Research on Data Storytelling Strategies for Cultural Heritage Transmission and Dissemination

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Abstract. Cultural heritage is non-renewable and irreplaceable, which needs to be preserved and passed on. In the digital age, cultural heritage can be brought to life through data storytelling, a communication tool that effectively blends science and technology with humanistic structures, empowering cultural heritage and promoting the transmission and dissemination of culture. The research begins with developing and studying data storytelling in the digital age. The concept and development of data storytelling are reviewed through literature research, and its theoretical basis and three essential elements are analysed: data science, visualisation, and narratology. The design objectives, data framework, and visualisation process of data storytelling in cultural heritage are analysed through desktop research and theoretical studies of the project and literature. Finally, the design strategy of data storytelling in cultural heritage is proposed, conducive to promoting digital humanities research, popularising cultural data information and value dissemination, and telling cultural stories.

Keywords: Cultural heritage · Data storytelling · Visualisation

1 Introduction

In terms of existence, cultural heritage is divided into tangible and intangible cultural heritage. They bear witness to the development and evolution of human civilisation and are the embodiment of the wisdom of working people, as well as a manifestation of the convergence and collision of different civilisations. However, there are still many challenges to the transmission and dissemination of cultural heritage, including the imperfection of traditional protection models, the destruction of geographical and climatic environments, loss or damage during transportation, and the loss of skills due to the loss of inheritors, which require our joint protection and transmission.

In the age of DT (Data Processing Technology), along with the growth of people's spiritual and cultural needs and the development of technological humanism and dataism, cultural heritage is increasingly being disseminated in a variety of forms, including digital composite publishing [1], digital collections, e-museums and others. It gradually forms a more systematic and holistic network of data perception and humanism. Traditional

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forms and models of preservation have proven to be limited and unable to meet the current needs of cultural heritage transmission and dissemination, and it is urgent to preserve cultural heritage and promote dissemination through digital technology [2]. As a tool for information exchange and dissemination that combines technical and humanistic frameworks, data storytelling, in contrast to traditional graphic narratives, use non-linear narratives to deconstruct traditional cultural and artistic forms, weave magnificent networks of values and culture, and enrich aesthetic, cultural experiences [3]. Given the diversity and complexity of cultural heritage information and the differences in perception and understanding among different people, research needs to clarify design goals and processes of data storytelling in cultural heritage and explore data narrative strategies for cultural heritage. The study of data storytelling is necessary and feasible to help promote the living heritage of cultural heritage [4].

For example, in the case of museums, the initial communication strategy was to attract new visitors by organising temporary and permanent exhibitions and updating the collections. However, this traditional approach not only consumed human and financial resources, but also had a limited impact on communication. Since the beginning of the 21st century, museums have been engaged in a digital movement for more than a decade, introducing new technologies such as social media and digital technology to enhance interest in collections and user experience and engagement in the field. Museums have focused on innovative information and communication technologies (ICT), including websites, mobile apps, interactive media devices and other forms of promoting and interpreting cultural heritage through data visualisation [5]. Data storytelling are lightweight, adaptable to various devices and scenarios, flexible, efficient and less costly to produce.

2 Background

The systematic theoretical study of data storytelling in academia and the formation of an academic community in the field can be traced back to 2001. Between 2001 and 2007, the open-ended challenges of digital narrative were explored by two European conferences of groups of researchers and developers (the International Conference on Virtual Narrative and the International Conference on Interactive Digital Narrative and Entertainment), which also facilitated exchanges and collaborations between scholars and developers across disciplines and fields. These two conferences were merged in 2008 to form the International Conference on Digital Narrative, with research findings covering multiple perspectives on digital narrative theory, technology, and practice [2].

The first forms of "data narratives" were Digital Storytelling or Virtual Storytelling, Interactive Storytelling, which focused on real-time and non-linear output and restructuring of storytelling forms through virtual reality technology; they have evolved into several other different conceptual representations, including Visual Storytelling [6], Data-driven Storytelling, and Analytical Narrative. It has evolved into several other different conceptual formulations, such as Visual Storytelling, Data-driven Storytelling, Analytical Storytelling, Storytelling with data [7]. Although digital storytelling are different from data storytelling in terms of their conceptual origins and development paths, there is still a great deal of overlap in their use in academic circles. Data storytelling have more diverse connotations than digital storytelling in terms of conceptual extension.

Data has gradually been integrated into people's daily lives and has become an integral part of information access. More and more content creators, guided by data science, are collecting, organising and processing complex raw data and information through data storytelling, in the form of charts and interactive interfaces that allow users to access and understand and remember critical information more intuitively and transparently. These digital forms are better than raw data tables and large amounts of textual information for effective communication, cultural and conceptual resonance and value realisation. Therefore, data storytelling require three essential elements: theoretical support from data science, visualisation tools, and narrative realisation channels [8]. 1) Data science originated in the 1960s with research related to data analysis, and in 1974 P. Naur defined the concept of "data science as a science-based on data processing", which encompasses various fields such as statistics, data analysis and scientific methods, aiming to treat data as an object of study and uncover its value. In the technical system of digital humanities, the reconstruction of knowledge, the reconstruction of scenarios, the description and representation of digital humanities, must be guided by theory and data [9]. 2) Visualisation is often used to represent the relationships between data. Rather than a single representation of local facts, data visualisation analyses, compares and maps a collection of multidimensional data to resolve connections, improve the audience's perception of information and show how the nature of the object of study is related to the phenomenon. The choice of visualisation strategy has a significant impact on the public's understanding of the information [10]. 3) Narrative is the fundamental way in which humans make sense of the world. It is a technique for telling facts, expressing opinions and clarifying ideas through stories. An overview of the data is presented by visual charts and graphs, while the narrative adds the specific context in which things happen. The two work together to enhance the appeal of cultural heritage to the public, increase the user's understanding of complex facts and data, and improve the efficiency of sharing and reception.

3 Research Methods

Compared to traditional textual narratives, data storytelling are more compelling in presenting the cultural connotations of cultural heritage, the current state of research and development, and the degree of intrinsic logical connection and relevance to audiences. The research begins with the dilemma of cultural heritage in today's digital age and is divided into three steps. Firstly, the research and analysis of literature on the preservation and development of cultural heritage in the digital humanities and interviews with researchers and relevant practitioners on the digitisation of cultural heritage were conducted to filter valid information and analyse the design objectives of the cultural heritage data narrative. Secondly, the data frame structure of cultural heritage is constructed, which is mainly explained in terms of data collection and data classification. Finally, based on the theoretical model of previous data visualisation processes, a visualisation process suitable for cultural heritage is proposed based on the inherent properties of cultural heritage [11].

3.1 Design Objectives for Data Storytelling in Cultural Heritage

Cultural heritage is an integral part of the development of human spiritual civilisation and can fully inspire national identity and pride and promote cross-cultural exchange and dissemination. Cultural heritage data narrative refers to preserving cultural heritage by digitally capturing, processing, displaying, storing and disseminating it by technological means. Through the integration and reproduction of data, cultural heritage is turned into a digital form that can be shared and regenerated, and the needs are fully explored, interpreted and preserved in a new perspective and innovative way. Therefore, the design objectives of the cultural heritage data narrative can be divided into three areas. 1) Data is one of the manifestations of information and reflects things' objective and essential properties. People can quickly obtain information from the processed data. The use of computer technology and information technology to collect data on cultural heritage scientifically can support the conservation of cultural heritage. Traditional forms of summarising cultural heritage often require manual recording and filming by professionals, and teaching by word of mouth and other forms of transmission between inheritors, which is less efficient. Digitally extracting and integrating data related to cultural heritage and presenting it as a digital narrative can balance the depth and breadth of information with visual presentation, enhancing the efficiency of reading and understanding for audiences and promoting the standardised preservation and dissemination of cultural heritage archives. 2) The themes of data storytelling should be clear, simple and original, and set in the context of the needs of the times and development trends to stimulate people's curiosity and desire for exploration. Data storytelling are a way to promote the transformation of cultural heritage from the "intangible" to the "tangible" [12], and to educate and disseminate cultural heritage on both a technical and spiritual level. For example, in the transmission of intangible cultural heritage, the main subject should be the performance and production process of the inheritors, which is also the core content of display and dissemination. Data storytelling for this type of cultural heritage should not be limited to static and passive local displays. However, they should be more comprehensive and holistic, incorporating dynamic data displays and interactive experiences, and dedicated to enabling people to understand and experience ICH skills holistically. 3) The data narrative should focus on the narrative logic of cultural heritage, with a rational planning of the data framework of cultural heritage and corresponding data classification according to the specific types of cultural heritage. Categorising data with common attributes according to the attributes of the data objects will also enhance the use of data information and integration efficiency. The researchers have been able to organise and summarise the data information in a way that helps people to access, understand and remember cultural heritage information more efficiently.

3.2 Data Framework for Cultural Heritage

Data Collection for Cultural Heritage. Data acquisition refers to the collection and collation of text, images, audio and video, motion capture, 3D modelling and virtual reenactment of cultural heritage through digital technology and equipment, and is a fundamental part of data narrative. In order to better accommodate diverse data types and formats, the way of data collection has become more diversified from the traditional observation

and recording method with the advancement and development of digital technology. This increase in methods and approaches has facilitated data acquisition, storage, and transmission and has dramatically enhanced research efficiency. One of the mainstream data collection methods is to collect and identify data at the data source, and the other is to use electronic devices to collect data, with common data collection software including Splunk, Flume and Nutch.

Cultural heritage data are collected and recorded for the following. 1) Data transformation and storage of documents, pictures, images and other physical materials such as cultural heritage items and related inheritors. 2) Digital recording and storage of cultural heritage field and related practice sites, products, utensils and so on. 3) For intangible cultural heritage, the dynamic process of intangible heritage practices needs to be recorded thoroughly to better pass on the skills. For example, in the case of image capture of embroidery techniques, the three-camera simultaneous filming method is usually used. One camera is used as a fixed distance camera to capture the overall scene of the embroidery, the second camera is used as a medium and close up camera to record the movements, posture and embroidery process of the inheritors, and the third camera is used to take close-ups of the hands to record the specific stitching process.

Data Classification of Cultural Heritage. Data refers to the basic information obtained by people in their productive lives, using various tools and means to perceive the objective world. Data is not numbers in the narrow sense, but also includes meaningful words, symbols, images and audio and video and so on. It is a wide variety and quantity, and therefore needs to be classified before doing visualisation. Data can be classified as quantitative, qualitative and temporal. 1) Quantitative data: Usually used to indicate the quantitative characteristics of things, including location, number, length and width. The places of origin and transmission routes of cultural heritage are quantitative data, as this geographical information can be expressed by latitude and longitude. The type, size, quantity and area of cultural heritage are quantitative data. 2) Qualitative data: Textual data, such as the cultural attributes and categories of things, usually indicate the symbolic meaning conveyed by cultural heritage motifs. In the case of intangible cultural heritage, the skills are closely linked to the bearer's limbs, emotions, physical abilities, and mental state. Variations in these factors lead to the differentiation and individualisation of skills, so it is crucial to collect qualitative data on the bearer, including brain activity, eye movements, muscle movements, limbs, and body posture. 3) Temporal data: Usually used to show the temporal attributes of things, such as dates, duration, years of inheritance, development chronology.

3.3 Visualisation Processes for Cultural Heritage

In Visualising Data, Ben Fry divides the process of data visualisation into seven steps: acquisition, analysis, filtering, mining, representation, modification and interaction [13]. In his book The Beauty of Data: Learning Visual Design in One Book, Nathan Yau suggests four questions for data visualisation. 1) What data do you have? 2) What information do you want to extract from the data? 3) Which visualisation method should be adopted? 4) What do you see? Does it make sense? The four questions interact with

each other [14]. Having analysed the type of data and how it is obtained, it is then time to consider what information to get from a large amount of data.

What information one wants to obtain depends mainly on the research topic and the purpose of the research, which needs to be further subdivided and clarified according to the actual situation. Then the corresponding data visualisation mapping is selected according to the purpose of the research. Based on the theoretical research of the two scholars, the design process for the visual narrative process of cultural heritage can be divided into five main steps: data collection, data processing, visualisation mapping, narrative mode and visualisation. When the research focuses on cultural heritage transmission and dissemination, the presentation of massive amounts of data in a single way should be avoided, and the focus should be on representing the stories and connotations behind the data. Choose an appropriate visualisation mapping method according to the audience's needs and design narrative logic and narrative modes in an innovative way to form an emotional connection with the audience. Data storytelling give a storytelling narrative based on visuals that are easy to perceive, understand and remember, and are conducive to making cultural heritage more accessible.

4 Discussion

The exploration and development of data storytelling in different languages and cultures have always revolved around the technical laws of data perception and value discovery and the humanistic framework or paradigm of the narrative discourse system, which constantly iterates and upgrades. Data storytelling, with data science as a platform, information visualisation as a product or service form, and narratology as a channel for value realisation, will be beneficial in promoting the living heritage and dissemination of cultural heritage, becoming an essential tool for integrating data resources and even spreading Chinese culture and Chinese stories.

4.1 Balancing the Professionalism and Communication of Data Storytelling

There is some highly specialised and technical content in the data and information on cultural heritage, which poses an obstacle to the access and interpretation of information by non-specialists. Excessive use of jargon can easily create an impression of being difficult to understand and discourage people from learning and understanding. The overly colloquial and colloquial expressions, on the other hand, tend to lose the depth of popular science and fail to honestly and effectively disseminate information on cultural heritage data, so a balance needs to be found between the two, and some measures can be taken as follows. 1) Reduce the use of jargon. If it is necessary to use it, explain its meaning in layman's terms so that it can be easily understood. 2) Identify who the audience is and their literacy levels and characteristics, and adapt the presentation of data and information to better suit their needs. 3) Develop a style guide in advance to standardise the language style of the narrative and ensure that the tone of the storyteller's language does not deviate from preconceptions. 4) Experimental or playful storytelling formats are used, while ensuring the professionalism and authenticity of the content.

The British Museum in London, for example, hosted an episode of the Royal Ur Game. The museum invited YouTube educational presenter Tom Scott to play against curator Owen Finkel, introducing the rules of the ancient board game in the form of a game that gained widespread attention and had a good impact on communication.

4.2 Use of Descriptive Language and Multisensory Interaction

In order to have a better effect on the transmission and dissemination of data storytelling in cultural heritage, descriptive, fascinating or poetic language should be used, based on respect for historical facts and objective laws. The use of images, audio, video and other sensory stimuli makes the data narrative more fleshed out and interesting. NYC has designed an interactive map where historical images of New York City from the 1980s are superimposed on a map. People can explore different neighbourhoods in a simulated way. Clicking on any point in a neighbourhood reveals more relevant real-life images and information. What is more, it tells people "you are here". (see Fig.1).

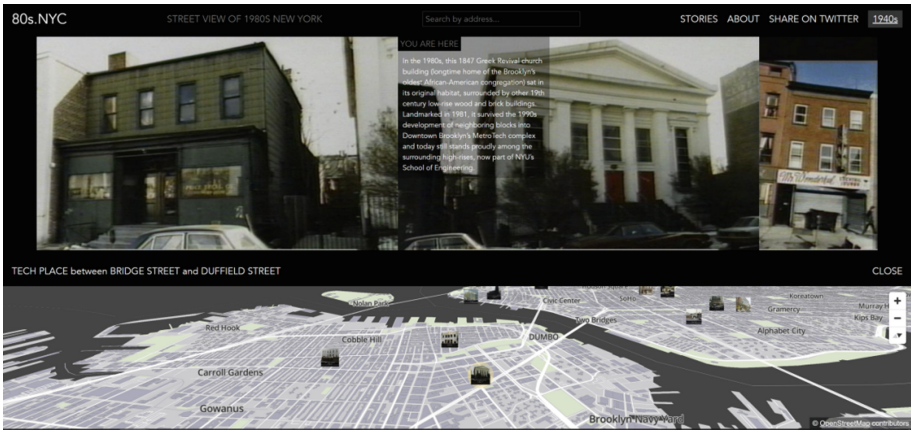

Fig. 1. Street view of 1980s New York

For the Faint Signals project, the British Library collected data on the sounds of Yorkshire, including wildlife, weather and nature sounds, as well as some extinct species, and created a digital sound forest environment for people to explore. People can move around the landscape by moving their mouse and hearing nature's corresponding sounds, with thousands of combinations to explore. The project reflects Yorkshire's natural ecology's complexity and diversity and evokes a sense of reflection and yearning for natural heritage. (see Fig. 2).

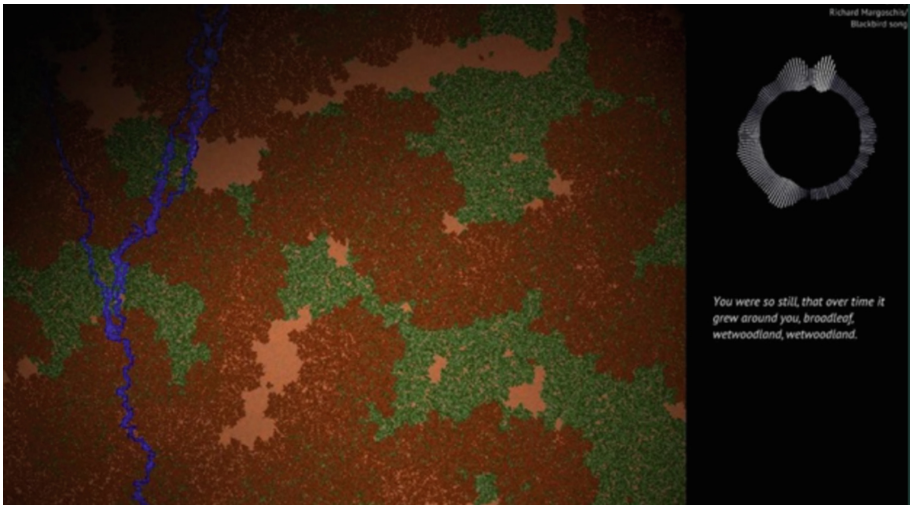

Fig. 2. Faint signals (British Library, London)

4.3 Focus on Personal and Historical Connections

Data storytelling can help people glimpse a snapshot of the times in cultural heritage. Incorporating personal stories into the cultural heritage story can make it more vivid and vibrant, with a warmth and human touch that triggers people's emotional resonance. In addition, the introduction of personal stories and historical experiences into the data narrative helps people focus and understand the characteristics of the era in which the cultural heritage is located. Data storytelling should shed light on the human significance of objects and heritage, who designed them and in what contexts, and who used them, all of which help increase awareness, understanding and empathy for cultural heritage.

Deconstructing Tibetan, a data visualisation created by students and teachers of Shanghai Academy of Fine Arts, uses a variety of data visualisations to deconstruct Tibetan, deconstruct writing and visualise the text of a Tibetan poetry collection in a work that is both fun and professional. It spotlights a Tibetan calligrapher, Gajang Nyima, as a data visualisation of a day in the research institution, including how he practices Tibetan calligraphy and learns about other things. In addition, the research team collected brainwave data and electromyographic data from his Tibetan writing to compare the content of the same poem with that of a Chinese calligrapher. Then they presented the results of the comparison in a graphic visualisation. A bridge between Tibetan and Chinese cultures was established by deconstructing Tibetan writing. (see Fig. 3).

Fig. 3. Deconstructing Tibetan (Shanghai University, China)

5 Conclusion

As one of the practical tools for interdisciplinary collaboration, data narrative deeply integrates humanistic concerns and modern technologies. In cultural heritage, it can be an effective tool for communicating the rational truth, emotional goodness and intellectual beauty of cultural heritage, helping people solve the cognitive challenge of the complexity of information access, and has an excellent cognitive driving value. This paper compares the changes and development of the connotation of data narrative, and analyses the essential components of data narrative from three aspects: data science, visualisation and narratology. Through desktop research and user interviews, the research process of data storytelling in cultural heritage is explored, i.e. identifying design goals, building data architecture and analysing visualisation processes. The design strategies for data storytelling in cultural heritage are analysed and refined from project examples. The data narrative changes the traditional one-way output-based narrative to the audience, enhances the user experience through visualisation and interesting interaction, gives new life to cultural heritage with technology, and allows the cultural lineage to continue and the spirit of civilisation to spread widely.

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