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A study on the Application of Virtual Reality Technology in
Children's Rehabilitation Therapy

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Abstract

This article discusses the value of virtual reality (VR) technology in paediatric rehabilitation therapy, which can create immersive, interactive and imaginative virtual environments and provide children with safe and interesting therapeutic modalities to effectively improve their cognitive, motor, speech and emotional problems. The article analyses the application of VR technology in different scenarios, such as attention training, motor training, verbal expression training and emotion recognition training, and points out that the advantages of VR technology are to increase the interest of treatment, enhance the patient's participation, and achieve personalised treatment. However, VR technology also has challenges such as technical limitations, evaluation difficulties and high equipment costs. With the continuous development and improvement of the technology, VR technology is expected to overcome these challenges and play a greater role in the field of children's rehabilitation therapy, bringing hope for the rehabilitation of more children.

1. Introduction

In today's society, children's rehabilitation therapy has become an important part of the paediatric medical field. With the continuous progress of science and technology, the means of rehabilitation therapy are also constantly innovating and developing (CHEN, WANG, ZHANG, ZHANG, CHEN, ZHANG, & LIU, 2022). Among them, Virtual Reality (VR) technology, as an emerging means of rehabilitation therapy, has brought unprecedented opportunities to the field of children's rehabilitation. The purpose of this paper is to explore the application value of virtual reality technology in children's rehabilitation therapy and provide theoretical basis for clinical practice.

Virtual reality technology is a computer technology that can create and simulate virtual worlds.

Through virtual reality devices, users can immerse themselves in the virtual environment and interact with the virtual world. In recent years, virtual reality technology has gradually gained attention in the field of rehabilitation therapy. Studies have shown that virtual reality technology, which is characterised by immersion, interactivity and imagination, can provide a safe and interesting way of treatment for children (Ma, Zhang, Shi & Zhang, 2021).

Children's rehabilitation therapy mainly includes cognitive dysfunction, motor dysfunction, speech dysfunction and emotional and behavioural problems. The application of virtual reality technology in children's rehabilitation therapy has significant effects. Firstly, virtual reality technology can simulate a variety of cognitive tasks and help children improve their cognitive abilities such as attention, memory and executive function. Secondly, virtual reality technology can provide rich movement scenes and tasks to guide children in upper limb, lower limb and whole body movement training. In addition, virtual reality technology can create language environments with interactivity to help children improve their verbal expression, communication skills, and so on. Finally, virtual reality technology can also provide children with a safe and comfortable therapeutic environment and reduce negative emotions such as anxiety and fear (Luan, Ding, Lu, Zhang, Yu & Yang, 2021).

Although the application of virtual reality technology in children's rehabilitation therapy is encouraging, it is still in the exploratory stage. In this paper, we will explore the application effect of virtual reality technology in children's rehabilitation therapy by analysing specific cases, aiming to provide useful references for clinical practice. In the future, with the continuous development and improvement of virtual reality technology, it is believed that it will play a greater role in the field of children's rehabilitation therapy and bring the hope of rehabilitation to more children.

2. A Study on the Application of Virtual Reality Technology in the Rehabilitation of Children in different Scenarios

2.1 Cognitive Dysfunction Rehabilitation

Taking children's attention training as an example, virtual reality technology can create a variety of interesting attention tasks, such as graph matching and sound recognition. In the virtual environment, children can devote themselves to the tasks and improve their attention level. For example, in one study, researchers designed a game called "Attention Pirate" using virtual reality technology[4]. In the game, children had to search for hidden treasures on an island full of pirates. By completing various attention tasks, such as identifying different pirates and remembering the location of the treasure, the children's attention was significantly improved.

2.2 Rehabilitation of Motor Dysfunction

Taking children's upper limb motor training as an example, virtual reality technology can simulate various upper limb motor tasks, such as grasping and carrying. Through virtual reality devices, children can complete these tasks in games, thus exercising upper limb motor skills (ZHANG, QUAN, & CAO, 2024). For example, in one study, researchers designed a game called "Magic Mover" using virtual

reality technology. In the game, children were required to use a virtual reality joystick to simulate the lifting of various objects, such as books and boxes. By completing the lifting tasks, the children's upper limb motor ability was effectively improved.

2.3 Speech Dysfunction Rehabilitation case

Taking children's speech expression ability training as an example, virtual reality technology can create interactive language environments, such as simulating supermarket shopping, restaurant ordering and other scenes. In these scenarios, children need to use speech to communicate with others, thus improving their verbal expression ability (LI & LI, 2023). For example, in one study, researchers designed a game called "Supermarket Adventure" using virtual reality technology. In the game, children need to use virtual reality helmets and handles to simulate shopping in the supermarket, communicate with virtual shopkeepers and complete shopping tasks. By completing these tasks, the children's ability to express themselves verbally was significantly improved.

2.4 Rehabilitation of Emotional and Behavioural Problems

Taking children's emotion recognition training as an example, virtual reality technology can simulate a variety of social scenarios, such as school and family. In these scenarios, children can observe and experience different emotional expressions, thus improving their emotion recognition ability. For example, in one study, researchers designed a game called "Emotion Detective" using virtual reality technology. In the game, children were required to use a virtual reality headset and joystick to explore a virtual world full of emotional expressions and to identify and categorise different emotions (Bao, 2023). By completing these tasks, children's emotion recognition ability is effectively improved.

Therefore, the application of virtual reality technology in children's rehabilitation therapy has significant effects. Through the discussion of different types of rehabilitation cases, we can see that virtual reality technology provides a safe and interesting way of treatment for children, which helps to improve children's cognitive, motor, verbal, emotional and other aspects. However, the application of virtual reality technology in children's rehabilitation therapy is still in the exploratory stage, and further research is needed to optimise the treatment plan and improve the rehabilitation effect. In the future, with the continuous development and improvement of virtual reality technology, it is believed that it will play a greater role in the field of children's rehabilitation therapy, and bring the hope of rehabilitation to more children.

3. Advantages and Impediments of Virtual Reality Technology Applied to Child Rehabilitation

The application of virtual reality technology in children's rehabilitation therapy has shown its unique advantages, but at the same time there are some limitations. The following is a specific analysis of its advantages and disadvantages:

Advantages:

1. Improvement of therapeutic interest: virtual reality technology can create a fun and interactive therapeutic environment, which makes children more willing to participate in the therapeutic process.

For example, in one study, researchers used virtual reality to design a game called "Attention Pirate" to train children's attention through the task of finding treasure. This kind of gamified therapy greatly improved children's participation and motivation (Wu, 2023).

2. Enhanced patient engagement: Virtual reality technology can provide children with an immersive therapy experience, allowing them to participate more actively in therapy. For example, in one study, researchers used virtual reality technology to design a game called "Magic Mover", which exercises children's upper limb motor skills through the task of lifting objects. The children could interact in real time with a virtual reality joystick, and the sense of participation increased their motivation for therapy.

3. Individualised therapy: Virtual reality technology can be used to tailor a personalised treatment plan for each child. For example, in one study, researchers used virtual reality to design a game called "Supermarket Adventure", which simulates a shopping scene to train children's verbal expression. The tasks in the game can be adapted to the child's speech and progress to provide the most appropriate training content.

Limitations:

1. Technical limitations: although virtual reality technology shows great potential in children's rehabilitation therapy, there are still some technical limitations. For example, the resolution and refresh rate of virtual reality devices may not be sufficient to provide a sufficiently realistic experience, or the tracking accuracy of the devices may not be high enough, resulting in a compromised experience for the child. In addition, the cost of virtual reality devices is relatively high, which makes them somewhat limited in clinical applications.

2. Difficulty in assessing rehabilitation effects: As a relatively new treatment method, virtual reality technology still has certain difficulties in assessing its rehabilitation effects. In the current study, more data and research are needed to support the specific effect and long-term impact of virtual reality technology in children's rehabilitation therapy. Therefore, doctors and researchers need to further explore and verify the effectiveness and reliability of virtual reality technology in clinical applications (Huang, Yang, Ren et al., 2021).

3. Higher cost of equipment: The relatively high cost of virtual reality equipment makes its application in children's rehabilitation therapy somewhat limited. Although the cost of the equipment is gradually decreasing with the advancement of technology, it still takes some time and effort to make it more popular and accessible.

In summary, the application of virtual reality technology in children's rehabilitation therapy has significant advantages, which can improve the interest and participation of treatment and achieve personalised treatment. However, there is still a need to overcome limitations such as technical constraints, difficulties in evaluating rehabilitation effects, and high equipment costs in order to further promote its application in children's rehabilitation therapy. With the continuous development and improvement of the technology, it is believed that virtual reality technology will play a greater role in the field of children's rehabilitation therapy and bring the hope of rehabilitation to more children (LIN,

& Chen, 2021).

4. Conclusions and Outlook

4.1 Conclusions

The application of virtual reality technology in children's rehabilitation therapy has achieved certain results, providing new therapeutic means for children's cognitive, motor, speech and emotional rehabilitation. Through the analyses and discussions in this paper, we can see the advantages and application potential of virtual reality technology in children's rehabilitation therapy.

First of all, virtual reality technology can create a fun and interactive therapy environment and improve the fun and participation of therapy. Through gamification, children are more willing to participate in the treatment process, increasing their motivation and drive. For example, the "Attention Pirate" game designed with virtual reality technology trains children's attention through the task of searching for treasures, so that they can unknowingly improve their attention level during the game.

Secondly, virtual reality technology can provide children with an immersive therapeutic experience and enhance their participation. Through virtual reality devices, children can interact with the virtual environment in real time, and this sense of engagement enhances their motivation for therapy. For example, the "Magic Mover" game, designed using virtual reality technology, exercises children's upper limb motor skills through the task of lifting and carrying objects, and they can interact in real time with a virtual reality joystick to feel their efforts and progress.

In addition, virtual reality technology can be used to tailor a personalised treatment plan for each child. By adjusting the tasks and difficulty in the virtual environment, it is possible to provide therapeutic content that is best suited to the child. For example, the "Supermarket Adventure" game designed using virtual reality technology to train children's verbal expression through simulated shopping scenarios can be adjusted according to the children's verbal ability and progress in order to provide personalised training content.

However, the application of virtual reality technology in children's rehabilitation therapy still faces some challenges and limitations. Firstly, technical limitations of virtual reality devices still exist, such as resolution, refresh rate, and tracking accuracy, which may affect children's experience and therapeutic effects. Second, assessment of rehabilitation effects remains difficult, and more data and research are needed to support the validity and reliability of virtual reality technology. In addition, the relatively high cost of virtual reality devices limits their popularity and accessibility in clinical applications.

Nevertheless, with the continuous development and improvement of the technology, the application of virtual reality technology in children's rehabilitation therapy still has a bright future. In the future, we can expect more advanced virtual reality technologies, such as devices with higher resolution and refresh rate, more accurate tracking systems, and more intelligent and adaptive therapy software. These technological advances will further enhance the effectiveness and user experience of virtual reality

technology in paediatric rehabilitation therapy.

In addition, as virtual reality technology becomes more popular and the cost of equipment decreases, more medical institutions and families can afford virtual reality equipment, making its application in children's rehabilitation therapy more widespread. Meanwhile, with in-depth research on virtual reality technology, we can better understand its specific effects and mechanisms of action in children's rehabilitation therapy, providing stronger evidence support for clinical practice.

The application of virtual reality technology in children's rehabilitation therapy has significant advantages and potential. By creating interesting and interactive therapeutic environments, providing immersive therapeutic experiences, and enabling personalised treatment, virtual reality technology brings new opportunities for children's rehabilitation. However, challenges such as technical limitations, difficulties in evaluating rehabilitation effects, and high equipment costs still need to be overcome to further promote its application in children's rehabilitation therapy. With the continuous development and improvement of the technology, it is believed that virtual reality technology will play a greater role in the field of children's rehabilitation therapy and bring hope of recovery to more children.

4.2 Outlook

The application of virtual reality technology in children's rehabilitation therapy has shown great potential, however, there are still some challenges and shortcomings. In the future development, we can expect to solve these problems and further optimise the application of virtual reality technology in children's rehabilitation therapy.

Firstly, the current technical limitations of virtual reality devices still exist, such as resolution, refresh rate and tracking accuracy. In the future, as technology advances, we can expect higher performance virtual reality devices that provide a more realistic and immersive therapy experience. Devices with higher resolutions and refresh rates will be able to present sharper images and smoother dynamics, reducing visual fatigue and discomfort for children. More accurate tracking systems will be able to capture children's movements and interactions more accurately, providing more precise therapeutic feedback and assessment (Fu, 2019).

Second, assessment of rehabilitation outcomes remains difficult, and more data and research are needed to support the validity and reliability of virtual reality technology. Future research could focus on the therapeutic effects of virtual reality technology on different types of children's rehabilitation problems, as well as its impact on children's long-term rehabilitation. Through large-scale randomised controlled trials and long-term follow-up studies, we can better understand the specific and sustained effects of virtual reality technology in children's rehabilitation treatment. At the same time, new assessment indicators and methods can be explored, such as the use of physiological signal monitoring and behavioural observation, in order to assess children's rehabilitation progress more comprehensively.

In addition, the relatively high cost of virtual reality devices limits their popularity and accessibility in clinical applications. In the future, as virtual reality technology becomes more popular and the cost of equipment decreases, more healthcare organisations and families will be able to afford virtual reality

equipment. This will enable the wider application of virtual reality technology in children's rehabilitation therapy, providing more children with rehabilitation opportunities and assistance. At the same time, new business models and financial support, such as government subsidies and health insurance coverage, can be explored to reduce the burden of children's rehabilitation treatment.

Finally, the application of virtual reality technology in children's rehabilitation treatment can also be combined with other technologies, such as augmented reality and artificial intelligence, in order to provide a more integrated and personalised rehabilitation treatment plan. For example, combined with artificial intelligence technology, virtual reality devices can automatically adjust the treatment tasks and difficulty based on the child's rehabilitation progress and feedback to provide the best treatment results. Combined with augmented reality technology, virtual elements can be superimposed onto the real environment to provide richer interaction and experience.

the application of virtual reality technology in children's rehabilitation therapy is promising. With the continuous development and improvement of the technology, we can expect to solve the current problems and challenges and further promote the application of virtual reality technology in children's rehabilitation therapy. Higher-performance equipment, more data and research support, lower equipment costs, and integration with other technologies will provide better support and assistance for children's rehabilitation. It is believed that in the near future, virtual reality technology will become an important means of children's rehabilitation treatment, bringing hope for more children to recover.

Reference

- Bao, Y. X. (2023). *Research on the design of virtual space in the rehabilitation room of autistic children*. Wuhan Light Industry University.
- CHEN, M. Y., WANG, X. L., ZHANG, Y., ZHANG, Y., CHEN, X., ZHANG, X. Y., & LIU, D. L. (2022). Research progress of immersive virtual reality technology to assess spatial navigation ability of patients with mild cognitive impairment. *Journal of Nursing*, 2022(07).
- Deng, W. T., Zhao, Y. W., & Luo, J. (2021). Feasibility study of ADHD-oriented hand motion data acquisition using HTC Vive. *Computer Measurement and Control*, 2021(04).
- Fu, Y. (2019). Research on the design of children's ADHD educational rehabilitation game based on virtual reality technology. *Central Academy of Fine Arts*.
- Huang, L. J., Yang, L., Ren, J. L. et al. (2021). Progress in the application of virtual reality technology in the rehabilitation of children with cerebral palsy. *China Contemporary Medicine*, 28(34), 31-34.
- LI, D. Y., & LI, L. (2023). Optimisation strategy of virtual reality supporting rehabilitation education for autistic children. *Journal of Suihua College*, 43(10), 89-93.
- LIN, C., & Gong, H. N. (2021). The application of intelligent rehabilitation in the rehabilitation training of autistic children. *Modern Special Education*, (10), 57-62.
- Luan, L. L., Ding, M., Lu, Z. L., Zhang, J., Yu, Q. W., & Yang, L. J. (2021). Progress in the application of virtual reality technology in critically ill patients in ICU. *Chinese Journal of Nursing*, 2021(08).

- Ma, D. H., Zhang, J., Shi, Y. X., & Zhang, Q. (2021). Progress in the application of serious games in nursing education. *Chinese Nursing Education*, 2021(10).
- Wu, C. C. (2023). Research on the intervention effect of virtual reality children's attention training system applied to attention deficit hyperactivity disorder. *Zhejiang University of Traditional Chinese Medicine*, 2023.
- ZHANG, X. J., QUAN, X. P., & CAO, S. (2024). Progress in the application of virtual reality technology in burned children. *General Practice Nursing*, 22(11), 2037-2040.