International Journal of Sport Culture and Science
March 2024 : 12(1)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2024.701

The Sport Applications and Implementations of Augmented Reality(AR) Technologies

Hakan ATEŞ[1]
[1]Technische Hochschule Deggendorf, Deggendorf, Almanya
https://orcid.org/0000-0001-5855-2009
Email: hakan.ates@stud.th-deg.de

Type: Review Article (Received: 29.09.2022 - Accepted: 29.02.2024)

Abstract:

New generation digital technologies are being applied in new areas every day. Augmented Reality (AR) technology is already being actively used in many different sectors from healthcare to art and education. Recently, studies about AR technologies supported by Artificial Intelligence (AI) were detected. In this study, AR technologies used in sports were studied and research was carried out on the steps of implementation and application with Unity software and briefly demonstrated. In addition, the first AR applications in sports were analysed and information about their development processes was given. Then, AR development software development kits are explained. In addition, some researches in the literature about athletes and AR applications are also mentioned in this study. Information was also given about Unity Mars, a special application development software for AR, which will be published in the following years.

Keywords: Augmented reality, AR, Sports informatics, AR applications, Unity, AI

Introduction:

Mainly, Augmented Reality (AR) is a technology that overlays computer generated visuals on real world images. So it is mixture of real world and virtual images (Goebert, 2020).

As seen in Figure 1, AR technologies are used in many different ways in professional sports. AR technologies such as "FoxTrack" AR technology in ice hockey to make it easier for spectators to follow the ball, "Hawkeye" to accurately detect points in tennis, and different AR technologies are actively used in different sports branches. All of that applications depend on sensing from environment and software processes (Cavallaro, 1997).

Figure 1. Different Broadcast AR Sport Applications

AR technologies used in sports can be classified in 4 classes. They are classified as “Head-Mounted Display AR, Projector Based AR, Broadcast AR and Smartphone-Based AR” (Goebert, 2020).

According to a study and survey conducted in Nuremberg, 53% of 227 athletes said that AR-like technologies could be useful in sports training. In this study, some sample AR sports applications are proposed such as combinations of single player training with AR, game object tracking (e.g. the ball in hockey or football). Another sample is the coach can analyze the team and give advices or commands inside of AR helmet (Gradl et al., 2016).

In another study, the relationship between Artificial Intelligence (AI) and AR in sports was investigated. According to the real world applications in sport field, it is stated that AI works for data collection and processing in the background, while AR is a tool for its representation (Victor et al., 2023).

In another review article, the guide AR project for the sport of climbing by projectors is mentioned. In this project, a guide route is created according to the previously collected and processed climbing visuals. Then guide route is projected to the real climbing track with the AR projector system. Thus provide AR guidence system to athletes (Bozyer, 2015).

In an alternative literature study, the applications of AR tools in sport and sport education were analysed. In general, it was determined that AR technologies have a positive effect on training of athletes (Soltani & Morice, 2020).

Aim of this study is improving general technical understanding about AR application development processes with sample applications. Therefore, various examples of AR sports

applications are shown and information about their development processes is given. In addition, the use of Unity software used to develop AR applications has been researched and some information has been given.

Method:

There are 3 different AR development software kits published by Google, Apple and Microsoft for these different classes of AR technologies. ARKit for Apple devices was released in 2015. Microsoft Hololens was announced in 2015. ARCore was annnounced and pre realesed in 2018. Unity software supports all these AR kits and platforms.

In this software section, the AR winter olympics article and app published in "The New York Times" are taken as an example. As seen in Figure 2. That iOS app provides, 3D models of athletes are displayed on the smartphone with camera environment and also information about the athletes is shared. In such application as this, the movements of the athletes can be recorded with “Motion Capture (MOCAP)” technology and processed on the computer with "Unity" software for various AR platforms.

Figure 2. Sample iOS AR Application about 2018 Winter Olympics

Motion Capture (MOCAP) technology was first used in the 90s. There are 3 different motion capture technologies. First technique of motion capture is mechanical one and depend on the use of an exoskeleton. Each joint is connected to an angular encoder devices. Second technique of motion capture is magnetic motion capture with electro magenta field type sensors to determine positions. Third technique of motion capture is optical motion capture with synchronized cameras (Rahul, 2018).

3D athlete models recorded with MOCAP can be processed with Unity and developed as an AR application. Unity software has a user-friendly interface. On the left side there is a

hierarchy section for application objects. At the bottom, there is a bar with the details of various assests and worked objects. On the right side there is a bar for detailed configurations.

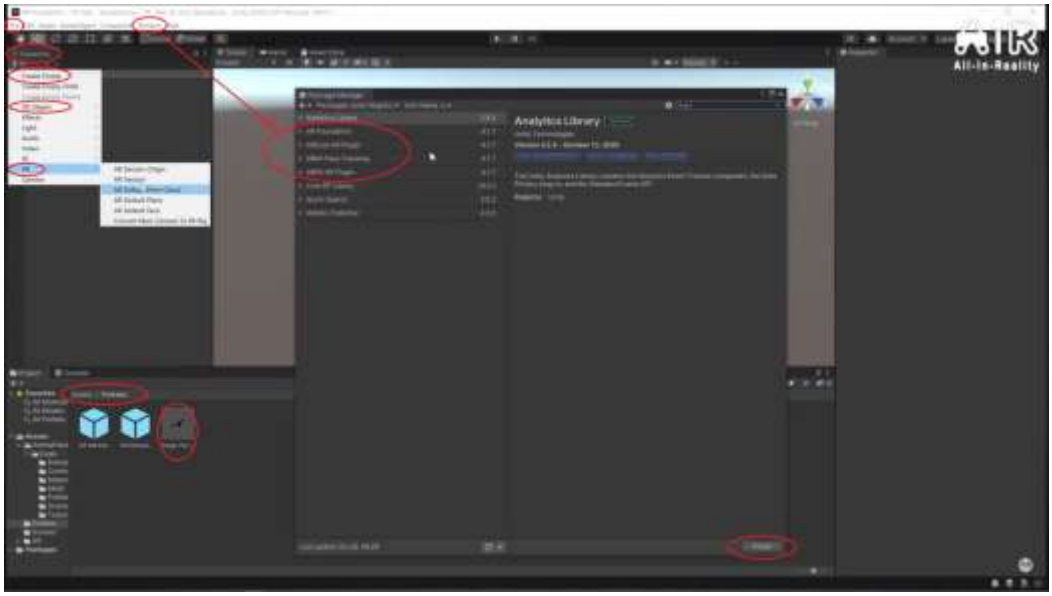

Figure 3. Unity Interface and Related Settings for AR Applications

In order to install AR-related packages in Unity software, the "Window/Package Manager/Unity Registry" section on the top left can be selected and the relevant AR-XR contents can be downloaded and installed from the menu that opens. AR Foundation is Unity's own AR package. ARKit is the package for Apple devices. ARCore is developed for android devices.

As seen in Figure 2, with the menu that comes by right clicking on the “Hierarchy” section on the left, objects can be added with "Create Empty" or "3D Object". To configure these objects, it may be necessary to drag them from “Hierarchy” to the bottom "Assest" bar.

When we click right click in the “hierarchy”, an options menu appears, Time periods, sessions can be added by clicking “XR/Session”.

With the bar at the left bottom, various assests and 3D objects could be configured. There are important options such as scenes, textures and materials in this left bottom bar.

From the "File/Build Settings" section at the top left, the Android and iOS platform can be selected as the output-output device and the AR unity application could run on the phone with the "Run in Device" option.

For the see how AR application works on smartphone; click the "File/Build Settings" section at the top left. In this section, Android or iOS platform can be selected as the output device and then AR unity application could run on the phone automatically when you click "Run Device/Build and Run" options.

Additionally, in june 2020 Unity Technologies announced “Unity MARS” for AR developers. With this platform, developing advanced AR contents will be easier in the future. It has more compact and accessible interface than normal Unity interface.

Assesment and Result:

AR technology application areas continue to diversify and increase in recent years. Today, AR technology is used in many different areas from different television broadcasts to smartphone applications.

In the near future, AR applications are expected to become more diversified because AR application development tools are becoming easier and more accessible. Beside, AI technologies start to support AR technologies. These situations will make AR technologies more accessible and feasible for the end user. Just as smart technologies become widespread in a short time, it is predicted that AR technologies will accelerate in the coming years and find different usage areas.

In this study, AR sports applications have been researched and how these applications can be developed has been studied and examined. Some basic information for AR application development steps with Unity software, it is also demonstrated.

REFERENCES

Bozyer, Z. (2015). Augmented Reality in Sports: Today and Tomorrow. *International journal of Science Culture and Sport*, 3, 314-325.

Goebert, C. (2020). Augmented Reality in Sport Marketing: Uses and Directions. *Sports Innovation Journal*, 1, 134-151.

Gradl, S., Eskofier, D., Mutschler, C., Otto, S. (2016). Virtual and Augmented Reality in Sports - An Overview and Acceptance Study. *ACM International Joint Conference*, 1, 885-888.

Rahul,M. (2018). Review on Motion Capture Technology. *Global Journal of Computer Science and Technology: Graphics & Vision*, 18(1), 22-26.

R. Cavallaro, (1997). The FoxTrax Hockey Puck Tracking System. IEEE *Computer Graphics and Applications*, 17, 6-12.

Silva, A., Albuquerque, G., Medeiros, F. (2021). A Review on Augmented Reality applied to Sports. *16th Iberian Conference on Information Systems and Technologies*, 1-6.

Soltani, P., Morice, H.P.A. (2020). Augmented reality tools for sports education and training, *Computers & Education*, 155, 103923.

Victor C.R.A., Carlgren D., Holash, D.R., Katz, L. (2023). Technological Breakthroughs in Sport: Current Practice and Future Potential of Artificial Intelligence, Virtual Reality, Augmented Reality, and Modern Data Visualization in Performance Analysis, *Applied Sciences*, 23, 12965.

URL-1: https://en.wikipedia.org/wiki/List_of_augmented_reality_software , (Access Date: 02.07.2022).

URL-2: https://sporttomorrow.com/10-great-ways-ar-will-impact-the-world-of-sports/, (Access Date: 02.07.2022).

URL-3: https://www.youtube.com/watch?v=pRjXRX9CEjI, (Access Date: 27.06.2022).

URL-4: https://www.youtube.com/watch?v=lelX8GGh_S8, (Access Date: 21.06.2022).

URL-5: https://www.youtube.com/watch?v=Ml2UakwRxjk&t=1475s, (Access Date: 21.06.2022).

URL-6 https://www.auganix.org/unity-mars-augmented-and-mixed-reality-authoring-studio-now-available/, (Access Date: 21.06.2022).