Journal of Advanced Sport Technology
DOI: 10.22098/jast.2025.17771.1427

Received: 04 July 2025	Accepted: 22 November 2025

ORIGINAL ARTICLE *Open Access*

The Role of Augmented Reality in Enhancing Sign Language and Communication for Deaf Athletes: A Narrative Review

Priya Sharma*[1], Lavisha Leona Mendonca[2]

1. Assistant Professor, College of Physiotherapy, Dayananda Sagar University, Bangalore, India .
2. Bachelor of Sports Sciences Student, JAIN (Deemed-to-be University), Bangalore, India.

Correspondence: Author's Name: Email: **Priya Sharma,** priyasharma782@yahoo.com

How to cite: SHARMA, P., Mendonca, L. Leona AR-Guided Sign Language & Communication in Deaf Sports - A Narrative Review. *Journal of Advanced Sport Technology*, 2026; 10(1): 1-10. doi: 10.22098/jast.2025.17771.1427

ABSTRACT

Deaf athletes compete in national and international events regularly, and most of them train in clubs alongside hearing athletes. People with deafness or substantial hearing loss claim to have a distinct cultural identity and belong to a sociolinguistic group, however the majority do not consider this a handicap. Hearing loss is linked to challenges with balance control, which can impede functioning. Athletes with hearing impairments face unique communication challenges in sports, where quick decision-making and effective coordination are crucial. AR is described as a technique that combines digital and physical information that occurs in real-time utilizing technological equipment. In particular, AR refers to the loading and merging of virtual items such as video, sound, photographs, text, 3D models, and so on into real-world perspectives. Thus, in the context of athletes who have difficulty hearing, Augmented Reality (AR) technology provides a unique solution that increases sign language interpretation, real-time game strategy communication, and referee signaling. Sign language (SL) is the primary mode of communication between deaf persons and other populations, and it is represented through both manual (body and hand gestures) and non-manual (facial expressions) characteristics. These characteristics are used to generate utterances, which transmit the meaning of words or phrases. This paper investigates the significance of AR in overcoming communication barriers for deaf athletes by combining wearable gadgets, haptic feedback, and visual overlays. By utilizing AR-driven captioning and gesture detection, deaf athletes may get rapid, context-aware information, enhancing engagement and performance.

KEYWORDS :Augmented Reality- Deaf Sports- Communication- Sports technology- Sign Language

Introduction

Deaf (D/deaf) athletes have distinct sports abilities, hearing loss, cultural and educational backgrounds, and communication styles. The way athletes feel about their hearing loss influences their identity. Athletes with hearing loss may identify as deaf or hard of hearing. Athletes who were born deaf, use native sign language, and primarily interact with the deaf community may identify as Deaf. Uppercase Deaf refers to a cultural and linguistic minority, whereas lowercase deaf refers to non-signers[1]. The Deaflympics, also known as the Deaf World Games, World Games for the Deaf, and International Silent Games, is the second oldest international multisport organization, behind the Olympics, which is the first and oldest global sports competition for those with disabilities.

The Deaflympics are held biannually for elite D/deaf athletes, alternating between summer and winter games (similar to the Olympics). Unlike Paralympics and separate Olympics, there are no rules adjustments or separate classes for D/deaf athletes.Visual cues such as flashing strobe lights, hand signals, and/or flags instead of auditory starting signals are the only adaptations necessary.

D/deaf individuals began participating in sports before persons with disabilities did. Since the establishment of residential schools for the Deaf in the 18th century, sign-language communities have grown. Deaf sports have helped develop sign-language communities and support social groups for people who are deaf or hard of hearing. Eugene Rubens-Alcais of France and Antoine Dresse of Belgium established the International Silent Games, often known as the Deaflympics, in Paris in 1924. At its creation, there were six established national federations for deaf sports[21]. Athletes must have a minimum hearing loss of 55dB in their ears to compete in the deaf Olympics and other deaf-specific sports. This includes global and regional championships, as well as Deaf Champions Leagues. Hearing Aids and Cochlear Implants are Not permitted in competition to level the playing field. Referees and officials employ visual tools during competitions, such as flashing lights, hand gestures, and flags, rather than aural communications[22] [23].

Augmented Reality (AR) has been effectively utilized to establish accessible and assistive environments that cater to the needs of Deaf and Hard of Hearing (DHH) individuals[2]. For instance, AR, in conjunction with Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) synthesis, has facilitated the provision of real-time live captions for DHH users.

Furthermore, extensive research has concentrated on the positioning[3], auditory identity[4], and personalization[5] of live AR captions within the visual field of DHH users. Additionally, various virtual sign language interpreters have been developed and deployed across diverse contexts, such as home entertainment[6] and educational settings[7], thereby enhancing the daily experiences of DHH individuals [8] [9]. Deaf athletes frequently have substantial communication obstacles with coaches, teammates, and officials, necessitating the use of interpreters or visual signaling devices to participate in the game. Limited access to specialized training programs and resources suited to their specific requirements might impede skill development and competitive chances. The lack of exposure and comprehension of Deaf sports in mainstream athletics results in less financial possibilities, sponsorships, and media coverage. Social isolation and misunderstandings about Deaf athletes' talents can exacerbate psychological difficulties, reducing motivation and confidence. To guarantee that Deaf athletes have equitable chances in sports, inclusive legislation, improved coaching tactics, and breakthroughs in assistive technology are required.

Research on the athletic performance of D/HH athletes has also looked into the influence on quality of life and self-esteem, albeit research in this area is scarce. The findings show a strong relationship between sports activity, self-esteem, and overall happiness, with recognition as a deaf athlete significantly impacting everyday living quality. Overcoming hurdles in training and competition boosts self-esteem, adding to the psychological advantages of sports involvement. However, it does not appear that age or sport-specific experience substantially impacts self-esteem levels. Due to the scarcity of research, more studies using varied approaches are required to increase scientific evidence on this topic[10] [11] [12] [13].

One of the most common challenges in deaf sports is communication due to minimal awareness of effective interaction with deaf individuals. Effective communication between athlete and coach is critical for effective collaboration, particularly among D/HH athletes who experience vestibular dysfunction-related challenges. Research repeatedly shows that strong communication with the coach is critical for outstanding athletic performance, with characteristics such as coach type, gender, and communication strategies playing important roles. D/HH athletes prefer hearing coaches, particularly those who can sign, to coaches with hearing problems. Female athletes with vestibular problems typically communicate better than their male counterparts. Both sign language and spoken communication are well received, however hard-of-hearing athletes tend to favor oral communication. [14] [15] [16] [17] Deaf athletes confront several obstacles in sports, including communication issues with coaches and teammates, restricted access to adequate training tools, and social prejudices about their talents[18]. The absence of hearing-specific accommodations, such as sign language-proficient coaches and visual signaling systems, significantly limits their participation and performance[19]. Overcoming prejudices and limiting media exposure is a continuing issue that affects financing and recognition in the sports community[20].

Material and Methods

The keywords “Augmented Reality”, “Deaf Sports”, “Communication”, “Sports”, “technology”, “Sign Language” were used to search PubMed, Google Scholar, Web of Science, and Scopus for relevant literature. These terms were used interchangeably and in conjunction with the Boolean operators "OR" and "AND" to find relevant articles.

Articles were chosen based on their relevance to AR applications in sports, deaf athlete communication, and assistive technologies. Studies published in English were included, while non-English research was excluded. This narrative review focused on the papers covering AR advancements in wearable technology, biofeedback, and deaf-inclusive sports strategies. Articles published from 2005 till 2025 were included in the study for the narrative review.

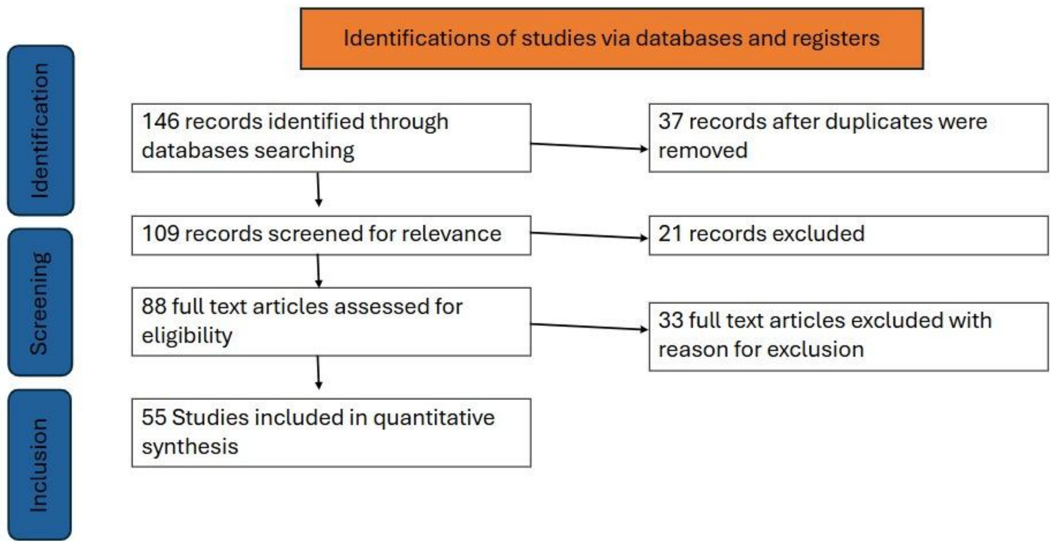

Figure 1: Flow Diagram of Study Selection Process

AR AND ITS APPLICATIONS IN SPORTS

Augmented reality is submitting the information or message which is desired to be delivered to user with the help of various technologies in a way where the real world perceived via our senses by enriching with external images, sounds, data and information to the simultaneous user. [56] A few firms have expressed interest in employing AR at large-scale sporting events in recent years. However, currently, no such system is accessible. A never-ending pursuit for perfection has always defined the landscape of sports, testing human boundaries and investigating strategies for better performance without sacrificing safety. As technology has become more prevalent in the sports business, new training, rest, and injury prevention approaches have arisen [24]. For example, Apple demonstrated the usage of augmented reality in a baseball game, but there is no additional information regarding the practicality or technology employed. Panasonic showcased the notion of deploying augmented reality in stadiums in 2018 with large-scale projection mapping. This used augmented reality technologies to recreate the genuine stadium experience. Similar to the baseball AR application, it is unclear when it will be marketed and made publicly available. A recent study simulated an AR experience at a stadium using a theater setting to see if it might benefit sports viewers[26]. Research indicates that augmented reality applications in sports primarily focus on developing expert systems to assist trainers in training athletes, managing competitions more fairly, and presenting competitions to audiences in an engaging manner.

An example of this is PingPongPlus, a sports training and analysis software that analyzes ping pong players' tactics and promotes interactive competition. Augmented Reality with Live Sports is another example of a large-scale AR use. Popular sports are transmitted to millions of viewers, providing them with information and statistics. Some other examples of AR in sports include AR sports equipment designed to boost training. AR glasses for swimmer training and AR apps for soccer training may combine hundreds of data points into real-time training feedback[27] [28]. Another study which is similar to PingPongPlus aims to prevent monotony in climbing walls by ensuring more productivity from trainings conducted in climbing walls and making the climbing more entertaining with various duties In the study, the area where the climbing wall is located was monitored and the collected images were processed; the next move of the sports people and the route information were reflected to wall again via projector by following the body motions of sports person. [57] Traditional sports broadcasting now incorporates mixed and augmented reality technology to combine complicated information visually into video footage. Visual overlays can display player names, paths, ball possessions, heat maps, and game signals (e.g., offside lines in football). These visualizations have the feature of being replays rather than real-time. Visualizations, especially in 3D, need perfect registration of cameras or sensors, which are becoming more common in modern stadiums[29]. A classic example of such a technology is the Eyeply system (Hurwitz & Jeffs, 2009) has been designed to offer services to various aims via their layers as stadium layer, player layer and friend layer. In stadium layer, while the spectators scan various parts of stadium via mobile devices; they can see various parts such as restaurants, cafes, loggias, exit doors and they are directly led to the seat where they sit. In the player layer; the previous statistics, performance tables and real time data regarding the players monitored via mobile device can be followed. In the friend layer, the options for socializations are offered. [58]

WEARABLE GADGETS IN SPORTS

Wearable technology enhances sports performance with real-time data processing and tracking. Both professional and amateur athletes use wearable sensors to improve training efficiency and competitive results. Wearable Technology (WT) has been utilized in healthcare, sports, entertainment, electronics, textiles, and defense industries for many years. Wearable technology includes non-invasive gadgets and sensors that may monitor health parameters without requiring subcutaneous applications. WT transforms sports by giving real-time data for players to train better and coaches to customize plans and industry insights. WT devices are the Internet of Things (IoT) with three layers: sensor, computation, and network. The first two layers, sensor and processor, comprise all processes performed purely on the WT's electrical hardware. WT includes external devices, processing processes, and communication protocols in the network layer[30].

An example of wearable technology we commonly use while working with athletes is accelerometers. Accelerometers monitor acceleration and can assess physical activity intensity over time. Accelerometers are popular wearable sensors for activity identification due to their precision, compact size, and low battery consumption[32] [33]. Vibrating wristbands alert players to referee whistles or game-start signals, allowing them to stay involved despite aural difficulties[34]. Smart glasses are perfect for displaying information during a sport activity. It also provides visual signals or captions for coaching input, improving communication between Deaf athletes and their teams[35] The information that is useful for a person doing sports would be performance measurement, performance comparison, maybe navigation, notifications about weather or messages, and so forth. The information can be displayed to the wearer in his peripheral vision without disturbing the sports activity. The smart glasses could also be used to take pictures or video during sports activated by a speech command. Custom software and sometimes hardware for each sport would be necessary as smart glasses for surfers would differ a lot from smart glasses for snow sports. [59] An example of such a smart glass would be Recon Jet by Intel. It is a sport-centered device. The unique feature is its low on-glass position. The glasses' computer is clipped on bottom of right lens, not on any temple as the rest of Temple-mounted models. Another similar model would be Kopin by Solos as it is a sport-based smart glasses model. The glasses unique feature is micro display design. [60]

HAPTIC TECHNOLOGY

Haptic technology simulates touch using forces[37], vibrations[38], movements[39] [40], and electrical impulses[41]. Haptic technology, which arose in the mid-20th century, was primarily used to boost mechanical and flying operations. The main goal was to enhance physical control while promoting safety and precision in these sectors [42].

Haptic feedback can be tactile or kinesthetic, providing a sense of touch (e.g., texture and vibration) or kinesthetic feedback (e.g., weight and resistance). As the haptic feedback field widely deals with the tactile sensations of the human body, resulting in biofeedback, it is essential to understand the psychophysics of the human tactile system to create a successful tactile communication interface that produces genuine sensations. The human touch system is well-developed, with the skin at its heart. The human touch sensation is classified as cutaneous or kinesthetic, depending on where the sensory input occurs[43]. The cutaneous sense has a variety of sensory receptors, including mechanoreceptors (respond to mechanical stimulation), thermoreceptors (react to temperature stimulation), and nociceptors. The cutaneous sense gets sensory input from receptors implanted in the skin (cold, warm, pain receptors, and mechanoreceptors). In contrast, the kinesthetic sense receives sensory input from receptors located in muscles, tendons, and joints. The human skin is densely packed with many mechanoreceptors, among the sensory receptors that transmit tactile inputs to the brain in the form of electric nerve impulses [44] [45].

Haptics have been used to improve interaction in various contexts, such as distributed groupware systems, where haptic awareness has been found to improve task performance. In a recent study, a device named HaptStarter, a haptic stimulus start system, was used to improve the starting performance of the Deaf and Hard of Hearing (DHH) sprinters by replacing standard auditory start signals with vibrating indications. The system comprises a wearable device (such as a haptic band or vest) outfitted with vibration motors. When the race begins, an electrical trigger sends a wireless signal to the gadget, which activates a pre-programmed vibration pattern that simulates the rhythm of a starting gun. These vibrations give time feedback, allowing athletes to anticipate the start and respond faster. According to studies, haptic signals minimize reaction time compared to visual cues, allowing DHH athletes to compete on the same level as hearing athletes. The gadget is in line with official timing systems, making it a fair and effective option for inclusive sports contests[46].

Villamarín & Menéndez (2021) designed a haptic glove that integrates with a sports broadcast system to improve the experience of Deaf viewers by converting audio signals into tactile vibrations[47]. Molina et al. (2024) conducted a study on vibrating wristbands designed to help Deaf athletes detect referee whistles in recreational sports. These wristbands provided real-time haptic feedback, ensuring athletes could respond promptly to game signals. The study highlighted the effectiveness of this technology in improving accessibility and inclusivity in sports for Deaf individuals. The researchers emphasized the potential for further development to enhance the accuracy and usability of such wearable devices.

INCULCATING SIGN LANGUAGE IN DEAF SPORTS

Deaf people face real problems in knowing sports results unless they are not watching TV or not presenting on-site at stadiums. Sports was first introduced to the deaf community in the 20th century. Deafness, often known as hearing impairment, is the inability to perceive specific sound frequencies. For almost a century, there has been no specific sport for people who are deaf or hard of hearing. However, several sports rely mostly on noises as signals. As more deaf individuals participate in sports, other terminology has emerged to reflect their perceived engagement by non-disabled athletes worldwide. On one level, deaf sport is described as a sport in which deaf athletes compete. Deaf sports should be viewed culturally. The Disabled People's Organizations, or DPO, have advocated for sports. Some DPOs, such as the International Committee of Sports for the Deaf, are overly active. They arrange the Deaflympics and provide an online site for results and updates. Illiterate deaf individuals may struggle to read and understand findings without the assistance of a sign language interpreter.

An example of a technological advancement in the use of sign language in the field of sports includes Sign language animation synthesis. It is a cutting-edge technique that employs artificial intelligence (AI), motion capture, and computer graphics to translate text or spoken words into animated sign language for deaf athletes and viewers. This technology analyzes linguistic patterns and transforms them into 3D avatars that can make realistic sign language motions. Natural language processing (NLP) models are used to read and decipher sports comments or directions, followed by gesture synthesis algorithms that create precise hand gestures, face expressions, and body postures. Motion capture data from human signers is commonly utilized to improve realism and fluidity. In sports, real-time sign language synthesis can be integrated into stadium screens, sports broadcasts, or wearable AR/VR devices, allowing deaf athletes to get game instructions quickly and spectators to follow live matches without depending on captioning. This invention makes sports more accessible, engaging, and inclusive for the hearing-impaired community [48].

Visual feedback

Visual scanning jobs in augmented reality include carefully monitoring and analyzing real-world surroundings and virtual overlays using devices such as smartphones or AR glasses. Visual scanning tasks include searching for and identifying both physical and virtual elements in the augmented space, distinguishing between real and virtual objects, interpreting visual cues and indicators overlaid on the real environment, adapting to changes in both the physical surroundings and the digital overlays, and maintaining spatial awareness of the real environment while engaging with virtual elements [49].

Delivering digital overlays in large-scale locations, such as stadiums or sports fields, presents unique problems that differ from standard AR applications. This is especially noticeable when providing material in the appropriate location and context for the user. Understanding the user's position and orientation about the graphic material is crucial. Additionally, the displayed material must be spatially represented (e.g., GPS coordinates in the field[50].

Deaf and Hard of Hearing (DHH) persons have difficulty understanding particular auditory cues in diverse real and virtual contexts while doing these jobs. They rely on visual and tactile clues and regularly change their focus to maintain spatial awareness[51] [52] [53].

Much research on visual scanning has been undertaken in real and virtual contexts, focusing on eye-tracking among DHH users. Eye gaze plays critical functions in visual languages such as sign language (e.g., gaze patterns accompanying kinds of verbs[54], locative pronouns[55], gaze fixation on the face and upper body, etc., as evidenced by eye-tracking studies. Furthermore, the perception of emotions by DHH users utilizing facial characteristics under varied situations and face and body postures has been studied using visual scanning.

Research conducted in 2024 recruited 11 DHH volunteers who played seven rounds of the AR game Angry Birds AR. Following the game, each participant participated in a brief structured and a longer semi-structured interview. Their study found that both modest audio cues and overwhelming visual clues had a detrimental influence on participants' performance. Alternative techniques, including dynamic surroundings and user-friendly haptic and textual signals, can help reduce this issue. Participants had to compromise on AR visibility to retain real-world spatial awareness. Incorporating spatially aware methods in AR can improve performance without diverting attention.

Conclusion

By combining real-time sign language translation, captioning, visual and haptic feedback, and wearable technology, Augmented Reality (AR) offers a revolutionary way to improve communication and accessibility in Deaf sports.

Key findings emphasize how AR inculcated in Deaf sports can improve athlete-coach interactions, facilitate real-time game strategy communication, and improve referee signaling through visual and tactile cues.

However, despite its potential, some obstacles remain, such as high costs, technological limitations in gesture recognition, and the need for standardized AR solutions across different sports. Future research should improve multi-sensory AR integration (visual, haptic, and AI-driven auditory substitutes) and guarantee wider accessibility through affordable solutions. To guarantee equitable chances and improved performance for Deaf athletes in competitive sports, sports organizations, tech developers, and accessibility advocates must work together to overcome these challenges.

Ethical Considerations:

Compliance with ethical guidelines

The authors commit to adhering to ethical guidelines.

Funding

Authors state no funding involved.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this Manuscript.

Acknowledgment

Nothing to declare

References

1. Padden, C. A. and Humphries, T. (1988) Deaf in America. Cambridge, MA: Harvard University Press

2. Mohammad Reza Mirzaei, Seyed Ghorshi, and Mohammad Mortazavi. 2012. Combining Augmented Reality and Speech Technologies to Help Deaf and Hard of Hearing People. In 2012 14th Symposium on Virtual and Augmented Reality. 174–181. https://doi.org/10.1109/SVR.2012.10

3. Dhruv Jain, Bonnie Chinh, Leah Findlater, Raja Kushalnagar, and Jon Froehlich. 2018. Exploring Augmented Reality Approaches to Real-Time Captioning: A Preliminary Autoethnographic Study. In Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems (Hong Kong, China) (DIS 18 Companion). Association for Computing Machinery, New York, NY, USA, 7–11.https://doi.org/10.1145/3197391.3205404

4. Ru Guo, Yiru Yang, Johnson Kuang, Xue Bin, Dhruv Jain, Steven Goodman, Leah Findlater, and Jon Froehlich. 2020. HoloSound: Combining Speech and Sound Identification for Deaf or Hard of Hearing Users on a Head-Mounted Display. In Proceedings of the 22nd International ACM SIGACCESS Conference on Computers and Accessibility (Virtual Event, Greece) (ASSETS '20). Association

5. Yi-Hao Peng, Ming-Wei Hsi, Paul Taele, Ting-Yu Lin, Po-En Lai, Leon Hsu, Tzu-chuan Chen, Te-Yen Wu, Yu-An Chen, Hsien-Hui Tang, and Mike Y. Chen. 2018. SpeechBubbles: Enhancing Captioning Experiences for Deaf and Hard- of-Hearing People in Group Conversations. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (Montreal QC, Canada) (CHI '18). Association for Computing Machinery, New York, NY, USA, 1–10. https://doi.org/10.1145/3173574.3173867

6. Vinoba Vinayagamoorthy, Maxine Glancy, Christoph Ziegler, and Richard Schäf- fer. 2019. Personalising the TV Experience Using Augmented Reality: An Exploratory Study on Delivering Synchronised Sign Language Interpretation. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (Glasgow, Scotland Uk) (CHI '19). Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3290605.3300762

7. Le Luo, Dongdong Weng, Guo Songrui, Jie Hao, and Ziqi Tu. 2022. Avatar Interpreter: Improving Classroom Experiences for Deaf and Hard-of-Hearing People Based on Augmented Reality. In Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (New Orleans, LA, USA) (CHI EA '22).Association for Computing Machinery, New York, NY, USA, Article 318, 5 pages.

8. Roshan Mathew, Garreth W Tigwell, and Roshan L Peiris. 2024. Deaf and Hard of Hearing People's Perspectives on Augmented Reality Interfaces for Improving the Accessibility of Smart Speakers. In the International Conference on Human-Computer Interaction. Springer, 334–357. https://doi.org/10.1007/978-3-031- 60881-0_21

9. Sanzida Mojib Luna, Jiangnan Xu, Konstantinos Papangelis, Garreth W. Tigwell, Nicolas Lalone, Michael Saker, Alan Chamberlain, Samuli Laato, John Dunham, and Yihong Wang. 2024. Communication, Collaboration, and Coordination in a Co-located Shared Augmented Reality Game: Perspectives From Deaf and Hard of Hearing People. In Proceedings of the CHI Conference on Human Factors in Computing Systems (Honolulu, HI, USA) (CHI '24). Association for Computing Machinery, New York, NY, USA, Article 36, 14 pages. https://doi.org/10.1145/ 3613904.3642953

10. Nemček, D., & Mókušová, O. (2020). Position of sport in subjective quality of life of deaf people with different sport participation level. *Physical Culture and Sport*, *87*(1), 1-8.

11. Nemček[1], D., & Kručanica, L. (2014). Satisfaction with health status in people with hearing impairments. *SPORTS, PHYSICAL ACTIVITY AND HEALTH*, *51*, 185.

12. Uchida, W., Marsh, H. W., & Hashimoto, K. (2015). Predictors and correlates of self-esteem in deaf athletes. *European Journal of Adapted Physical Activity*, 21-30.

13. Açak, M., & Kaya, O. (2016). A Review of Self-Esteem of the Hearing Impaired Football Players. *Universal Journal of Educational Research*, *4*(3), 524-530.

14. Brancaleone, M. P., & Shingles, R. R. (2015). Communication patterns among athletes who are deaf or hard-of-hearing and athletic trainers: a pilot study. *Athletic Training & Sports Health Care*, *7*(1), 29-33.

15. Rochon, W.; Feinstein, S.; Soukup, M. Effectiveness of American Sign Language in Coaching Athletes Who Are Deaf. *Online Submission* **2006**, 1–26

16. Acak, M. Evaluations of Deaf Team Athletes Concerning Professional Skills of Their Coaches. *J. Rehabil. Health Disabil.* **2015**, *1*, 1–11.

17. Okan, I. Deaf Football Players' Perception of the Coaches' Occupational Skills. *Anthropologist* **2016**, *25*, 180–185

18. Mesch, J., & Clark, B. (2023). Deaf sport. *In Routledge Encyclopedia of Sport Studies*. https://doi.org/10.4324/9780367766924-RESS70-1

19. Osborn, M. M., & Meyer, C. M. (2023). Providing athletic training resources to Deaf and hard-of-hearing persons. *Indiana State University*. https://scholars.indianastate.edu/cgi/viewcontent.cgi?article=1142&context=clinat

20. Gaweł, E., Soto-Rey, J., & Zwierzchowska, A. (2024). Trends and future directions in the sports performance of Deaf and hard-of-hearing athletes: A systematic review. *Applied Sciences*. https://www.mdpi.com/2076-3417/14/16/6860

21. Jordan, J. M. and Giansant, T. (2001) ' Origins of CISS ', in Lovett, J. M., Giansanti, T., and Eickman, J. (eds) CISS 2001: A Review. Redditch: Red Lizard, pp. 12–15.

22. Clark, B. and Mesch, J. (2018) ' A global perspective on disparity of gender and disability for deaf female athletes ', Sport in Society, 21(1), pp. 64–75. doi:10.1080/17430437.2016.1225808

23. Kovoor, M., Durairaj, M., Karyakarte, M. S., Hussain, M. Z., Ashraf, M., & Maguluri, L. P. (2024). Sensor-enhanced wearables and automated analytics for injury prevention in sports. *Measurement: Sensors*, *32*, 101054. https://doi.org/10.1016/j.measen.2024.101054

24. Bozyer, Z. (2015). Augmented Reality in Sports: Today and Tomorrow. International Journal of Sport Culture and Science, 3(Special Issue 4), 314-325. https://doi.org/10.14486/IJSCS392

25. Zollmann, S., Langlotz, T., Loos, M., Lo, W. H., & Baker, L. (n.d.). ARSpectator: Exploring augmented reality for sport events. University of Otago.

26. Goebert, C. (2020). Augmented reality in sport marketing: Uses and directions. Sports Innovation Journal, 1(November), 134–151.

27. Sano, Y., Sato, K., Shiraishi, R., & Otsuki, M. (2016). Sports support system: Augmented ball game for filling gap between player skill levels. In Proceedings of the 2016 ACM international conference on interactive surfaces and spaces (pp. 361–366).

28. https://virtualeye.tv/

29. 30. Seçkin, A.Ç.; Ate¸ s, B.; Seçkin, M. Review on Wearable Technology in Sports: Concepts, Challenges and Opportunities. Appl. Sci. 2023, 13, 10399. https://doi.org/ 10.3390/app131810399

30. Polar UK, (2015). "Innovations | Polar UK". Retrieved from http://www.polar.com/uk-en/ about_polar/ who_we_are/innovations.

31. Chen, K. and Bassett, D. (2005). "The Technology of Accelerometry-Based Activity Monitors: Current and Future", Medicine & Science in Sports & Exercise, 37 (Supplement), pp. S490-S500.

32. Ermes, M., Parkka, J., Mantyjarvi, J. and Korhonen, I. (2008). "Detection of Daily Activities and Sports With Wearable Sensors in Controlled and Uncontrolled Conditions", IEEE Transactions on Information Technology in Biomedicine, Vol.12, No. 1, pp. 20-26.

33. https://scholars.indianastate.edu/cgi/viewcontent.cgi?article=1142&context=clinat

34. Q.Liu,S.Ghodrat,G.Huisman,K.M.B.Jansen,Mater.Des.2023, 233, 112264; b) M. Zhu, S. Biswas, S. I. Dinulescu, N. Kastor, E. W. Hawkes, Y. Visell, Proc. IEEE 2022, 110, 246.

35. Y.Huang,K.Yao,J.Li,D.Li,H.Jia,Y.Liu,C.K.Yiu,W.Park,X.Yu, Mater. Today Phys. 2022, 22, 100602;

36. H. Bai, S. Li, R. F. Shepherd, Adv. Funct. Mater. 2021, 31, 2009364.

37. J. Yin, R. Hinchet, H. Shea, C. Majidi, Adv. Funct. Mater. 2020, 31, 2007428.

38. Z.Zhou,Y.Yang, J. Liu, J.Zeng,X.Wang,H. Liu, IEEE Trans. Haptics 2022, 15, 464; b) P. Kourtesis, F. Argelaguet, S. Vizcay, M. Marchal,C.Pacchierotti,IEEETrans.Haptics2022,15,479;c)K.Kim, Curr. Opin. Biomed. Eng. 2022, 21, 100368.

39. F. Morosi,M.Rossoni,G.Caruso,Autom.Constr.2019,105,102848.

40. Dahiya, R. S., & Valle, M. (2013). *Robotic tactile sensing: technologies and system* (Vol. 1). Dordrecht: Springer.

41. Johansson, R. S., & Vallbo, Å. B. (1983). Tactile sensory coding in the glabrous skin of the human hand. *Trends in neurosciences, 6*, 27-32.

42. Goethals, P., Reynaerts, D., & Van Brussel, H. (2012, May). Pneumatic tactile display controlled by a miniaturised proportional valve. In *National Congress on Theoretical and Applied Mechanics, Date: 2012/05/09-2012/05/10, Location: Brussels, Belgium* (pp. 1-4).

43. Shitara, A., Namatame, M., Sarcar, S., & Ochiai, Y. (2024). HaptStarter: Designing haptic stimulus start system for deaf and hard-of-hearing sprinters. *International Journal of Human-Computer Interaction*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1071581923001775

44. Villamarín, D., & Menéndez, J. M. (2021). *Haptic glove TV device for people with visual impairment*. *Sensors, 21*(7), 2325. https://doi.org/10.3390/s21072325

45. Uchida, T., Sumiyoshi, H., Miyazaki, T., Azuma, M., Umeda, S., Kato, N., ... & Yamanouchi, Y. (2019). Systems for supporting deaf people in viewing sports programs by using sign language animation synthesis. *ITE Transactions on Media Technology and Applications*, *7*(3), 126-133.

46. Luna, S. M., Tigwell, G., Papangelis, K., & Xu, J. (2024). *Exploring visual scanning in augmented reality: Perspectives from deaf and hard of hearing users.* ACM. https://doi.org/10.1145/3663548.3688535

47. Raja S. Kushalnagar, Gary W. Behm, Aaron W. Kelstone, and Shareef Ali. 2015. Tracked Speech-To-Text Display: Enhancing Accessibility and Readability of Real-Time Speech-To-Text. In Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility (Lisbon, Portugal) (AS-SETS '15). Association for Computing Machinery, New York, NY, USA, 223–230.

48. Keita Ohshiro and Mark Cartwright. 2022. How people who are deaf, Deaf, and hard of hearing use technology in creative sound activities. In Proceedings of the 24th International ACM

SIGACCESS Conference on Computers and Accessibility (Athens, Greece) (ASSETS ’22). Association for Computing Machinery, New York, NY, USA, Article 66, 4 pages. https://doi.org/10.1145/3517428.3550396

49. Kyrie Zhixuan Zhou, Weirui Peng, Yuhan Liu, and Rachel F Adler. 2024. Exploring the Diversity of Music Experiences for Deaf and Hard of Hearing People. arXiv preprint arXiv:2401.09025 (2024). https://doi.org/10.48550/arXiv.2401.09025

50. Robin Thompson, Karen Emmorey, and Robert Kluender. 2006. The relationship between eye gaze and verb agreement in American Sign Language: An eye-tracking study. Natural Language & Linguistic Theory 24, 2 (2006), 571–604.https://doi.org/10.1007/s11049-005- 1829-y

51. Robin L Thompson, Karen Emmorey, Robert Kluender, and Clifton Langdon. 2013. The eyes don’t point: Understanding language universals through person marking in American Signed Language. Lingua 137 (2013), 219–229. https://doi.org/10.1016/j.lingua.2013.10.002

52. Laura J Muir and Iain EG Richardson. 2005. Perception of sign language and its application to visual communications for deaf people. Journal of Deaf studies and Deaf education 10, 4 (2005), 390–401. https://doi.org/10.1093/deafed/eni037

53. Maria Bianca Amadeo, Andrea Excelsior, Mario Amore, Gianluca Serani, Beatriz Pereira da Silva, and Monica Gori. 2022. Face masks affect perception of happy faces in deaf people. Scientific Reports 12, 1 (2022), 12424. https://doi.org/10.1038/s41598-022- 16138-x

54. Brittany A Blose and Lindsay S Schenkel. 2024. Facial and Body Posture Emotion Identification in Deaf and Hard-of-Hearing Young Adults. Journal of Nonverbal Behavior (2024), 1–17. https://doi.org/10.1007/s10919-024- 00458-9

55. Luna, S. M., Xu, J., Tigwell, G., Saker, M., Chamberlain, A., Schwartz, D., & Papangelis, K. (2025). *Exploring Deaf and Hard of Hearing Peoples' Perspectives on Tasks in Augmented Reality: Interacting With 3D Objects and Instructional Comprehension*. ACM. https://doi.org/10.1145/3706598.3713678

56. Bozyer, Z. (2015). Augmented reality in sports: Today and tomorrow. *International Journal of Sport Culture and Science*, *3*(Special Issue 4), 314-325.

57. Kajastila, Raine & Hämäläinen, Perttu. (2014). Augmented climbing: Interacting with projected graphics on a climbing wall. Conference on Human Factors in Computing Systems - Proceedings. 10.1145/2559206.2581139.

58. Hurwitz, A., & Jeffs, A. (2009). EYEPLY: Baseball proof of concept — Mobile augmentation for entertainment and shopping venues. *2009 IEEE International Symposium on Mixed and Augmented Reality* - *Arts, Media and Humanities*, 55-56.

59. Schweizer, H. (2014). Smart glasses: technology and applications. Student report.

60. Poláček, R. (2020). User interface concept for smart glasses (Doctoral dissertation, Ph. D. Dissertation. University of West Bohemia. https://doi. org/10.13140/RG. 2.2. 26591.69288/1).

نشریه فناوری ورزشی پیشرفته

DOI: 10.22098/jast.2025.17771.1427

تاریخ دریافت: ۱۴۰۴/۰۴/۱۳ تاریخ پذیرش: ۱۴۰۴/۰۹/۰۱

Journal of Advanced Sport Technology

«مقاله پژوهشی»

ارتباط و زبان اشاره هدایت‌شده با واقعیت افزوده در ورزش‌های ناشنوایان: یک مرور روایتی

پریا شارما[1]، لاویشا لئونا مندونکا[2]

۱-دانشگاه دیاناندا ساگار، بنگلور، هند

۲-دانشگاه جین ، هند

نویسنده مسئول: پریا شارما / priyasharma782@yahoo.com

چکیده

ورزشکاران ناشنوا به‌طور منظم در رقابت‌های ملی و بین‌المللی شرکت می‌کنند و بیشتر آن‌ها در باشگاه‌ها در کنار ورزشکاران شنوا تمرین می‌کنند. افراد دارای ناشنوایی یا کم‌شنوایی شدید، خود را دارای هویت فرهنگی و متعلق به یک گروه جامعه‌شناختی-زبانی خاص می‌دانند و بسیاری از آن‌ها این وضعیت را نوعی ناتوانی تلقی نمی‌کنند. با این حال، کاهش شنوایی با چالش‌هایی در کنترل تعادل بدن مرتبط است که می‌تواند بر عملکرد فرد تأثیر بگذارد.

ورزشکاران دارای اختلال شنوایی در محیط‌های ورزشی با چالش‌های ارتباطی ویژه‌ای مواجه هستند؛ محیط‌هایی که در آن‌ها تصمیم‌گیری سریع و هماهنگی مؤثر اهمیت زیادی دارد. واقعیت افزوده (Augmented Reality یا AR) به‌عنوان فناوری‌ای تعریف می‌شود که اطلاعات دیجیتال و فیزیکی را در زمان واقعی و با استفاده از تجهیزات فناورانه ترکیب می‌کند. به‌طور خاص، واقعیت افزوده شامل بارگذاری و ادغام عناصر مجازی مانند ویدئو، صدا، تصاویر، متن، مدل‌های سه‌بعدی و سایر داده‌های دیجیتال در دیدگاه واقعی کاربر است.

در زمینه ورزشکارانی که با مشکلات شنوایی مواجه هستند، فناوری واقعیت افزوده یک راهکار نوآورانه ارائه می‌دهد که می‌تواند تفسیر زبان اشاره، ارتباطات لحظه‌ای درباره راهبردهای بازی و علامت‌دهی داوران را بهبود بخشد. زبان اشاره (Sign Language)اصلی‌ترین روش ارتباطی میان افراد دارای کم‌شنوایی یا ناشنوایی و دیگر گروه‌های اجتماعی است و از ویژگی‌های دستی (حرکات دست و بدن) و غیردستی (مانند حالات چهره) تشکیل شده است. این ویژگی‌ها برای ایجاد پیام‌ها و انتقال معنای واژه‌ها یا عبارات مورد استفاده قرار می‌گیرند.

این مقاله به بررسی اهمیت فناوری واقعیت افزوده در رفع موانع ارتباطی ورزشکاران ناشنوا می‌پردازد و نقش ترکیب ابزارهای پوشیدنی، بازخوردهای لمسی و نمایشگرهای بصری را بررسی می‌کند. با استفاده از زیرنویس‌گذاری مبتنی بر واقعیت افزوده و تشخیص حرکات، ورزشکاران ناشنوا می‌توانند اطلاعات سریع، متناسب با شرایط و آگاهانه از موقعیت دریافت کنند که این امر موجب افزایش مشارکت، تعامل و بهبود عملکرد ورزشی آن‌ها می‌شود.

واژه¬های کلیدی: واقعیت افزوده- ورزش‌های ناشنوایان- ارتباطات- **فناوری ورزشی- زبان اشاره**