



# APPLICATION OF VIRTUAL REALITY TECHNOLOGY-BASED TRAINING AND SKILL ACQUISITION IN VARIOUS SPORTS: A SYSTEMATIC REVIEW

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## ABSTRACT

Around the world, virtual reality training is frequently used to assist athletes in winning more medals in their sport. However, for Indian athletes to compete internationally and achieve their goals, virtual reality technology must be incorporated into Indian training materials. Virtual reality (VR) is a commonly used technology that is gaining interest from players and coaches, especially in team ball sports, because it offers a simple tool for imitating, assessing, and training situations that are frequently too difficult to recreate on the field. Virtual training has received relatively little academic attention in the field of virtual reality (VR) in sports, there hasn't been a single study on the topic in Indian sports, and even the virtual training approach isn't used in regular sports training. All pertinent studies were categorized according to the names of the authors, the year of publication, the primary objective of the study, providing an overview of the methodologies used and the results from studies using VR in all sports, as well as highlighting knowledge gaps and unresolved scientific issues in order to conduct a systematic review. Following that, the many results of Virtual reality technology in Sports were examined. This study's findings revealed the usefulness of virtual reality training in assessing sports performance accuracy and improving the sports performance of the player. Even though the authors provide the general training program, the accuracy of these methods was lower than that of the virtual reality training method. Players are more equipped to handle the challenges they confront in the competition thanks to this technique, and virtual reality technology enables researchers to standardize and regulate scenarios while focusing on particular talents and subskills. This research report also discusses the usage of virtual reality (VR) to enhance our comprehension of athletic performance.

**Keywords:** Virtual Reality Technology (VRT), Virtual Environment (VE), Performance, Sports

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## Introduction

Virtual reality is interactive, real-time technology. It's a phrase for 3D computer-

generated settings that let people engage with and experience multiple realities. There are many different ways that users



can interact with computers and the artificial environment. The idea is referred to as "immersive virtual reality." In immersive virtual reality, the user is entirely immersed in a synthetic, three-dimensional world created by a computer. The cornerstones of modern virtual reality are total sensory input and output and immersion in a simulated environment. "Virtual reality is a sort of computer technology that first came into widespread use in the 1980s. It consists of computer programming, 3D hardware, and a variety of sensor data manuals in the virtual world" (Li, 2014).

The world would make considerable use of virtual reality technologies. Nevertheless, the popularity of VR technology has increased as a result of the recent release of low-cost consumer-grade VR headsets for leisure and gaming. It is now clear that VR has found extensive use in a variety of industries, including online gaming, sports, entertainment, education, and construction, and that it has significant economic value for society. "Virtual reality has proven to be an excellent tool not only for entertainment purposes, but also for several other applications such as training, rehabilitation, and human behavior" (Liu, 2020).

Virtual reality is stimulating in contrast to conventional programming instructions, and players may be open to the idea of

employing VR for training. The use of virtual reality (VR) technology, which enables players to interact with and create objects in a virtual environment, fosters player immersion and engagement. (Sunday, 2022) also mentioned that "The surroundings with virtual technologies and tools allow immersion created for the users, by using virtual glasses, gloves with movement sensors".

By using computers and related technology, users may interact with VR equipment more successfully using this way. Immersion is another essential component of VR technology. Users of immersive VR are scarcely conscious of their surroundings since they are perceptually engulfed by the virtual environment. Therefore, when the sensory input from the real world is suppressed, it may seem as though a human has physically joined the virtual environment and created an illusion of involvement in the generated world. "Tracking head movements in real-time, researchers can update the player's viewpoint in the virtual environment in real-time, which helps enhance the player's feeling of presence" (Bideau, 2010).

Sports and physical education benefit more from the usage of virtual reality training using various tools of new, cutting-edge technology. Players gain experience playing the game virtually through this novel approach to sports training, and as a result,



they are better equipped to deal with any challenges that arise during the competition. The athlete's performance is greatly influenced by their training in sports. "VR sports systems use advanced technology to integrate motion feedback platforms with actual sports to provide users with the feeling of actual exercise in virtual reality and are expected to offer the considerable benefit of actual exercise effects through immersion" (Bum, 2018).

Sports use a variety of training techniques to help athletes improve their physical preparedness, skill performances, and teamwork. With the aid of new technology, numerous novel training techniques have been developed in the modern era to improve athletes' performances. The majority of the new technologies in sports were utilized to study sports performances using biomechanical analysis, but relatively little technology is used in Indian training programs to improve the physical and mental performances of athletes. "VR is a created state that is shown to the client through programming, causing the client to suspend disbelief and recognize it as a valid domain" (Ahir, 2019). The lack of sports technology tools in India previously prevented players from putting on competent international performances. The players' psychological needs could not be given the trainers' full attention. The creation of new training techniques that improve athletes' physical and mental

performance makes use of a wide range of new technology. "Virtual reality (VR) has been inserted in many different fields and has established itself as a valuable tool for improvement of performances or skill acquisition" (Pastel, 2022).

In the area of esports, it combines innovative and cutting-edge technologies, but it is now extensively employed in physical education and sports as well. With the help of sensor- and video-based VR training, which allows players to receive customized training regimens tailored to their game in a virtual setting, physical education can become more engaging and active. "The real environment encompassing the reality itself, including direct or indirect (via displays) views of a scene, represents the one extreme of the continuum" (Capasa,2022) Virtual reality technology may be used in sports instruction at colleges and universities to help students effectively prevent injuries while training. Students can release their hands and feet while practicing and completely demonstrating action technology using virtual reality technology without having to worry about unintended accidents "It is essential to develop a training environment that is free from outside interference, avoids sports injuries, and gives the athletes a sense of immersion" (Zhao, 2022).

## RELATED WORK



Virtual reality technology has undergone several improvements and is now employing new ways to provide better outcomes. This section provides a comparative study of several existing research that quickly highlight some of the virtual reality training, performance analysis, and immersion through head movement display in sports.

Benoit Bideau, Franck Multon, and Richard Kulpa, 2004 investigated real handball goalkeepers' reactions to virtual scenery as in real games. Human-like figures are typically needed in sports applications to replicate game circumstances, such as duels. virtual training and research on sports. In fact, it gives sports scientists a new tool to study motor control in extremely complicated scenarios involving a variety of characters.

Jeremy B., Kayur P., and Alexia N., 2008 examined Virtual reality (VR) opens up new learning opportunities, particularly for teaching people how to do physical movements like those used in physiotherapy and exercise. As technology and our knowledge of how to use its interactive features advance, we should experience more learning benefits through VR.

Mathias W., Roland S., and Robert R., 2010 explored the level of presence by measuring how the virtual competitors' activities

caused the seasoned rowers to behave differently. The believability illusion in our virtual world might be strengthened by a more accurate simulation of competition behavior. Making a virtual trainer that continuously evaluates performance and offers appropriate feedback is one solution.

Benoit B., Richard K., Nicolas V., Sébastien B., and Franck M., 2010 presented that the perception-action loop that athletes use needs to be better understood if performance in sports is to be improved. Three steps are involved in the analysis of sports performance using VR technology. Players must move as accurately as possible for technology to assess sports activities from a behavioral standpoint to work. By participating in the action with their players and offering real-time analysis as the game situation develops, they can then better assist them in guiding their players' decision-making.

Pierre N., Annie S., Mylene H., and Christian C.J., 2012 explored determining whether the use of virtual reality might help identify attention and inhibition issues in adolescent patients. Compared to the conventional test, neuropsychological evaluation using virtual reality demonstrated heightened susceptibility to the subtle highlights of sports concussions.

Guangxue Li, 2014 investigated VRT, in addition to conventional computer



technology, which has the qualities of visual perception, motion perception, auditory perception, tactile perception, and haptic perception, even incorporating the olfactory sense and taste perception, as well as other distinctive characteristics. This technology is used in sports training to improve the professional aspect of athletes among university students and the quality of training. The use of VRT in contemporary athletic sports is significant; as a result, the technical distinctions between real athletes in motion and virtual 3d athletes have been thoroughly examined. VRT can be enhanced to some extent, but the normal university's sports training basis is different and unscientific, and coach technology level not higher practical issues, to increase the standard of college physical training and students' technical and tactical skills.

Pedro Kayatt, & Ricardo Nakamura, 2015 examined the current generation of HMDs' technological advancements are sufficient to overcome various issues that were previously found in the practical use of those devices. HMD improved performance while having no adverse effects on user experience. Other application domains may potentially see the implementation of fresh experiments.

Emil M.S. and Ekaterina P.F., 2016 investigated Virtual reality (VR) is being used more frequently in training settings, including sports. With support for precise

performance evaluation and user feedback, VR offers the chance to practice in a realistic, secure, and regulated environment. Compared to the programs listed above, our application's user interface more closely simulates the ski jumping method, making it potentially more effective for training. These features should have been combined with gesture detection for "smart physical training" to the fullest extent possible.

Anne A.C. and Ineke J.M.V.H. 2016 investigated whether one's memory for their own physical ability can be influenced by fake, manipulated reconstructions of these events that are shown from a first-person perspective in virtual reality. VR's user-specific views and expansive, three-dimensional range of view naturally provide a strong sense of immersion, making it a tremendously rich form of media. It is important to examine in future study how strongly the feelings of competence and performance motivation are related.

David L. N., Robyn L. M., and Patrick R. T., 2017 introduced the use of VR in sports to more fully comprehend the findings of this research. There are several occasions where researchers employed an approach that was close to the concept of VR sports applications that was put forth. VR has the potential to be a useful supplement to current real-world sports training and participation. Researchers, coaches, and



sportsmen will be able to exploit VR environments to their advantage as well as the benefit of society at large.

Jonathan S., Lewis C., Gert J.P., and Leigh E.P.,2018 explored the factors to take into account when designing a professional cycling simulator for the velodrome for the 2018 Commonwealth Games. There is a lot of potential for VR in athletic training. It will be easier to confirm the generalizability of this framework and gain a deeper understanding of the potential of VR technology for performance measurement and enhancement by raising fidelity and developing sports simulators from various sports.

Felix H., Jan P.G., Barbara H., Stefan K., 2018 explored augmented feedback that is automatically generated inside of a virtual reality CAVE-based training environment for athletes. Combining more advanced, higher-level features from our pipeline might be one solution. Be aware that the resulting augmented feedback can only be effective if the classification itself performs effectively.

Kunjal A., Kajal G., Rutvik G., and Manan S.,2019 investigated the use of VR in education, the military, and athletic training is possible. Look closely at the apps that have been abused in study sessions with positive results when using VR for training. VRT can be useful in all these disciplines

since it makes understanding concepts simpler and more practical than traditional approaches, and it offers a platform for various modeling activities that in the actual world carry a risk of life or death. It will be of immense value to the world and make a significant contribution to the sports industry.

Huimin L., Zhiquan W., Christos M., and Dominic K.,2020 introduced a virtual reality game program that may be used to create racket sports exercise routines. It evaluated if the participants' performance had improved as a result of their involvement in training in virtual reality sessions. Application for playing virtual reality racquet sports and a way to combine exercise routines. With this approach, the user can alter the cost terms' specifications, and our device will immediately create an activity drill that achieves the user's given goals. Other virtual reality entertainment programs that can be used for training and exercise may be developed in the future.

Oliver R.L.F., Kirsten S., and Livvie B.,2020 introduced Virtual Reality and the use of technology for coaching, skill development, and sports. in order to create and implement environments that are suitable for improving performance and learning particular skills. Implementing such technologies has shown positive outcomes in coaching and skill acquisition. Sports-



related VR technology study will alter how coaches train their athletes.

Jian Z.,2020 investigated sports training with virtual reality technology, which can produce more effective training results. It will alter the present single-teacher teaching style, pique students' interest, and enhance the learning environment. Through many sophisticated abstractions, VR technology can give students some theoretical concepts and scientific direction so they can learn and develop in the game.

Deniz Bedir, and Süleyman E. Erhan, 2021 examine a comparison between (VMBR + VM) and virtual reality-based imaging (VRBI) training methods to determine how they affect athletes' shot performance and imagery abilities. Results from the VRBI program were more favorable in terms of both performance and imagery abilities. VR technology offered a significant benefit in terms of the athlete's ability to control the process and feel immersed in the surroundings.

Man F., Fan Y., and Rongqi Y.,2021 investigated the use of virtual reality (VR) technology in professional practice and academic settings for sports rehabilitation. Technology based on virtual reality offers a wealth of materials, an easy environment to foster diverse thinking, and integrates study and practice. The rehabilitation training industry will undoubtedly undergo a

profound revolution as a result, and sports rehabilitation training techniques will advance as a result.

Stefan P., Petri K., Chen C. H., Ana M. Wiegand C., Stirnatis M., Nübel C., and Schlotter L., 2022 explored It's uncertain how much VR training tools can be used to help athletes learn difficult sports moves. The participants were instructed to watch the movement on the monitor three times in each of the four groups that underwent testing and various types of interventions For beginners, in particular, VR is an excellent tool for learning sport-specific methods. It would be beneficial to incorporate outside commentary from the instructor or avatar to convey the true worth of participants' movement.

Kun Zhao and Xueying Guo,2022 explored the use of VRT in Soccer training and the fusion of VR technology with sports training. Creating a training environment free from outside interference and that prevents sports injuries is crucial. Due to its superiority and high level of simulation, virtual reality (VR) technology has generally advanced football training, and the VR system has been a vital guide to the players' physical and tactical training, considerably enhancing their psychological state and teamwork during games. The benefits of VR technology should enable coaches and athletes to receive better training to advance their skills.





## CONCLUSION

This review looks at existing studies on the impact of virtual reality training improve performance in sports. The review's major purpose was to identify research gaps in the field of virtual reality training in sports. In order to determine the necessity for further research, a variety of scientific articles published between 2004 and 2022 were defined and reviewed. The primary goal of the research is analysis, and correction in the player's performance, and evaluation of the player's progression. To this end, all structured publications were cataloged by author name, year of publication, and the technique used for recognition of the virtual reality training method applied in the sports domain. The key point to remember is that virtual reality is a useful advanced training tool that makes difficult skills easily performed and assesses sports performance.

Therefore, this work effectively performed a comprehensive evaluation of Virtual reality training applications and their influence in the sphere of sports. Future research Recommended that apply virtual reality training programs conducted for assessment in various sports, skill acquisition, rehabilitation of injured players, and physical fitness for enhancement of the player's performance.

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