Frontiers in Computing and Intelligent Systems
ISSN: 2832-6024 | Vol. 8, No. 1, 2024

Research on the Optimization of Headset Optimization Technology based on Cloud and Edge Computing

Qijie Lai [1], Chao Ma [1], Qiaoyang Yin [1], Qiuying Li [2,*], Kewei Zhou [1], Zilin Ma [1]

[1] Tianjin Renai College, Intelligent Comegrated Engineering College, Tianjin 301636, China
[2] Tianjin Renai College, Department of Mathematics, Tianjin 301636, China

*** Corresponding author:** Qiuying Li (Email: liqiuying@tjrac.edu.cn)

Abstract: In the fast -paced life, people's pursuit of high -quality audio equipment has continued to increase. With the advancement of science and technology, the combination of cloud and edge computing provides the possibility for processing large amounts of data and real -time response. To deal with, a set of optimized solutions is proposed on the problem of poor sound quality of Bluetooth headsets on the current market. The optimized Bluetooth headset is effective on the reduction of background noise, providing a clearer listening environment. The decline has greatly improved the purity of the audio and the fineness of hearing. In terms of energy consumption efficiency, the battery life of the Bluetooth headset has been improved.

Keywords: Edge Calculation; Iteration Algorithm; Bluetooth Headset; Delay Optimization; Border Cloud Collaboration.

1. Introduction

As the indispensable part of the interconnection of all things in the 5G era, Bluetooth headset has become a research hotspot in the field of wireless communication in the Internet of Things. The increasingly increasing application scenarios, limited audio processing algorithms can no longer meet people's increasing demand. When buying headphones, people have a higher pursuit of audio processing level. At present, the Bluetooth headset mainly models the audio signal by using DSM (Delta-Sigma) technology, and then uses DSP (Digital Signal Processing) technology for model optimization processing to achieve the effect of audio optimization, but this technology will lead Audio delay and other series of issues.

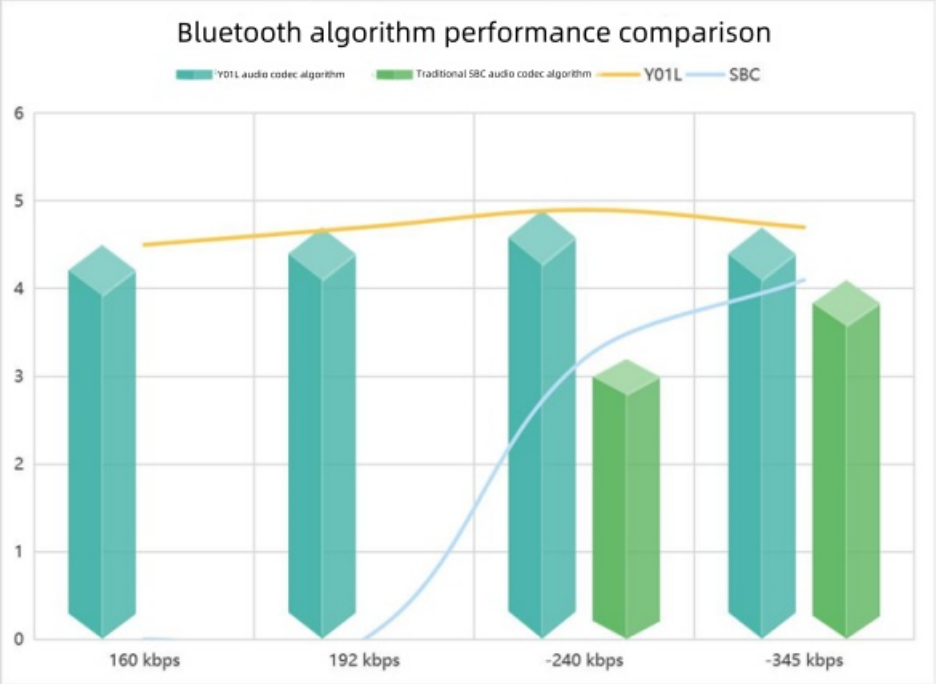

Fig 1. algorithm performance test comparison chart

Bluetooth headsets face problems such as unstable sound quality and easily interference, which seriously affects the user's hearing experience and use comfort [1]. Therefore, improving Bluetooth headset sound quality has become one of the hotspots of market demand and technology research and development. With technology In advance, the combination of cloud and marginal computing provides the possibility for processing a large amount of data and real -time response. The real -time response capacity of the powerful data processing capacity and edge calculation of cloud computing is used to optimize the sound quality transmission of Bluetooth headsets, enhance the user's hearing of the user's hearing Experience is a full embodiment of scientific and technological innovation to serve life. Edge computing technology can allocate tasks and data processing in different devices to improve audio transmission speed and

improve the sound quality of the headset. At the same time, cloud computing can also provide necessary storage. Space and greater computing power make the headset a more intelligent device. The introduction of edge computing and cloud computing technology not only improves the audio technology of Bluetooth headset, but also improves the overall performance and intelligent level of the headset equipment. The synergistic application of algorithms [2] and edge computing technology optimizes the sound quality of the headphones, which not only solves the problem of audio delay, but also reduces energy consumption, improves the stability and efficiency of audio transmission, and will also be portable audio equipment such as Bluetooth headsets. Future development provides technical support and innovative ideas.

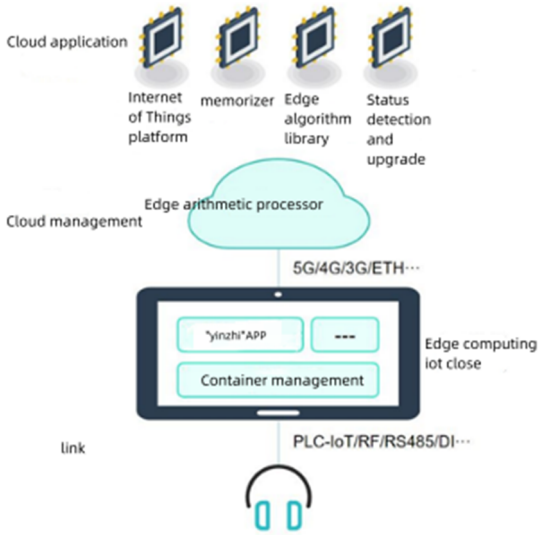

Fig 2. Principles of marginal modules and cloud management

This article aims to propose a set of optimized solutions through the collaborative treatment of cloud and marginal computing technology. In response to the problem of poor sound quality of Bluetooth headsets on the market. Due to technical and environmental restrictions, Bluetooth headsets have obvious shortcomings in sound transmission and processing. . Through researching and developing advanced audio signal processing algorithms, optimization technology of edge equipment, and system architecture design of the collaborative system of cloud edges, the sound quality of the Bluetooth headset sound is significantly improved, enabling Bluetooth headsets to better adapt to users' usage scenarios and improve audio The speed and quality of the transmission, while avoiding occupying the network bandwidth and reducing the delay problem.

2. Audio Signal Processing Algorithm

The audio signal processing algorithm includes noise reduction, equilibrium, volume control, etc. to improve audio quality. At present, the optimization of the sound quality of the headset needs to be used for training and adjustment. From CD, Hi-Res, or Multi-Sound recording high-quality source files, these parameters are more reasonable, accurate and narrow in the audience, and lack of information such as the environment and mentality when users use headphones in real worlds. This is based on these. The results of data calculation are difficult to accurately reflect the sensory experience of users in different scenarios. Some existing audio processing algorithms have been widely used in different occasions, but they do not consider human hearing characteristics, such as: everyone's hearing curve, Listening protection strategies and other differences. Therefore, these algorithms cannot achieve satisfactory sound quality effects on various headphones. In addition, there are other well -known algorithms such as neural network models. Optimize the characteristics of the real -time nature of algorithms and the limitations of equipment resources.

3. Edge Equipment Optimization Algorithm

How to reasonably distribute audio processing tasks to cloud and edge devices to maximize processing efficiency and optimize audio quality. For some delayed applications, such as games or videos, some algorithms may be introduced, so Affects user experience. When designing and using these algorithms, you need to solve this problem to ensure real -time nature and provide non -delay audio processing. Deep learning -based noise reduction algorithm, sound field equilibrium algorithm, etc. The implementation of these algorithms usually requires high performance. The chip has certain challenges in storage and computing. The characteristics of different people in the hearing are different, and different sound quality parameters are required to adapt. Therefore Hearing data. Edge computing is a distributed open platform near the network edge of the network near the object or data source. It provides edge intelligent services nearby through a distributed open platform that integrates networks, computing, storage, and application of core capabilities. In terms of, the technology is analyzed directly in the local device or network near the data generated by the data collected from the terminal, and the data is not needed to transmit the data to the cloud data processing center. The edge computing has four characteristics. One is low latency, effectively optimizing the audio delay problem of Bluetooth headsets; second, the data storage is small, only useful processing information to the remote transmission, no redundant information; the third is low payment cost; Privacy and security are high. The data generated by the terminal device does not need to be transmitted to the distant cloud data center processing. Instead, the data analysis and processing are completed on the edge of the network. The cost is lower and the effect is better.

4. Technical Route

Through laboratory testing and actual scenario verification, the feasibility and stability of the system is verified, and the system is optimized.

4.1. Sound Quality Detection Model Design

Build a deep learning model to accurately identify and evaluate the sound quality of Bluetooth headsets. This model will train information such as a large amount of audio data, user feedback, and environmental noise. By analyzing these data, the model can identify sound quality issues and give it to The corresponding assessment. The first step of the process is the collection and pre -processing of audio data, and then select the appropriate deep learning algorithm and network structure to train and optimize the model.

4.2. Edge Equipment Sound Quality Optimization Algorithm

Under the limited situation of ensuring edge equipment

computing resources, the development of sound quality optimization algorithms suitable for Bluetooth headsets and capable of operating efficiently on the edge equipment. These algorithms need to dynamically adjust the audio signal processing process based on the suggestions provided by the sound quality detection model, including but not but not Limited to the functions of noise reduction, echo elimination, balanced adjustment, etc. It also needs to optimize these algorithms to reduce their demand for edge equipment calculation and storage resources.

4.3. Cloud Data Processing and Transmission

Processing large -scale data through the cloud [3] to improve the accuracy and efficiency of the sound quality optimization algorithm. Make the appropriate data transmission protocol to ensure that data transmission from edge devices to cloud is fast and safe. This contains audio data containing audio data The upload, data acquisition after cloud processing, and feedback from optimized recommendations.

4.4. System Integration and Test Process

Integrate sound quality detection models, edge equipment sound quality optimization algorithms and cloud data processing systems to form a complete optimization solution. In this process, we need to pay close attention to the stability and performance of the system, and continue to adjust the optimization through a series of tests. Tests will not be limited to laboratory testing, actual scene application testing, etc. to ensure that the final product can achieve the expected sound quality optimization effect in practical applications.

4.5. Experimental Environment

Our achievements have built a set of experimental environment, including Bluetooth headsets as edge devices for testing, and a set of cloud server for model training and algorithm optimization. The laboratory is also equipped with professional audio capture and analysis tools for recording and evaluation Sound quality.

4.6. Data Collection and Pre -processing

The two stages of data collection have been implemented: first, audio files of different types (such as popular, classical, rock, etc.) and quality (such as MP3 files with different ratios) are played, and professional audio capture equipment is used Audio. This forms the original audio data. Second, through the online questionnaire survey, the subjective evaluation of the user's sound quality of the Bluetooth headset includes the audio type, quality parameter and user satisfaction score. Pre -processing steps include standardization of audio signals , Noise, and feature extraction, such as sampling rate conversion, spectrum analysis, etc., so as to facilitate model training and analysis.

4.7. Model Training and Optimization Algorithm Test

Based on the collection of data, we designed and trained a sound quality detection model based on deep learning. The goal of the model is to predict sound quality issues and give corresponding optimization suggestions. At the same time, we have developed a series of sound quality optimization algorithms, and on the edge equipment (Bluetooth headset) uses streaming technology to test and test the audio data to meet the real -time requirements.

4.8. Validity Verification

We have optimized the audio files before and after blind testing, so that a group of independent users evaluate the sound quality. The results of the blind test results are consistent with the degree of improvement of the model prediction, which further proves the effectiveness.

5. Main Result

This article uses edge computing technology to improve the sound quality of Bluetooth headsets, realize a personalized user experience, and significantly improve energy consumption efficiency. This result not only represents a major progress of Bluetooth headset technology, but also for future smart audio equipment It has opened up new development directions. Through experimental verification, we observe the significant improvement of marginal computing technology on the sound quality of Bluetooth headsets. In terms of environmental noise suppression, the optimized Bluetooth headset reduces the background noise and provides a clearer listening sound. Environment. In terms of audio distortion, the distortion rate has been reduced, and the purity and hearing of audio are improved. In addition, the range of frequency sound is widened, and users can enjoy a richer and more vivid sound quality experience [4].

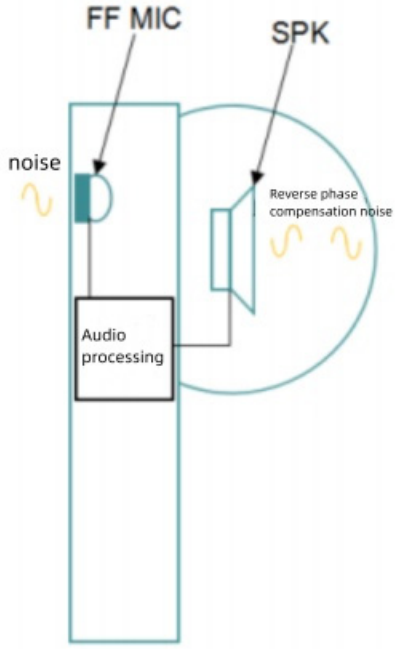

Fig 3. headphones feedback active noise reduction

And through user behavior and preference learning algorithm analysis [5], the audio output settings are customized for each user to meet their personalized needs. Experimental data show that through personalized settings, users' satisfaction of sound quality has been improved. The frequency of equipment use has also increased significantly. In terms of energy consumption efficiency, it has improved the battery life of Bluetooth headsets. This improvement benefits from the efficient data processing algorithm and energy -saving signal transmission mechanism, which greatly improves the user experience [6].

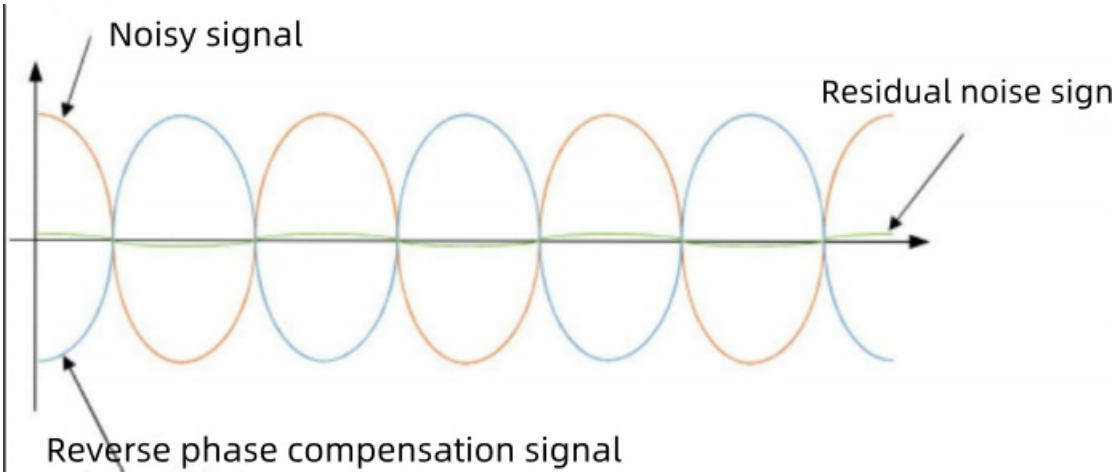

Fig 4. Headphone feedback Active noise reduction signal

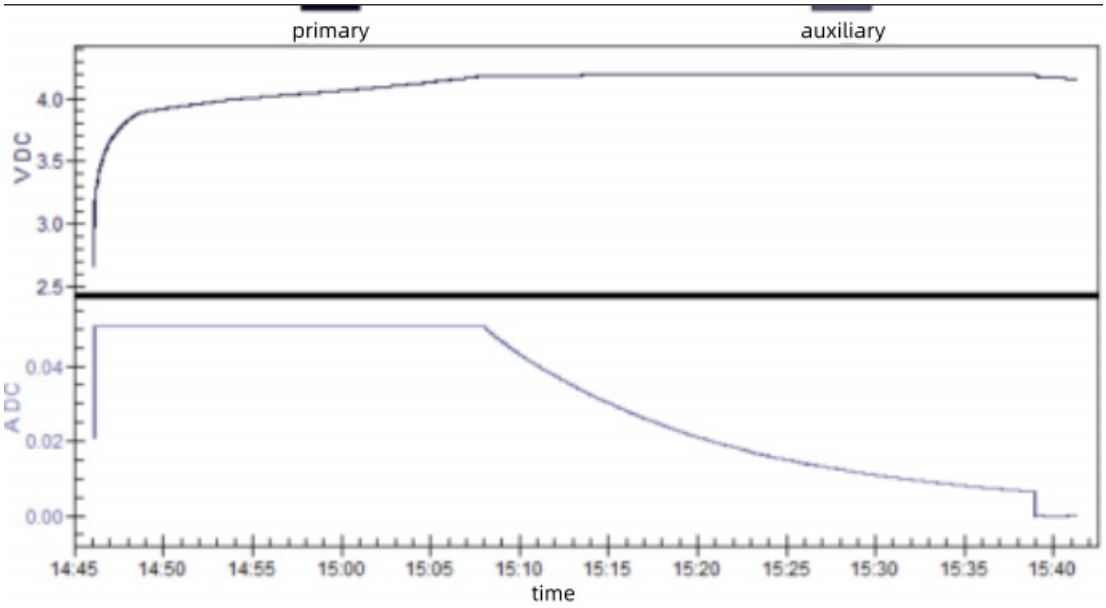

Fig 5. The voltage and current curve of the headset charging process

Acknowledgments

College student innovation and entrepreneurial project (number: 202314038043).

References

[1] Wang Erpeng, Shi Zeyu, Wu Yuefeng. Bluetooth headset design strategy based on excavation of consumer preferences based on comments [J]. Packaging engineering, 2024, 45 (02): 134-141. (in Chinese)

[2] Xun Zhu Fang, Chen Qinglin, Li Linfeng, et al.. Multi -user marginal computing task unloading scheduling and resource allocation algorithm based on deep enhanced learning [J]. Computer Journal, 2022,45 (4). (in Chinese)

[3] Qiao Shaojie. Cloud Computing Guide [J]. Radio engineering, 2023,53 (2): 245-246. (in Chinese)

[4] He Wentao, Zhang Ning. Research on patent value evaluation based on the random coefficient logit model-take active noise reduction technology as an example [J]. Intelligence magazine, 2024, 43 (01): 191-198. (in Chinese)

[5] The subjective evaluation method of Liu Rui. Bluetooth headset [J]. Electronic test, 2020, (01): 55-56. (in Chinese)

[6] Zhang Xianchao, Ren Tianshi, Zhao Yao, et al. Calculate the combined optimization method of delay and energy consumption [J]. Journal of the University of Electronic Science and Technology, 2022,51 (5): 737-742. (in Chinese)