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APPLICATION OF NEURAL NETWORKS FOR VIRTUAL AND AUGMENTED REALITY

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Abstract*—The article analyzes modern virtual reality and augmented reality algorithms and ways of their implementation using neural networks. As a result, a classification of current virtual reality tasks is presented, the advantages and disadvantages of algorithms are identified, and the use of convolutional neural networks is proposed. As part of the study, a qualitative analysis of modern convolutional neural network architectures was carried out and their individual disadvantages when used in virtual reality systems were shown. As a result of the study, the optimal ways of applying neural networks in various tasks of identification, generativity and support in augmented and virtual reality systems were established. The functional and structural description of convolutional neural networks, the optimal structure and parameters for initialization and training of a convolutional neural network suitable for solving virtual reality problems are presented.*

keywords—Neural networks; virtual reality; machine learning; image identification; augmented reality.

I. INTRODUCTION

Virtual and augmented reality (VR and AR) are two of the most exciting and rapidly evolving technologies of the 21st century. As the capabilities of these technologies continue to expand, they are being used in a variety of fields, from entertainment to education to healthcare. One of the key components of VR and AR is the ability to create realistic and immersive experiences, and this is where neural networks come in. Neural networks are a type of artificial intelligence (AI) that can be used to create realistic and interactive virtual environments. In this talk, we will look at the application of neural networks in virtual and augmented reality, and how they can be used to create more immersive and engaging experiences.

Neural networks are widely used in many areas of research and development, including virtual and augmented reality. Neural networks are artificial intelligence systems inspired by the structure and functioning of the human brain. They consist of interconnected artificial neurons that are capable of learning from data and making decisions. Neural networks are used to create virtual and augmented reality applications that are more realistic and interactive than ever before.

The application of neural networks to virtual and augmented reality is a research area that has experienced significant growth in recent years. Neural networks are a type of artificial intelligence that can be used to create virtual and augmented reality that is more realistic and immersive than ever before. Neural networks are used to create virtual and augmented reality by mimicking the behavior of the human brain. They are able to learn from their own experience and can be used to create virtual and augmented reality that is more realistic and immersive than ever before.

Neural networks can also be used to create augmented reality applications that are more realistic and interactive than traditional computer programs. For example, neural networks can be used to create augmented reality applications that can recognize and react to objects in the real world. Neural networks can also be used to create augmented reality applications that can interact with the user in a more natural and intuitive way. The potential for further research and development in the application of neural networks to virtual and augmented reality is enormous. For example, research could be conducted to develop more sophisticated neural networks that can learn faster and more accurately from data. Research could also be aimed at developing more efficient and cost-effective neural networks [1].

II. VIRTUAL REALITY AND ITS APPLICATIONS

Virtual Reality (VR) is a computer-generated simulation of a three-dimensional environment that can be interacted with in a seemingly real or physical way. This technology has been around for decades, but has recently seen a resurgence in popularity due to the development of more sophisticated hardware and software. Virtual reality has a wide range of applications, from gaming to

medical training, and has the potential to revolutionize the way we interact with the world.

Currently, in the field of virtual reality, an underwater VR system for diving training has been proposed that will allow diving students to experience an arbitrary underwater environment and be able to use virtual reality technology to train in confined water spaces. The ImmerTai system was designed to capture the movements of a Tai Chi expert and capture them in an immersive CR experience to perform Chinese Tai Chi exercises. The student's movements are also presented in the PC environment in a multimodal format to deliver the captured movements to the student. The student's movements are also captured for quality assessment and used to form a virtual environment for collaborative learning. In addition to this, a virtual reality system is proposed for teaching skiing using an indoor ski simulator. The system is based on a simple indoor ski simulator with two trackers to capture the movement of the skis. Users can control the skis on the provided virtual ski slopes and can train their skills by recreating the performances of professional skiers. An output function with 3 channels and an image resolution of 512×256 was obtained. [2], [3]

The United States is the home of advanced virtual simulation technology, and NASA's Ames Laboratory is a major player in the field, making engineering applications of virtual simulation (e.g., data helmets, data gloves, virtual reality simulations of space stations) increasingly sophisticated, and virtual simulation of the Hubble Space Telescope is one of the technological achievements, and NASA has established a corresponding space science virtual simulation training system as well as multitasking applications in the space station virtual simulation operating system. Due to its enormous training and testing capabilities, virtual reality technology is often used first in sectors such as defense and aerospace, and then gradually expanded to industries such as healthcare, education, and entertainment, which have created huge markets for it and have reaped significant economic benefits.

In just a few decades, virtual reality technology has become increasingly sophisticated for every aspect of everyone's daily life, enabling managers, leaders, and engineers to quickly use, modify, and design a projected system. Some mature motion capture products and interactive virtual reality solutions fall short of expectations in terms of experience and are difficult to popularize among the general user base. Thus, high-quality motion capture system design and virtual interaction system development for the industry means lowering economic costs and improving user experience. Being a key issue in the field of virtual reality, it attracts a lot of attention from researchers. In the application-specific microservice architecture visualization system, a special analysis is developed for the integration of the distribution network. During the visualization process, application components are simplified, which in turn provides a more meaningful view for enterprise administrators and increases management efficiency on the part of operational and technical personnel. Here, meaningfulness and efficiency are taken as the main starting point, and the application components are effectively displayed, and then enterprise managers can clearly identify the application components, determine whether the components in the architecture system have great application value, and then find the useful elements associated with them according to the application value of the components and their significance, and finally visualize the architecture.

Secondly, some visualization tools are used in practice with excellent results and continuously improve the effectiveness of development managers to troubleshoot problems. The number of channels obtained by convolving this original feature with a third 3×3 in the encoder is 32, and the image resolution is 512×256 [4]. The features are spliced. With the help of upward and downward dependency diagrams of the system architecture, developers can quickly find the source of the problem in case of failure using these dependencies, which significantly reduces the time to troubleshoot the problem (MTTR). With the help of an application dependency architecture diagram, you can display the correlation between application components in a system or perform a failure simulation for each component on which the system depends to assess the reliability of the system in the face of local failures.

III. AUGMENTED REALITY AND ITS APPLICATIONS

Augmented Reality (AR) is a technology that overlays digital information on the physical world, allowing users to interact with their environment in a more immersive way. It is used in a wide range of applications, from entertainment and gaming to education and industrial processes. In this essay, we will take a closer look at the applications of augmented reality, focusing on its potential in various fields and the existing limitations.

To begin with, augmented reality has been used in the entertainment industry for many years. Video

games are one of the most popular applications of AR, and games like Pokemon Go and Minecraft Earth allow players to explore virtual worlds in a more realistic way. Augmented reality is also used to enhance live events such as concerts by adding interactive elements such as 3D visuals and holograms. In addition, AR is used in the movie industry to create special effects and virtual sets.

Augmented reality is also used in the education sector to help students learn in a more immersive way. For example, AR can be used to create interactive 3D models of complex concepts such as the human body or the solar system. This can help students better understand and memorize the material. Augmented reality can also be used to create virtual field trips, allowing students to explore places they would not be able to visit in person.

In the industrial sector, augmented reality is used to improve safety, efficiency, and accuracy. For example, augmented reality can be used to provide workers with real-time data and instructions, allowing them to complete tasks faster and more accurately. AR can also be used to guide workers through complex processes such as maintenance and repair. In addition, AR can be used to provide employees with virtual simulations of dangerous tasks, allowing them to practice without putting themselves at risk.

Finally, augmented reality has potential applications in the medical field. For example, augmented reality can be used to create 3D models of organs and other parts of the body, allowing doctors to better understand and diagnose diseases. Augmented reality can also be used to provide surgeons with real-time information during operations, helping them make more informed decisions. In addition, augmented reality can be used to create virtual simulations of medical procedures, allowing medical students to practice without putting patients at risk.

IV. Application of Neural Networks for Virtual Reality

The use of virtual reality (VR) technology has grown significantly in recent years, with applications ranging from gaming and entertainment to medical and industrial training. As VR technology continues to improve, there is a need to develop more advanced algorithms and techniques to maximize its potential. One such technique is the use of neural networks (NNs) for virtual reality.

This paper will provide an overview of the various applications of neural networks for virtual reality. We will discuss the different types of ANNs, their advantages and disadvantages, and how they can be used to process data from a virtual reality environment. We will also discuss challenges and current research in this area, as well as potential future applications.

Due to the growing prevalence of virtual reality, a significant amount of research has been conducted on the use of ANNs for virtual reality applications. For example, researchers have developed ANNs that can detect objects in a scene, such as people or furniture. These networks can be used for more realistic interaction with the virtual environment. In addition, networks have been developed that can recognize the shape of objects in a virtual environment. This can enable more accurate interaction with the virtual environment, such as identifying objects that are similar in shape.

Despite these advances, there are still several challenges that need to be addressed to fully realize the potential of ANNs for virtual reality. For example, networks that can accurately recognize objects in a virtual environment, even in the presence of noise or other distractions, still need to be developed. In addition, these neural networks must be able to learn and tune themselves as they go along to become more accurate over time.

As virtual reality technology continues to evolve, there is potential for ANNs to be used in a variety of areas. For example, ANNs can be used to create a more realistic interaction between the user and the virtual environment. For example, networks can be used to detect objects in a scene or recognize the shape of objects.

Additionally, ANNs can be used to provide more accurate navigation in a virtual environment. For example, networks can be used to detect obstacles or other objects in the environment and determine the best path for the user. This can be useful for applications such as medical training or industrial training.

V. Advantages of Neural Networks Application for Virtual Reality

A. Improving the immersive component of virtual reality

Neural networks in virtual reality (VR) offer a number of benefits, the most notable of which is improved immersion. Neural networks are used to create virtual environments that are more realistic, more responsive, and more interactive.

The use of neural networks in VR can help create a more realistic simulation of a physical environment. Neural networks can be used to create virtual environments that are highly detailed and

responsive to user actions. This can create a more immersive experience for the user as they can interact with the environment in a more natural way. For example, neural networks can be used to create virtual environments that are able to recognize and respond to the user's movements or gestures. This can create a more natural and realistic experience for the user, as they can interact with the environment in ways that would not be possible in a traditional virtual reality environment.

Neural networks can also be used to create more interactive virtual environments. Using neural networks, developers can create virtual environments that can respond to user actions in real time. This can create a more immersive experience for the user, as they can interact with the environment in a more meaningful way. For example, neural networks can be used to create virtual environments that are able to respond to voice commands or facial expressions. This can create a more interactive experience for the user, as they can interact with the environment in a more natural way.

Neural networks in virtual reality can also be used to create more intelligent virtual environments. Neural networks can be used to create virtual environments that are able to learn from data entered by the user and then use that information to make decisions or perform actions. For example, neural networks can be used to create virtual environments that are able to recognize a user's movements or facial expressions and then use that information to make decisions or perform actions. This can create a more intelligent experience for the user, as they can interact with the environment in a more meaningful way.

In general, neural networks in virtual reality offer a number of benefits, the most notable of which is improved immersion. Using neural networks, developers can create virtual environments that are more realistic, more responsive, and more interactive. This can create a more immersive experience for the user as they can interact with the environment in a more natural way. In addition, neural networks can be used to create more intelligent virtual environments because they are able to learn from user input and then use that information to make decisions or perform actions. Thus, neural networks in virtual reality provide a number of benefits that can help create a more immersive and engaging experience for the user.

B. Improving the interactivity of virtual reality

Convolutional neural networks (CNNs) can be used to improve interactivity in virtual reality (VR) applications. A convolutional neural network is a type of artificial neural network that is particularly well suited for image processing tasks such as object recognition or scene analysis. By using ANNs, VR developers can create more interactive applications, providing users with a more immersive experience [10].

One of the main advantages of using ANNs for VR applications is their ability to quickly recognize objects and scenes. With traditional computer vision methods, recognizing objects and scenes can take a significant amount of time because the computer has to process each image separately. However, ANNs can quickly recognize objects and scenes because they are able to recognize patterns in images. This allows users to interact with their environment in a more natural way, as they can quickly recognize objects and scenes without having to wait for the computer to catch up. There's a number of image recognition approaches that could be used for VR using CNNs and are shown on Fig. 1. These method varies from very simple to more complex that could be used for extracting hardly recognizible elements of surrounding images.

In addition to improving the interactivity of VR applications, ANNs can also be used to create more realistic virtual environments. For example, ANNs can be used to create photorealistic images from real photographs, allowing the user to experience a more realistic representation of the real world. This can be particularly useful for applications such as training simulations, as it allows users to practice in a realistic environment that closely resembles the real world.

Finally, ANNs can be used to create more responsive VR applications. By using ANNs, developers can create applications that can respond quickly to user input, as ANNs will be able to quickly recognize patterns in user input and respond accordingly. This allows users to have a more responsive and immersive experience as the application will be able to respond quickly to their input.

C. Reducing costs when developing virtual reality technologies

One of the biggest advantages of using neural networks in virtual reality is the cost savings they provide. Neural networks require minimal hardware and software resources, making them much cheaper than traditional computing methods. This is especially important for virtual reality applications, as they often require a lot of computing power. The cost savings from using a neural network can be especially significant for large-scale projects, such as gaming and entertainment.

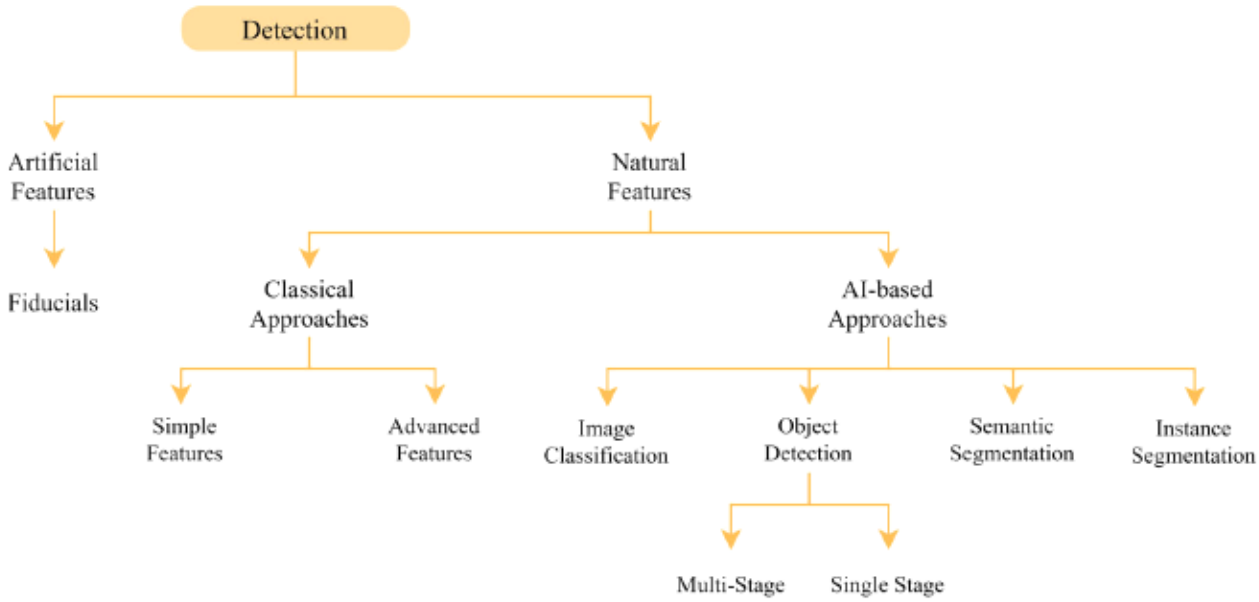

Fig. 1. Visual display of methods for identifying virtual reality elements

Neural networks can also reduce development costs for VR applications. Neural networks are much easier to program than traditional computational methods, and they can help automate many development tasks. This reduces the amount of time and money spent on development, making the creation of VR applications more cost-effective.

In addition to reducing development costs, neural networks can also reduce the maintenance costs of VR applications. Neural networks are able to continuously learn and adapt to changes in the environment, which means they require less maintenance than traditional computing methods. This can save developers money by reducing the amount of time and money spent on maintenance.

Finally, neural networks can reduce costs by improving the user experience. Neural networks are able to detect and respond to changes in the environment, which means they can provide a more immersive experience than traditional computational methods using methods of identifying VR elements (Fig. 1). Usage of these can lead to increased user engagement, which can help increase sales and reduce marketing costs.

VI. Disadvantages of Neural Network Application for Virtual Reality

A. Limited data availability

One of the main challenges of using NNs for VR applications is the limited availability of data. Neural networks require large amounts of data to train and produce accurate results. However, in the case of VR applications, the amount of available data is often limited. This can be due to various factors, such as the limited amount of data available in a particular industry or the difficulty of collecting data in a virtual reality environment. As a result, the performance of neural networks can be significantly reduced when working with a limited amount of data [6].

This problem is further complicated by the fact that NNs require data that is representative of a particular task or application. For example, if a NM is used to identify objects in a virtual reality environment, the data must be representative of the objects in that environment. This can be challenging because the data may not be available or of sufficient quality. In addition, it can be difficult to train a NM when only a small amount of data is available, as the NM may not be able to acquire the necessary patterns or features.

Despite the challenges associated with limited data availability, there are a number of potential solutions that can be used to address this issue. One of the simplest solutions is to collect more data.

Collecting more data can help ensure that the data is representative of the task at hand, and provide the NS with more information from which to learn. However, this approach may not always be feasible, as collecting large amounts of data can be difficult or expensive.

Another approach is to use data augmentation techniques. Data augmentation is the process of creating additional data from existing data. This can be done by modifying existing data or combining data from different sources. This approach can help to increase the amount of data available and also

ensure that the data is more representative of the task at hand [7].

Also use transfer learning methods. Transfer learning involves using a previously trained model on another task to improve the performance of the current task. This approach can be used to utilize existing datasets and pre-trained models to improve the performance of a specific task. This approach can be especially useful when the available data is limited, as a pre-trained model can be used to learn the necessary features and patterns.

B. High computing power requirements

One of the main challenges associated with using ANNs for VR is their high computing power requirements. ANNs are generally considered to be computationally intensive applications, which means that they require a large amount of resources to function correctly. This is due to the fact that ANNs consist of many layers of neurons, each of which must be mathematically calculated to obtain the desired results. As a result, the size of the network can grow exponentially, which leads to the need for more computing power for efficient data processing [8].

In addition to the size of the network, the complexity of the data being processed is also a factor in determining the amount of computing power required. For example, if the input data is very complex (e.g., images or video), then more computing power is required to process it correctly. Likewise, if the data is large (e.g., high-resolution images or video), the network will need more computing power to process it. Thus, the size and complexity of the data being processed by the network are important factors to consider when determining the required computing power [9].

Due to the high computing power requirements of ANNs, it is often impossible to run them on standard computers or laptops. In order to get the best results, it is often necessary to use powerful servers or specialized hardware such as GPUs or TPUs. This can be expensive, both in terms of hardware cost and ongoing maintenance costs associated with running a powerful server.

VII. CONCLUSION

The article analyzes modern virtual reality and augmented reality algorithms and ways of their implementation using neural networks. As a result, the article classifies current virtual reality tasks, identifies advantages and disadvantages of algorithms, and proposes the use of convolutional neural networks.

In general, neural networks are used in virtual and augmented reality in various ways. Neural networks are used to create realistic virtual environments, recognize objects in augmented reality, and provide natural interaction between virtual and augmented reality environments. Neural networks are also used to create more realistic and immersive virtual and augmented reality experiences. As the technology continues to evolve, neural networks will continue to play an important role in the development of virtual and augmented reality applications.

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В. М. Синєглазов, І. О. Бориндо. Застосування нейронних мереж для віртуальної та доповненої реальностей

У статті проведено аналіз сучасних алгоритмів віртуальної та доповненої реальностей, а також шляхи їх імплементації, використовуючи нейронні мережі. В результаті було наведено класифікацію актуальних завдань віртуальної реальності, виявлено переваги та недоліки алгоритмів та запропоновано використання згорткових нейронних мереж. В рамках дослідження було проведено якісний аналіз сучасних архітектур згорткових нейронних мереж та показано їх окремі недоліки при використанні в системах віртуальної реальності. В результаті дослідження було встановлено оптимальні шляхи застосування нейронних мереж у різних завданнях ідентифікації, генеративності та підтримки у системах доповненої та віртуальної реальностей. Наведено функціональний та структурний опис згорткових нейронних мереж, оптимальну структуру та параметри для ініціалізації та навчання згорткової нейронної мережі, яка підходить для вирішення завдань віртуальної реальності.

Ключові слова: нейронні мережі; віртуальна реальність; машинне навчання; ідентифікація зображень; доповнена реальність.

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