice interaction and virtual reality [6]. We are currently in the fourth stage of the development of human-computer interaction technology. The development of new technologies has continuously upgraded human-computer interaction methods. The next part will briefly introduce voice interaction technology, virtual reality technology and intelligent interaction technology.

First of all, the voice interaction. Voice interaction mainly includes the following steps. Step one is the voice recognition. The sound wave signal is extracted through a microphone. Next, the vibration signal of the sound wave is converted into an electric signal, and then the electric signal is processed. The signal characteristics after analysis and processing are matched with the text information in the database. Step two is the semantic recognition. Let the computer “understand” the meaning of the sentence through the recognized text information. Step three is the speech synthesis. It can be divided into two parts: online speech synthesis and offline speech synthesis. Online speech synthesis synthesizes a synthetic voice close to human voice through a cloud database, but the sound quality and synthesis rate will be affected by the network environment. Offline speech synthesis requires the user to download the local speech package in advance, and the computer directly calls the local speech package for synthesis after receiving the sentence to be synthesized. Its timbre is slightly inferior to online speech synthesis. But the advantage is that it is not restricted by the network environment, and the synthesis speed is faster [7].

The earliest voice interaction technology is an interactive voice response system. The user interacts by dialing, but the system cannot answer the user’s questions. The system can only broadcast pre-recorded sounds, such as voice mail, dial prompts, etc. Moreover, this interactive voice response system has a narrow application range, low interaction efficiency and a rigid interaction mode. It cannot solve practical problems in users’ lives. Due to these drawbacks of the interactive voice response system, the system cannot solve many practical problems of users. So smart products such as Siri, Google, Mi AI, Amazon Echo, DUER and other voice interactions were born. These voice interaction products combined with AI technology have been widely praised since they came out. The birth and success of the products have accelerated the development of voice interaction technology. With the improvement of AI technology, speech recognition and semantic understanding technologies have gradually matured and perfected, and the humanization of voice interaction has become possible. The form of interaction has also advanced from a mechanical dialogue to a more fluent multi-round dialogue, and can even recognize multiple languages and regional dialects, which makes voice interaction a qualitative leap in flexibility and experience.

The second one is virtual reality technology. Virtual reality technology is actually a kind of simulation technology. It integrates the cutting-edge technology of many disciplines such as computer graphics, human-machine interface, multimedia fusion technology, sensor technology, etc. Virtual reality technology mainly includes the following

aspects. The first one is to simulate the environment. It refers to the computer-generated dynamic three-dimensional images, and requires a high degree of fidelity. Next, it is perception. The ideal virtual reality technology should have all the perception capabilities that humans have. In addition to the visual perception capabilities corresponding to computer vision, it should also have the capabilities of hearing, touch, motion perception, pressure perception and even smell. The last is natural skills. It means that virtual reality can detect and track various human movements, such as head, eyeballs, gestures, limbs, etc. And convert the sensed action signals into data for analysis and real time feedback, where the feedback objects are the user's facial features and skin and other sensory organs. It is mainly realized through interactive devices. Such as eye tracking technology. The eye tracking system can record the user's focus and eye movement. The system uses infrared light to illuminate the human eye. The camera sensor is used to record the human eye response, and the software is used to determine the pupil position and eye direction. Humans mainly perceive the surrounding environment through vision, so the eyes can show what the user is thinking. The device can distinguish the focus of the user's attention and their reaction through the eyes. The advantages of eye tracking technology can be reflected in the experience of games, VR, and AR. Although virtual reality technology is constantly upgrading, it still faces many challenges. Excessive use of virtual reality and technology may affect physical health. For example, the "VR dizziness" symptoms that people often discuss at present refer to the continuous use of VR products for a period of time, which will produce dizziness-like effects similar to motion sickness. This symptom is caused by the inconsistency between the video seen by the vision and the condition perceived inside the body. In addition, the limited sensor accuracy and network transmission speed affect the user experience of virtual reality technology to varying degrees. However, with the application of 5G communication networks, the hardware and software requirements of virtual reality technology will be met [8].

The third one is intelligent interaction. Intelligent interaction is the process of interaction between humans and intelligent systems designed to improve the performance of intelligent systems. It is an effective means to improve robot performance in the field of intelligent robots. Intelligent interaction is also an important part of machine adaptive learning. Adaptive learning means that in the process of human interaction with the machine, the machine accumulates user feedback or actively asks the user for the key information needed for model learning and improvement. And based on this information, the machine will appropriately modify the model and its parameters to improve the accuracy of model prediction. These series of operations will make the model continue to learn and modify, and then improve and evolve itself [9]. Intelligent interaction is currently mainly used in personalized services of service robots. For example, for a home service robot, it needs to adapt to different home environments and provide personalized services for each family member. However, at the beginning, the robot cannot fully establish the cognition of all users. In other words, the robot cannot understand each family member and provide corresponding personalized services. This requires robots to actively learn the information and preferences of different users through intelligent interaction. Then gradually establish relevant cognition and enhance the understanding of each member, so as to better serve different family members. Therefore, the use of

intelligent interaction technology can more accurately initiate functions and responses that are closer to the user's intention. It enables users to obtain a more natural and personalized experience.

5 Innovative Application Models of Human-Computer Interaction Design in Data Journalism

The innovative application of human-computer interaction design in data journalism is fundamentally a deepening of the audience's reading experience and the enhancement of user participation. Charts and data in traditional news only play a supporting role. In data journalism, pictures and data are the narrative language of news. It has the advantages of intuition, image and logical rigor, which enhance the audience's reading experience [10]. When the audience is reading data journalism, they need to actively participate in the work and strengthen the interaction with the work. Therefore, strengthening the application of human-computer interaction technology in data journalism is not only the need for the development of data journalism, but also the need for improving the audience's reading experience in news dissemination.

First of all, it is necessary to adapt to the user's usage habits, while optimizing interactive operations. With the advent of the mobile internet era, the mobile trend of news dissemination is getting stronger and stronger. Obtaining new information through mobile devices has become one of the main ways for users to obtain information. However, most of the interactive visualization data news works at this stage can only be displayed and interacted on the PC, but not on the mobile terminal. Moreover, some visual interactive operations cannot perfectly adapt to the operating habits of mobile client users. Therefore, the interaction designer should start from the user experience. The human-computer interaction design of data journalism should be combined with the mobile screen size, interaction method, and fragmented reading habits of mobile users. As mentioned above, the screen touch interaction method has operational difficulties for some people with disabilities. It will also reduce the user experience. So, mainstream media should pay close attention to the development of intelligent voice information. They can carry out in-depth cooperation with scientific research institutions, technology companies, and terminal manufacturers. Jointly innovate and develop targeted and highly matched intelligent voice interactive data journalism products. When the user interacts with the terminal through voice, it not only eliminates the operational difficulties of some disabled persons, but also optimizes the user experience. Such as the "Financial Times" and Google's "Hidden City" voice interaction project launched at the end of 2018. The first issue focused on Berlin, Germany. It launched a map of Berlin with "hidden information". Readers use voice interaction to unlock hidden content. The president of the "Financial Times" personally introduces the new Berlin airport and tells users which places are worth visiting. At the same time, we need to optimize interactive operations and be good at applying advanced interactions and game interaction design. At present, the visual experience in most interactive visualization reports is too simple and the interactive means are too single. In addition, the interactive picture is too simple to provide users with beautiful reading and immersive experience. Therefore, we should use dynamic interactive views as much as possible in visualized data journalism. We can

try to hide part of the data in the dynamic interactive chart, and guide the audience to click on the corresponding icon to view the relevant data. When the reader manipulates the mouse to interact, it can stimulate the audience's interest in exploring, so that the audience can independently read the data a second time. In addition, the audience can also actively discover and solve problems through the game. The reward and punishment mechanism set up around the problem will also trigger the audience's interest in participation and increase the audience's understanding of news reports. The New York Times specially opened a "You Draw It" section. It is committed to allowing users to deepen their understanding of various social issues and enhance the fun of interaction by drawing diagrams. Advanced interaction and game interaction will become the future development trend of data journalism interactivity. At the same time, it can also bring new reading experience and feelings to the audience.

Secondly, leveraging 5G technology and combining virtual reality technology to give audiences a stronger "presence" experience. 5G technology has the characteristics of high speed, large capacity, low latency, and low energy consumption. It can provide fully mobile and fully connected data support for human-computer interaction technology in data journalism. In addition, sensors and the Internet of Things can generate a huge amount of data information, providing a data foundation for in-depth data reporting. This also provides the possibility for predictive reporting of event development and trends based on authentic data, which is also the value and advantage of data journalism.

Moreover, the use of virtual reality technology can enable users to achieve a high degree of "presence" and "immersion." It allows readers to get close to the scene infinitely and get a "live" experience. Wall Street Journal once in "Nasdaq Coming to Another Stock Market Bubble?" had tried to use VR data visualization. This work uses the combination of VR technology and line graphs to let the audience experience the ups and downs of the Nasdaq Composite Index from 1994 to 2016 in the form of a roller coaster ride. It vividly embarked on an expedition to the American stock market [11]. Moreover, with the continuous upgrading of virtual reality technology, the audience's sense of experience will continue to strengthen. In the future, force feedback technology and eye tracking technology may also be used. It alleviates the decrease in experience when the user is in an immersive virtual environment and must use the virtual keyboard-based text input behavior. Through the use of advanced technical means, to provide users with a new human-computer interaction experience.

Finally, data needs to be updated and maintained in a timely manner. At the same time, users need to be encouraged and guided to crowdsource production. The biggest difference between interactive data journalism and traditional news is that interactive data journalism is no longer a simple one-time data display. It surpasses news content to some extent and becomes an application product with a tool nature. The simple one-time data display in the past has been transformed into a tool-like application product. If we want to realize this kind of non-disposable display, we need the editing team to continuously update and maintain the data, add the latest data provided by readers, and correct and update the data that has changed.

For example, the data news visualization works of Bloomberg and The Guardian pay much attention to the update and maintenance of data. Its interactive works will continue

to update and maintain data within a certain period of time, which is not a simple one-time data display in the past. Among them, The Guardian “Australian Covid-19 Map” will update the works in real time based on data from each state. Bloomberg “Covid-10 Vaccine Tracker” will be updated from time to time based on the latest information. “Comparison of Oil Prices in Various Countries” is updated every quarter. “U.S. State Economic Health Data” and “Bloomberg Best” are updated weekly. “Bloomberg Billionaires Index” uses daily real time data. The data involved in financial reports often changes at any time according to the latest developments in the situation, market and policy changes. Regular updates of data visualization works in the time dimension can not only reduce information misleading caused by expired data to readers, but also show data changes in different time periods through the superposition of new and old data. Provide users with a new perspective on reading and exploration.

Moreover, some data news production is currently affected by traditional news production thinking. That is, producers control the rights of news production, and users cannot participate in news production. As mentioned above, the interaction of data journalism cannot be limited to one-way content delivery, but to supplement data through interaction with users to enrich the news content. For example, the Guardian launched the “Word of the year poll” project in December 2020. It invites the public to participate in the 2020 annual vocabulary selection through public opinion polls. And in a short time, 6185 pieces of data uploaded by users have been sorted out. Then the data visualization team of The Guardian made these data into visual data journalism, and announced the results to the public. The Guardian guides the public to upload data actively. It interprets the data in a visual way, gives the data new vitality, and makes the content of the article more vivid.

6 Conclusion

Negroponte in *Being Digital* had predicted that “The challenge of the next decade will go far beyond providing people with larger screens, better music, and easier-to-use graphical input devices. The challenge will be: Let the computer know you, understand your needs, understand your words, expressions and body language [12]”. Today, the era of intelligent communication has arrived, and human-computer interaction design has also developed rapidly. Interactive data journalism is also considered the trend and direction of data journalism development. Interactive data journalism is a great innovation to traditional journalism forms under the background of the development of human-computer interaction design. As mentioned above, strengthening the application of human-computer interaction design in data journalism is not only the need for the development of data journalism, but also the need for improving the audience’s reading experience in news dissemination. In the future, the interactive visualization of data journalism will be bound closely with the innovation of human-computer interaction design. As a result, a new form of news expression with a higher level of intelligence, a stronger user experience, and a tool nature can be produced. But at the same time, the application of human-computer interaction design in interactive data news also needs to be wary of formalism and technological supremacy. Human-computer interaction design should be human-centered and dedicated to bringing users a better reading and using experience.

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