# Analysis of Computer Aided Interaction Design Based on Virtual Reality Technology

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**Abstract:** The conventional method of computer-aided interaction design faces challenges due to ambiguous user experience characteristics, resulting in a reduced number of identifiable frames. To address this issue, a novel computer-aided interaction design approach utilizing virtual reality technology has been developed. This method facilitates communication through visual computing, enabling the acquisition of feedback structures from computer vision. It allows for the mapping of human body contours and the extraction of user experience characteristics via virtual reality technology. Additionally, it measures the time required for reading and generating pertinent information, thereby constructing an effective computer-aided interaction mode. Experimental findings reveal that the average frame identification rates achieved by the proposed method are approximately 81(fps), 74(fps), and 72(fps), respectively. These results, when we will compare with two other computer-aided interaction methods, demonstrate that the integration of virtual reality technology significantly enhances performance. This review revealed that the majority of studies are centered on practical case analyses within specific application scenarios, employing empirical evaluation methods to assess objective or subjective metrics. We then concentrated on elucidating the foundational principles of interface design and their evaluation methodologies, providing a reference for future research endeavors. Additionally, the limitations, challenges, and future directions in VR interaction interface design research were discussed, highlighting the need for further research in design evaluation to continuously refine the development of standards and guidelines for VR interactive interface design.

**Keywords:** Digital Technology, VR, VRT, Computer-Aided Interaction, VR Interaction

## INTRODUCTION

Digital technology has significantly transformed the creation and experience of traditional art, with virtual reality technology elevating artistic expression to new heights. The evolution of virtual reality technology can be categorized into distinct phases.

The preparatory phase, spanning from the 1950s to the 1970s, laid the groundwork for future developments. The application phase, occurring from the early to mid-1980s, marked the transition of virtual reality technology from a mere research focus to practical applications. As this technology matured, traditional art began to diminish in prominence, while new forms of art emerging from virtual reality gained traction as the prevailing trend. The rapid development phase, from the late 1980s to the early 1990s, saw virtual practice emerge as a result of advancements in computing, the Internet, information technology, and virtual reality. This practice, aby product of societal and urban progress, facilitated the integration of virtual reality technology into computer-aided interactive creation and presentation, establishing a new mode of artistic practice distinct from traditional scientific methods. Virtual technology empowers artists to transcend material limitations, allowing them to achieve their ideal artistic visions. Common virtual practices involve intentional and reciprocal perceptual interactions between subjects and objects with in a digital environment. Furthermore, the essence of interaction design is encapsulated [1].

## I. LITERATURE

Additionally, enhancements in graphics processing and computer algorithms have made visual data more accessible for human interpretation or for instruments designed to detect images. The domain of visual interaction is significantly propelled by technological advancements, including 3D graphics, pattern recognition, augmented reality, and virtual environments. Essentially, computer vision employs various imaging systems as input mechanisms, allowing computers to process and interpret visual information in a manner analogous to human cognition. The demand for visual interaction has grown as new applications in computer-aided design have emerged, leading to previously uncharted user tasks, novel design challenges, and unforeseen usability concerns. The overarching aim of computer vision research is to enable computers to perceive and comprehend the world visually, akin to human beings, while also possessing the capability to autonomously adapt to their surroundings. By utilizing visual input for communication, computers can execute commands through actions, employing dynamic tracking technologies to recognize user instructions and provide visual feedback, thereby facilitating real-time visual interaction [2], as illustrated in Figure 1.

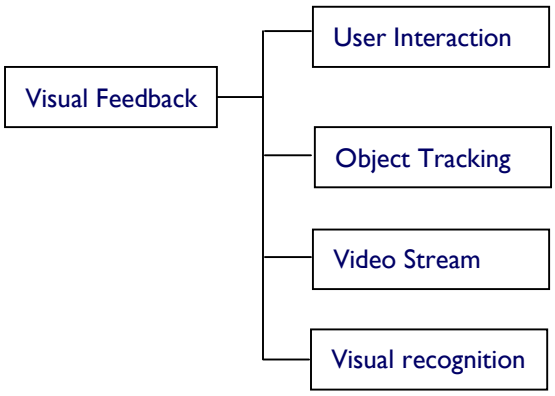


**Fig.1** Visual Interaction Flow

The information presented in Figure 1 illustrates the consistency principle across various feedback dimensions offered by computer assistance to users. The impact of visual interaction on the development of computer-generated works is significant, enabling creators and developers to collectively experience the interactive capabilities of computer applications and convey the authentic narratives of creators through technological means. This objective necessitates sustained effort overtime. Consequently, prior to achieving the ultimate goal, the intermediate aim of human endeavors is to establish a visual system capable of executing specific tasks intelligently, informed by a certain level of visual sensitivity and feedback. Visual interaction design harmonizes aesthetics, humanity, and technology. A notable application of computer vision is in the visual navigation of autonomous vehicles. Currently, no system exists that can fully recognize and comprehend any environment to autonomously navigate as effectively as humans do under conditional circumstances. The present research focus is on developing a visual-assisted driving system with the capability to track roads on highways, thereby preventing collisions with preceding vehicles. This area of study examines how individuals engage with their surroundings through sensory perception and physical movements. Importantly, "visual interaction design" emphasizes the quality and rationality of these interactions. It is essential to clarify that while computers serve to augment human cognitive functions in assistance; this does not imply that visual information processing must strictly adhere to human visual perception. The design and development of visual interactions should be grounded in fundamental aspects of human psychology and physiology. Computer vision is capable of, and should be designed to, process visual information in alignment with the inherent characteristics of computer systems. Providing effective feedback is paramount in the realm of visual interaction [3]. Virtual reality technology originated from a new computer technology developed by the US military [9-10]. The feature of instant interaction is very important in the application of some AR digital products to express virtual 3D scenes. It takes computer technology as the core, and combines the latest achievements of 3d graphics technology, sensing technology, servo technology, panoramic technology, natural interaction technology, multimedia technology and other high-tech fields [3]. The virtual reality structure is shown in Figure 2:

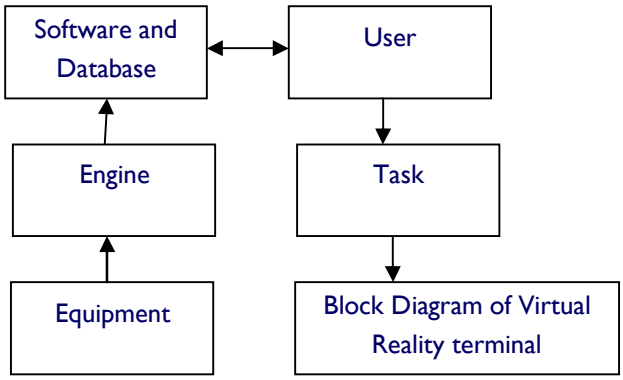


**Fig.2:** The virtual reality structure

It can be seen from Figure 2 that the ultimate goal of digital virtual space-time structure, communication mode and organization mode is to meet the realistic needs of human beings. Through different forms of input and output devices, a three-dimensional virtual world is established to realize a variety of sensory experience, providing participants with real immersive experience. The human-computer interaction achieved by using mouse and keyboard is a more traditional form, while the general audience can use part of the way of person-to-person information transmission for virtual-reality interaction. In the virtual world, people can observe the changes of objects from multiple angles through interactive devices and carry out visual interaction. This is actually to enhance the user's sense of immersion in augmented reality scenes, such as body modeling, voice dialogue, rich expressions, etc. Compared with traditional simulation technology, VR technology is different in that it provides a three dimensional virtual world generated by computer technology, with which users can interact in various forms. At present, virtual reality technology usually uses hand, face and screen interaction technology to enhance reality on mobile terminals of mobile apps, which generally includes two sections: virtual-real interaction and hand segmentation recognition[11-13]. Through the interaction of participants in the simulation virtual reality system, and the use of human's own perception and cognitive ability to contact with things, to help inspire participants 'thinking, omni-directional acquisition of various spatial information and logical information of things. Complete the definition of action, real-time monitoring of human limbs and facial expressions and capture their relative orientation, and then design the classical action used by users to achieve natural and fast interaction between human and machine. Experience is usually generated by the direct participation of the observer of the event. It is like a feeling that touches people's deep heart and unconsciously guides behavior activities. It is the experience and feeling of users after personal contact and use. The process of visual simulation can be divided into three aspects, one is the application of visual processing, in one is the selection of visual and the last is the visual simulation. As the nature of the consumer group is different and the positioning of the product is different, the experience effect is very different [4].

In the data processing of the simulation model, we should first judge whether there is original 3D data model data in the memory of the system, if there is, we should first eliminate the operation, and analyze and determine the scope of the model that can be observed at this time. User experience should be satisfied with the two states of "touch" and "use", and its main research areas include "usability" and "function-centered" design of products. Display model refers to the 3D model displayed in the system. Different models are designed to display data and models in different ways. The realization of 3d model should be divided into two parts, and data processing should be pre- processed before, which has a great impact on the quality of modeling. User experience is a process as well as a psychological feeling. It refers to a psychological reaction and feeling constructed by consumers during the process of using products or receiving services. Due to the different living environment, educational background and growth process, people shape various characters. Each user's unique personality factors determine the results of user real experience with different characteristics, which cannot be completely simulated and reproduced by other methods [5].

In addition, with a strong subjective color and experience guidance, it is not possible for one person to be the same as others. Therefore, there will be many uncertain factors in the experience results obtained by different people for the same product. If you want to get a full degree and similarity of strong product experience as a result, we need to target products do a relatively clear user community research, In order to "availability" and "user as the center of design" as the foundation, for the model, through the data transformation and data standardization of two steps, and, of course, the early and inspection on the data, It is mainly to check whether the value is correct, whether there are empty values and soon. For this specific group to do the same user test, in order to achieve as much as possible the common needs of user experience, design a good experience model in line with this kind of products. Reconstruction of real entities according to their prototypes constitutes the scene model of visual simulation. In the modeling process of 3D virtual reality scenes, only with the support of data can an accurate mathematical model be established so as to better display data and rationalize the display and comparison of real world scenes. Avoid the model design cannot be very good to the real world display, resulting in three-dimensional simulation distortion.

By preprocessing the unconnected human contour, a simple connected human contour can be formed, so the initial point and initial vector of contour extraction can be determined. Then, the expression formula of the initial candidate region is as follows. Whenthe3D simulation model is established, the real situation of the real world should be simplified. By simplifying the real situation of the real world, the scenes of the real world can be displayed intuitively. Availability including product functions, features and ease of use on common sense, refers to products for users effectively, to learn, easy to remember and satisfactory degree, the user can finish his task, with product efficiency, subjective feeling of how, in fact from a user perspective to consider the product can use value degree, is important basis of product is competitive. In order to avoid the real world scene is too complex; the establishment of models and late data display caused too much data over head. The content of the product refers to whether the output information and structure of the product are accurate and reasonable. It is designed and organised according to the needs of users and technical processes, so as to achieve the integration of user and product.

## II. BUILDING COMPUTER AIDED INTERACTION PATTERNS

The concept of human-computer interaction design was initially applied in the field of computer science and software interface design. Computer graphics has become a major channel of interaction design, through which people can use computers to design virtual physical models. Users can only use and obey fixed software programs and a requirement, which finally makes users form a dull and monotonous single mode when using computers. At the same time, with the continuous efforts of the academic community, the government and industry also began to realize the importance of human-computer interaction. They are increasing the circulation of computer publications and publishing more articles and books on interaction design. Today, with user experience as the core of design, product design ends to be diversified, which not only horizontally develops product categories, but also continuously enrich is the personality of products vertically. In addition, the computer field has developed a large number of research programs to expand the research field of interaction design. These are joint projects between computer companies and academic institutions. In daily life, there are many common possibilities between people's behavioral consciousness and the characteristics of the product itself. Designers discover the behavioral rules of target users through research and combine the interaction design dominated by behavioral consciousness. As a result, the cooperation between academia and industry has become closer and closer, many excellent interaction designers and researchers have been cultivated, as well as a large number of academic seminars and training courses with human-computer interaction as the theme. These "common possibilities" are transformed into design elements and symbols to be applied in product design, so as to highlight the individuality of products and the uniqueness of user experience, diversify the interaction modes and enhance the competitiveness of products in the market. Human-computer interaction has been developed and improved on a large scale. But from an interaction design researcher's point of view, computer technology has come a long way, but the designer's range of knowledge and understanding of the user has not changed much. According to the Euclidean distance in the standard library template image, the formula for calculating the minimum distance of pixels in the current frame video image.

Product interaction design emphasizes the interaction behavior, transmission mode and emotional experience of information exchange between users and product system, as well as the background technology supporting such behavior and function. It is a design that has a direct impact on the end user of the product. This is becausepeoplekeeptrackofthingsinchronologicalorder,soiftheyforgetwhereafile was, they know when it was last modified Interaction design is essentially in product design and implementation on the basis of a set of complete and idealized system design, introducing the ideas in product design and use, not only solved by the cognitive differences cause the failure of lack of experience and interaction, and can also provide for people's life, learning and entertainment interactive products more reasonable and comfortable, make life more comfortable and diversification. Or remember when the information was read and generated. The study found that many people think content is related to time. Time is an effective way for users to manage computer information, which has the same benefits as hierarchical management and space management. Therefore, the product interaction design with emotional experience brought by the information exchange between users and products surpasses the traditional industrial product design. Animations can also help users remember what happened. When you minimize a window on the dock, it shrinks to a specific location. Since users were used to the way the dock worked in previous versions, they were already familiar with this form of interaction. Based on the above description, complete the steps of constructing the computer-aided interaction mode.

## III. EXPERIMENTAL ANALYSIS

In this design of computer-aided interaction method, all operations must be connected with the database before database access for 3D model display. Build physical models and human models consistent with the real scene through Unity platform, and conduct texture mapping and baking processing for each model. At the same time, use global lighting technology to illuminate dynamic objects. The basic function test of the platform includes verifying the verisimilitudes of virtual models. The rationality of the layout as well as the simple human-computer interaction functions (free roaming of characters and perspectives witch), ASP.NET access to the SQL Server database, the need to set up the interface to access the database. The common database interface for ASP.NET is ODBC. Three high-performance computers were selected, with one computer as the central server and the other two as node servers. When the user clicked the AR model, it was recorded automatically. The accuracy was determined by the Physic. Ray Cast method in the Update method to the millisecond level. Using these three machines, a small local area network (LAN) is built to connect servers through switches.

The platform selects Oculus Rift CV1 as the display device, data glove and capture device as Noitom neuron, Unity development language is C++ and C#, and the test is carried out on LAN with band width of 1Gbps. In the above experimental environment for experimental testing, and get the experimental results. The computer-aided interaction method based on artificial intelligence and the computer-aided interaction method based on improved genetic algorithm are selected to conduct experimental comparison with the computer- aided interaction method in this paper, and test the identification frames of the three interaction methods under different running time conditions respectively. The higher the value, the higher the performance of the proof method. The experimental results are shown in Figure 2-4:

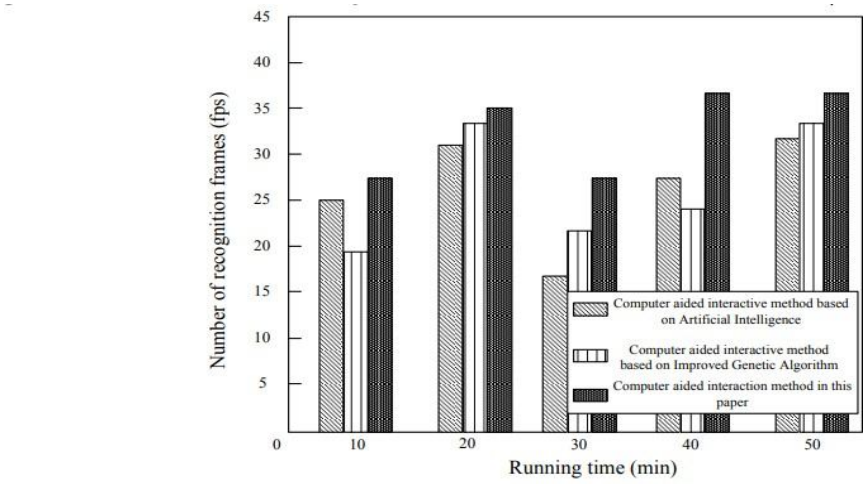


Fig. 3 Number of identification frames in running time of 50min (fps)

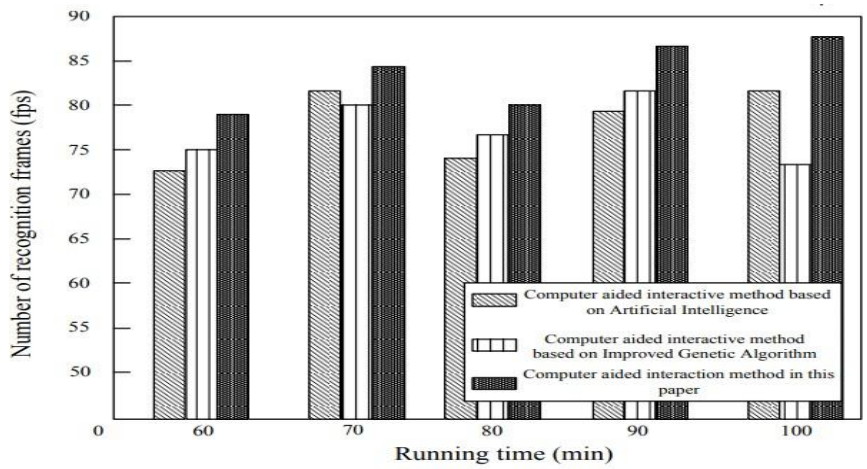


Fig. 4 Number of identification frames in running time of 100min (fps)

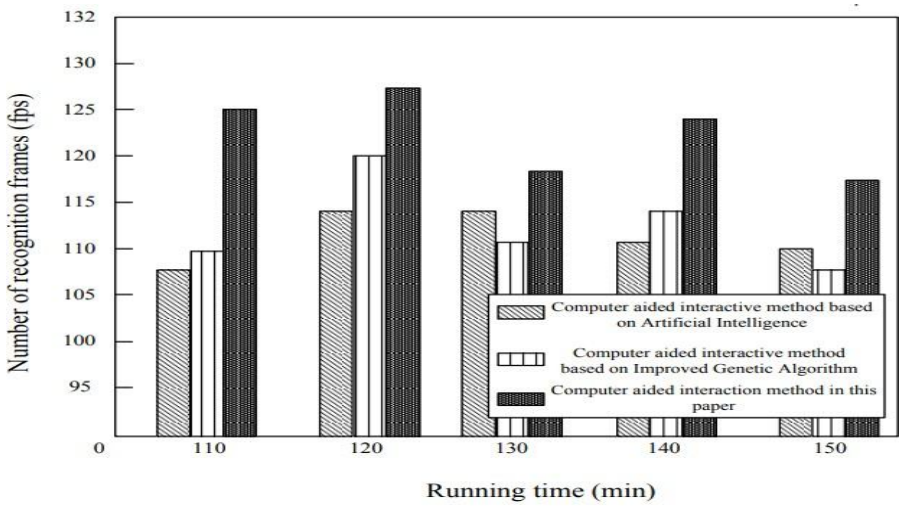


Fig. 5 Number of identification frames in running time of 150min (fps)

## IV. RESULT ANALYSIS

Virtual reality technology synthesizes various design methods in computer image design and visual communication design to create an artificial simulation design environment. In this illusory design environment, we can effectively simulate various system perception behaviors of humans in the natural environment. Therefore, fundamentally speaking, virtual reality technology is a modern human-computer interaction technique that can enhance the design experience of designers by optimizing the design environment and tools reasonably. At the same time, it can also enhance the visual expression and impact of computer image design and visual communication design. In the technical environment of virtual reality technology applications, it is mainly generated and controlled by computers automatically. Therefore, this technology is closely related to image design technology and visual communication design technology, which can enable participants to perceive objects in the virtual design environment in person. In the specific design process, coordination and control can be achieved through virtual and accurate technology and three-dimensional technology can be used to realistically present the object elements that exist in reality, thus achieving friendly human-computer interaction. Based on the above analysis, the article combines virtual reality and interactive image design. It combines artificial neural network technology and information fusion optimization algorithms to construct an algorithm model for an ocean scene interactive experience. Relevant parameters are studied and analyzed for the application of the model. The algorithm's feasibility is verified by comparing it with relevant research progress, laying a foundation for further improvement of image design applications.

## V. CONCLUSION

The method of combining human behavior recognition technology with virtual reality system is proposed, which not only puts forward a new human-computer interaction mode, but also provides a harmonious human-computer interface with human center. The purpose of human behavior recognition is to interact with virtual reality systems. In this paper, the method based on template matching is adopted to match the recognized human behavior with the human behavior template in the database. The matching human behaviour corresponds to various operations in virtual reality, so as to achieve the effect of interaction with the virtual reality system. So the work of the future will be to enable machines to understand the meaning of human behaviour.

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