Conversation N: Visualization Installation Design Based on Voice Interaction

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Abstract. Deep learning allows machines to have human-like learning and thinking capabilities, but its internals are often considered a black box about which we know very little. As AI (Artificial intelligence) penetrates deeper into life, the development of AI is maybe uncontrollable under the influence of human data. Questions about privacy, autonomy, fairness, and the potential for misuse of technology will become even more pressing.

In the unstoppable process of technological development, art and design can often reveal science's mysteries and even predict technology's development. In this paper, through the research of algorithmic bias and AI ethics, we design an interactive installation with audience participation. Based on voice dialogue technology, the Installation uses visualization based on two-dimensional screens and physical Installation to demonstrate how AI constantly changes and generates a certain form in the learning process, hoping to trigger thinking about the subjectivity between humans and artificial intelligence. It summarizes what AI believes audiences think about AI on some issues.

Keywords: Voice Interaction · Artificial Intelligence · Interactive Installation

1 Interaction

In the information age, artificial intelligence technology is applied in every scene of life. How to make machines understand people better and realize relatively intelligent depth perception is a key problem in the field of human-computer interaction. In response, scientists have provided a learning path for machines, such as deep learning through big data training, or interactive machine learning, which increases the opportunity for users to influence AI [1]. Several studies have shown that such artificial intelligence created by computer scientists and based on human samples to learn and serve often shows some unexpected results instead of idealized absolute neutrality due to imperfect algorithms and limited training samples [2–4].

Subjectivity implies that an entity has personal experiences, feelings, beliefs, desires, or self-awareness, characteristics that we usually associate with consciousness. As AI evolves and becomes more complex, it may exhibit forms of intelligence that we have not yet fully imagined, and its subjectivity can affect the relationship between humans and machines. As early as 2000, Ray Kurzweil described the future relationship between

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humans and machines in his book The Age of Spiritual Machines, arguing that humans will respond to robots according to a collaborative orientation and a discrete orientation, and vice versa [5]. Google's AI chief, John Giannandrea thought the problem of bias in machine learning is likely to become more significant as the technology spreads to critical areas like medicine and law, and as more people without a deep technical understanding are tasked with deploying it [6]. Lionel P. Robert Jr. et al. proposed the need to focus on fair, ethical, and trustworthy AI, as well as designing transparent and explainable AI [7].

As AI becomes more integrated into our daily lives, questions about privacy, autonomy, fairness, and the potential for misuse of technology will become even more pressing. These considerations must play a significant role in guiding the development and deployment of AI technologies. Art has always been regarded as an early warning of human perception, which itself can imitate or predict the development of science and technology [8]. The application of technology to art can strengthen the audience's immersive interaction in art design and bring a more real experience.

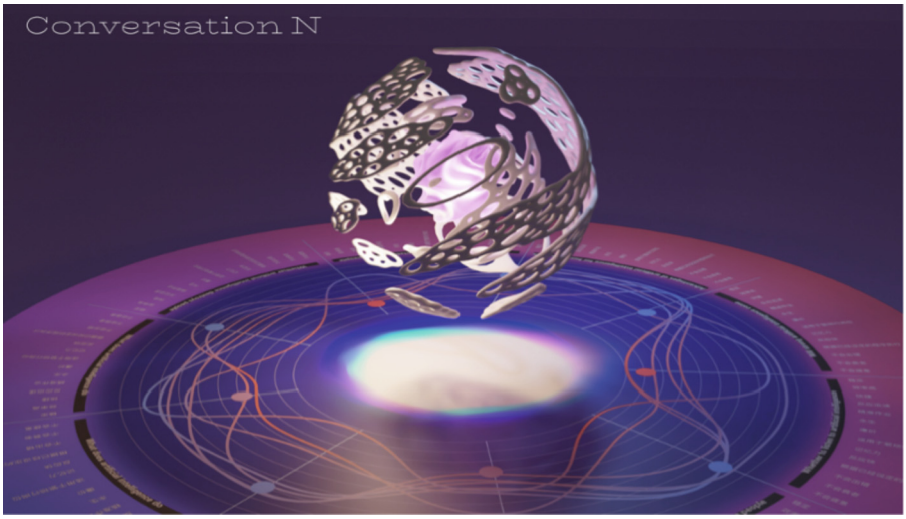

Fig. 1. The interactive installation is based on voice interaction: Conversation N

Based on this background, the author designed an interactive installation for audience participation based on the technology of voice interaction: Conversation N (Fig. 1). The audience and the AI will discuss some social issues that may cause algorithmic bias. In this process, the voice data during the interaction between the viewer and the installation is collected and visualized in real-time. Using visualization based on two-dimensional screens and physical installations, we seek to show in an artistic form how the AI is constantly changing and generating certain forms during the learning process. It is hoped to draw the viewer's attention to the issue of subjectivity between humans and AI.

2 Methodology

2.1 Design Research Through Practice

Many artists have expressed the concept of the subjectivity of artificial intelligence, but most of the works are mainly reflected in artistic expression, and it is difficult to make the audience associate with artificial intelligence in real life. The use of interactive forms will often bring real feelings to the audience, such as Australian artist STELARC designed an art installation "Artificial head" when someone passes through the "head space", the sensor will send signals to control the artificial head to make the corresponding rotation, open the eyes and start a dialogue which will serve as a warning to people.

This paper carries on design research through practice [9]. The whole process of research takes place in the course of the exhibition. In the combination of technology and art, art can mimic the development of data and exceed the maximum speed of the data, anticipating the results in a virtual way [10]. When the viewer approaches the installation, the installation will initiate a dialogue to attract the viewer to interact with it. During the exhibition, the viewer will become a part of the design, and express their views on artificial intelligence through dialogue with the installation which is a step further than a normal interactive installation. Through the setting of rules, the installation enables the audience to influence the state of the work, and then conduct research and discovery.

2.2 Data Visualization

Visualization helps with the transfer of information. Collecting, storing, and analyzing data to obtain valuable information is an important goal of information visualization [11]. With the advances and accessibility of technology, there is a growing interest in the richness of interaction in visual diagrams and the practice of interactive and dynamic visual information visualization is increasing [12, 13]. The most important purpose of data visualization is to organize complex numbers and transform them into easy-to-understand graphical language that presents the event itself. In voice interaction, visualization is of great importance due to the invisibility of the voice. In terms of human functioning itself, human memory for voice data is also much lower than that of visualization, as evidenced by the emergence of both subtitling and voice-to-text functions equipped in film and television productions. In the expression of voice data visualization in the field of art and design, visualization usually aims to enhance emotional communication, and designers often need to find a balance between information communication and aesthetics. More common are the designs of music visualization, where the visual and auditory sensory pairing in the company of emotions can bring a fresher and more complete immersive experience and better access to the mood in the musical depiction.

Our work is mainly oriented to human voice data, which is the language of computers. Therefore, in the field of natural voice understanding, machines need to transform voice into text and data forms for analysis, which is itself a process of science and demonstrating how machines process human language. In addition, the transmission volume and efficiency of voice information is limited, so the process of converting voice into a

visual state in the process of voice interaction is not only in line with the understanding process of the machine itself, but also in line with the physiological requirements of human beings. The work uses the screen and tangible form to visualize how voice data affects AI. The physical part in the middle represents the physical representation of artificial intelligence in real life, showing its "personality" through the dynamic changes of lights. The words and curves on the screen are the processes by which the machine understands the language.

3 Development

This work is an interactive installation design in which the viewer becomes a part of the design throughout the exhibition, expressing his or her views on artificial intelligence through dialogue with the installation and influencing the final state of the work. The input of the installation is voice interaction, which can also be controlled by the viewer on the interface, and the output is data visualization in the screen and the ever-changing "Tangible AI" (Fig. 2).

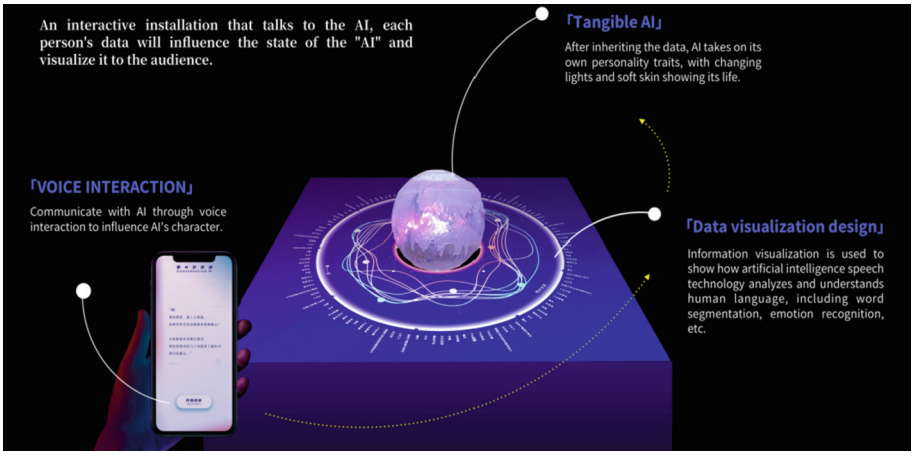

Fig. 2. Components of the installation

3.1 Voice Interaction

Voice interaction is an important channel for the connection between humans and AI [14]. One of the standards for the research and development of artificial intelligence by technology companies is to hope that artificial intelligence can "talk to you like humans" [15]. Therefore, voice dialogue is chosen as the main interaction form of the installation in this work. Based on voice dialogue technology, in this design, artificial intelligence is mainly used to ask questions, and the viewer answers. It can not only limit the scope of the content answered by users, but also accurately collect user data, and the way of

active inquiry of artificial intelligence can cause users to pay attention to the subject of artificial intelligence to a certain extent.

When the viewer approaches the installation, the installation will initiate a dialogue to attract the viewer to interact with it. The main content of the voice interaction will focus on the core of the problem – the subjectivity between humans and artificial intelligence. In the topic selection of voice interaction content, the author has carried out several iterations on the research plan of the previous data. Finally, the author starts from the real situation, understands the algorithm bias problem in the current artificial intelligence, and sets the voice interaction content in combination with the user's disputes about artificial intelligence in the interview process. Starting from the point that artificial intelligence is very important to human development, the final specific voice interaction script explores the trend of cooperation/alienation, high/low influence, and good/evil under the influence of human beings in the development process of artificial intelligence.

3.2 Visualization Installation Design

Since the expression of the work aims to enhance the viewer's understanding of the computer language, the visual presentation of the work is designed mainly based on the program logic of voice dialogue technology.

In the natural language understanding of the program, the work invokes Aliyun's voice-to-text function, text analysis function, and text literacy function. The audience's voice data is first transformed into the form of text, then the whole text is split according to the lexicality, the emotion score is marked for the words in the database, and finally, the voice data is generated. Thus, during the interaction process of the installation, the data appears simultaneously with the voice interaction and influences the final form of the AI in the order from outside to inside.

The analyzed data is exported and sorted to produce data visualizations that can be presented interactively in the field. Based on research trials, the results are positive for a closer relationship with people, showing it as having a living state in red, and negative for a greater separation from people, showing the electronic nature of the AI in blue, with perceptual differences from people. The visualization of the two-dimensional screen will be closely around the entity visualization of the central area, the two correspond to change and produce correlation. The whole visualization process is: presenting the keywords during the dialogue at the edge of the corresponding questions to form the corresponding emotional analysis data, and after the 9 questions are answered, the connection becomes a complete curve, and the data will gradually accumulate so that the viewer can observe the complete state of the work (Fig. 3).

In the overall shape design of the interactive installation, the solid part in the middle is the physical representation of the AI in real life. In the creation concept of this work, it is hoped to express that the AI has its own personality characteristics after inheriting the data, so it needs to show its characteristics of having a sense of electronic life. The interior of the entity is mainly composed of a light array, combining LED lights into a coral-like form, and through the color and dynamic changes of the light array, to show its characteristics of a sense of technology. The exterior uses silicone as the material. Silicone is often used in the medical field to simulate skin because of its viscosity, elasticity and softness, which is close to the texture of human skin. In the specific form

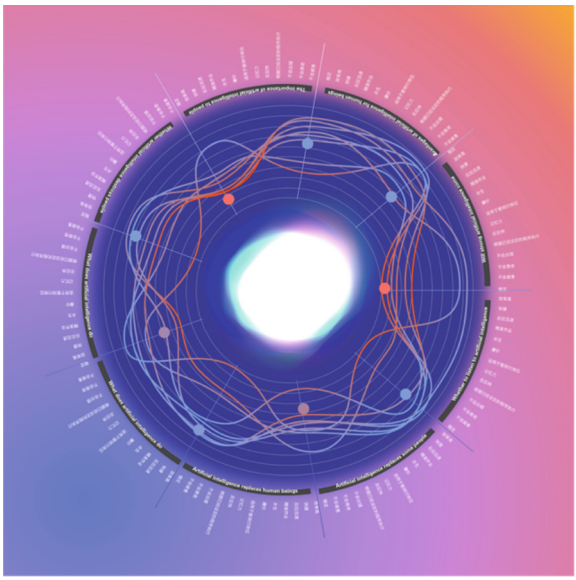

Fig. 3. Graphics generated from voice data

design, in order to make its specific form and color can be more suitable for the needs of the design, by adding curing agent to change the speed of silica gel solidification, and silica gel attached to the transparent acrylic surface for shaping, to show artificial intelligence or perhaps a sense of life state.

4 Results and Discussion

The installation was exhibited for 12 days and a total of 218 data were obtained. During the interaction, the state of the installation changed several times. The overall data of the final audience and installation for the discussion of AI-related issues were relatively neutral. After filtering out the incomplete data, the specific data are shown in Table 1 (Fig. 4).

In this paper, we conduct an in-depth study of natural voice interaction technology in the field of artificial intelligence and learn about the basic implementation process method of voice interaction technology and the current development status. Currently, the main problem faced in the field of voice interaction and even in the field of artificial intelligence is the lack of sufficient as well as high-quality human data samples, which often require technicians to organize the samples. In the deep learning process, collecting samples during human contact is the driving force, but it also raises concerns about data leakage from individuals. Therefore, engaging the audience in reflection from an art and design perspective is a realistic solution.

This paper explores the ways and possibilities of combining art and design with technology. The installation has the significance of popularizing science to the public, revealing the process of AI understanding language through visualization, which can

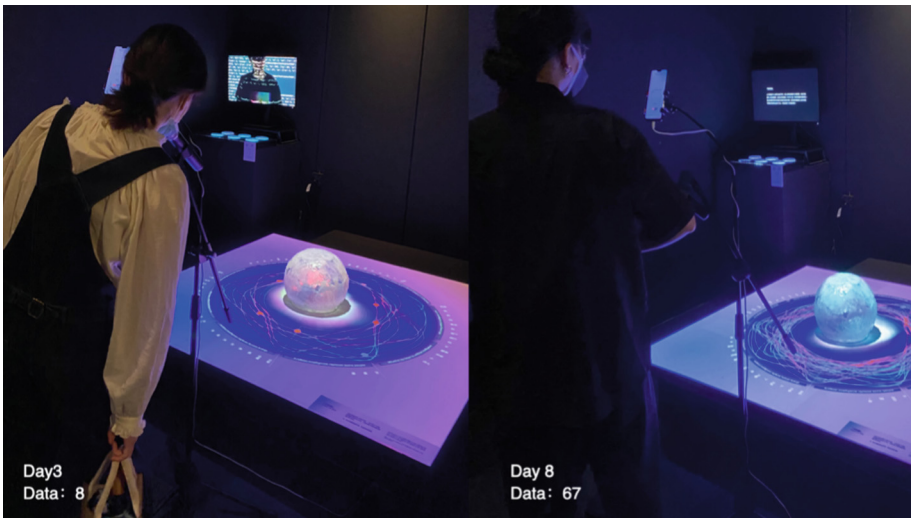

Fig. 4. Exhibition and practice

Table 1. Discussion of issues related to artificial intelligence

	Positive	Negative
Cooperation/Alienation	0.443624	0.556377
High/Low Influence	0.580839	0.419161
Good/Evil	0.451025	0.548975

make the public understand voice interaction technology more understandably. This study is experimental and predictive, demonstrating how human data can lead to bias in AI during its engagement with people. By predicting the development of AI in art forms, some thoughts are brought to the direction of technological development.

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References

1. Amershi, S., Cakmak, M., Knox, W.B., Kulesza, T.: Power to the people: the role of humans in interactive machine learning. AI Mag. **35**, 105–120 (2014). https://doi.org/10.1609/aimag.v35i4.2513
2. MacCarthy, M.: AI needs more regulation, not less (2020). https://www.brookings.edu/research/ai-needs-more-regulation-not-less/
3. Cummings, M.L., Li, S.: Subjectivity in the creation of machine learning models. J. Data Inf. Qual. **13**, 1–19 (2021). https://doi.org/10.1145/3418034

4. Hao, K.: AI is sending people to jail-and getting it wrong (2019). https://www.technologyreview.com/2019/01/21/137783/algorithms-criminal-justice-ai/
5. Kurzweil, R.: The Age of Spiritual Machines: When Computers Exceed Human Intelligence. Penguin Books, New York (2000)
6. Knight, W.: Forget Killer Robots—Bias Is the Real Al Danger (2017). https://www.technologyreview.com/2017/10/03/241956/forget-killer-robotsbias-is-the-real-ai-danger/
7. Robert, L., Bansal, G., Lütge, C.: ICIS 2019 SIGHCI Workshop Panel Report: Human Computer Interaction Challenges and Opportunities for Fair, Trustworthy and Ethical Artificial Intelligence (2020). https://doi.org/10.17705/1thci.00130
8. Wilson, S.: Information Arts: Intersections of Art, Science, and Technology. MIT Press, Cambridge (2002)
9. Koskinen, I.K. (ed.): Design Research Through Practice: From the Lab, Field, and Showroom. Morgan Kaufmann/Elsevier, Waltham (2011)
10. Perpiñán Lamigueiro, Ó.: Displaying Time Series, Spatial, and Space-Time Data with R. CRC Press, Taylor & Francis Group, Boca Raton (2018)
11. Vassakis, K., Petrakis, E., Kopanakis, I.: Big data analytics: applications, prospects and challenges. In: Skourletopoulos, G., Mastorakis, G., Mavromoustakis, C.X., Dobre, C., Pallis, E. (eds.) Mobile Big Data: A Roadmap from Models to Technologies, pp. 3–20. Springer International Publishing, Cham (2018)
12. Meirelles, I.: Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations. Rockport, Beverly (2013)
13. Dimara, E., Perin, C.: What is Interaction for data visualization? IEEE Trans. Visual Comput. Graph. **26**, 119–129 (2020). https://doi.org/10.1109/TVCG.2019.2934283
14. Adiwardana, D., et al.: Towards a human-like open-domain chatbot. arXiv preprint arXiv: 2001.09977 (2020)
15. Langner, B.: Data-driven natural language generation: making machines talk like humans using natural corpora (2010)