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Literature review on the relationship between Artificial Intelligence Technologies with Digital Sports Marketing and Sports Management

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Abstract. In recent years, artificial intelligence has shown its supremacy in various domains in a wide range of amusement games and has increased its utilization in the sports industry. The computer vision program used for matches provides a complete analysis of the matches that have happened, gathers and categorizes the data so that the coach or teams may make better strategic planning decisions, and displays the study results. They can make assessments that individuals ordinarily cannot do because of applications of artificial intelligence. The players' performance on their teams may be evaluated in this manner, allowing coaches to devise optimal game-play techniques for their respective squads. Analysis performed using artificial intelligence is also applied in the sporting arena, namely in motorsports racing. Follow-up on fouls committed is accomplished with artificial intelligence, and a chance to get an advantage over one's rivals in terms of strategy is investigated and pursued. The advent of new digital technologies has brought about a revolution in sports marketing, as in every other industry. It has led to the development of digital sports marketing. In this study, an examination employing artificial intelligence and digital technology was carried out, with the primary emphasis on digital sports management and digital sports marketing studies. There has been an investigation into the potential for many technologies, including artificial intelligence, artificial neural networks, the metaverse, virtual reality, and augmented reality, to be used in competitive sports.

Keywords: artificial intelligence; digital marketing; artificial neural networks; metaverse; digital sports marketing

INTRODUCTION

The phrase "artificial intelligence" (AI) refers to a more comprehensive concept that describes the use of a computer to simulate intelligent behaviour with just minimum involvement from humans. It is widely agreed that the development of robots marked the beginning of artificial intelligence. The word "robot" originates from the Czech language and refers to artificial organisms exploited to do forced work (Hamet & Tremblay, 2017).

The discipline of artificial intelligence is now the subject of the most rigorous and in-depth research being conducted anywhere in the world. Advancements have significantly impacted the realm of sports in artificial intelligence, which have also permeated practically every other facet of our life. The term "artificial intelligence" refers to a collection of computer programs and hardware systems that can perform various tasks, including mimicking human behaviour, performing arithmetical thinking, moving, speaking, and perceiving sounds. In a nutshell, artificial intelligence makes it possible for computers to think like people do (Nalbant, 2021a).

When searching for research on computer vision, it has been noticed that there are not many due to the phrase "metaverse" being a recently developing concept. As a result, the purpose of this work is to conduct a review study. A hypothetical artificial environment connected to the real world is called the "metaverse." This name comes from the combination of the prefix "meta," which means "transcending," with the term "universe." In Neal Stephenson's futuristic fiction titled Snow Crash, published in 1992, the term 'metaverse' was introduced for the first time. In this book, Neal Stephenson portrayed it as a three-dimensional virtual world, where individuals live in the form of avatars and interact with various software agents (Joshua, 2017; Nalbant & Uyanik, 2021).

In recent years, new augmented reality (AR) technology has arisen and is now being used in various industries. The ability of a gadget to recognize real-world things as virtual ones enables the process known as "augmented reality," which combines computer-generated content with actual photographs. Adding new items on top of the ones already there makes the world seem even more genuine. To put it another way, the physical and virtual worlds are not fully independent; instead, they coexist inside a single reality that they share. It is necessary to have Internet connectivity and the appropriate equipment (smartphones, smart glasses, or tablets) to use this technology and define augmented reality in the surrounding world (Nalbant & Uyanik, 2022).

Some implementations of machine learning, in particular deep learning, which seeks to model the activity that occurs in the human brain to identify patterns, can do a wide range of tasks, including recognizing pictures and voices. The availability of new data for improved analytics is another benefit of machine learning. Machine learning can now find probabilistic matches across databases, which refers to data that is likely to be linked with the same person or firm but in somewhat different forms. In the past, the task of data curation required a significant amount of manual effort (Davenport & Ronanki, 2018).

Deep learning models are a kind of neural network that is more complicated than traditional neural networks. These models "train" networks, which are then used to detect and categorize situations depending on the input data. The data often comprise not only the depth of the problem (millions or billions of data items) but also the breadth of the problem (each element can have thousands of features). Voice or picture recognition are two common examples of applications that often make use of deep learning. The models are often effective in these applications; yet, because of the intricacy of their structure and the abstract character of the characteristics or variables it contains, it is difficult for human analysts to grasp them (Davenport, 2018).

An investigation was conducted using artificial intelligence and digital technology, focusing on studies of digital sports marketing and sports management. The literature has

received attention due to the shortage of research in this field. Bartlett (2006) investigated recent advancements in using artificial intelligence (AI) in sports biomechanics, which has occurred during the last ten years. He discussed the potential applications of expert systems as diagnostic tools for analyzing flaws in athletic motions (also known as "techniques"). His discussion included some sample knowledge rules for such an expert system. He then contrasted the study of sports tactics, in which Expert Systems have found a limited place to far, to the analysis of gait, in which they are commonly utilized. Following this, consideration is given to applying Artificial Neural Networks (ANNs) in sports biomechanics, emphasizing Kohonen's self-organizing maps and multi-layer networks. Kohonen self-organizing maps have been the most widely used method for technique analysis, while multi-layer networks have been utilized more frequently in biomechanics in general.

Ratiu et al. (2010) examined recent breakthroughs using artificial intelligence (AI) in sports biomechanics. They gave some sample knowledge rules for such an expert system and discusses the potential applications of expert systems as diagnostic tools for analyzing flaws in sports motions. Also, a comparison is made between the study of sports tactics, in which Expert Systems have found a limited place to date, and gait analysis, which is commonly used. The application of Artificial Neural Networks (ANNs) in sports biomechanics is discussed, particularly on Kohonen self-organizing maps and multi-layer networks.

The educational conversations now taking place concerning digital media are driven by digital games' immersive and engaging qualities. Continued efforts are being made by game scientists, researchers in (pedagogical) settings, and practitioners to incorporate digital games into educational environments (Kretschmann, 2012). An essential topic for Kretschmann's (2012) study is whether a virtual game focused on sports management may be helpful to aspiring sports managers and students of sports management. He addressed that it is crucial to research the occupation of sports managers in "real" life and compare the gameplay of a digital sports management game and their experiences. As a result, EA Sports' commercial off-the- shelf (COTS) game FIFA Manager 09, widely considered the best-selling and most well-known of its kind, has been chosen as the object of this study. The abilities of "virtual" sports managers were compared to those of "real-world" sports managers to see whether there was any overlap. Consequently, there is an extremely high degree of unity between the sport-management competence models and the gameplay of the digital game.

Artificial Neural Networks, often known as ANNs, are a technology that has been successfully used in a variety of scientific, industrial, and commercial fields to extract information from massive volumes of data. On the other hand, there hasn't been much use of ANN approaches in the athletic world. In sports at the professional level, teams, games, practices, and individual players have saved data (McCullagh & Whitfort, 2013). McCullagh and Whitfort (2013) trained and tested artificial neural networks (ANNs) using player data from the premier Australian Football League (AFL) competition to predict the beginning of injuries. Based on the results, artificial neural networks (ANNs) seem to have the potential to aid athletic teams in predicting injuries.

Fok et al. (2018) created a Human Action Recognition (HAR) system for use in the surveillance system to decrease the number of human resources required to protect the population through public safety and crime prevention. In their study, a deep learning network that employs Recurrent Neural Networks (RNN) with Long Short-Term Memories (LSTM) is utilized to assess the dynamic video motion of sports movements to identify the various sorts of acts and how well they perform. For efficiency and the conservation of memory, it could categorize the many kinds of human movements using a limited amount of video frames. Tanaka (2018) provided an overview of the digital sports services system that Fujitsu has commercialized and analysed the prospects for digital enterprises in the market beyond 2020.

Claudino et al. (2019) aimed to determine whether AI methods have been used to explore sports performance and injury risk and which AI strategies each sport has been using up to this point. Rajšp and Fister (2020) aimed to give a comprehensive literature evaluation of smart sports training, presenting 109 additional research. Methods of intelligent data analysis that are presently applied in smart sports training (SST) are discussed in their study. In their study, sports fields in which SST is already being used are described, and stages of training are outlined, in addition to the level of development of SST methodologies. Finally, suggestions are made on potential lines of inquiry for further exploration in the burgeoning discipline of SST.

Mamo and Andrew (2021) aimed to highlight diverse data sources and modern analytical techniques that will leverage BD to advance scholarship in sports management. Big data is becoming increasingly important for managers and researchers to transform sports management practices. Big data (BD) is becoming increasingly important for managers and researchers to transform sports management practices. Powell et al. (2021) presented insights into sports-related concussion (SRC) clinical evaluation methodologies and the translational value of digital approaches, emphasizing off-field digital tools to identify important SRC metrics/biomarkers. They also offered insights and recommendations regarding digital approaches' expected benefits and challenges. They aimed to transition from novel technologies to an effective, valid, reliable, and integrated clinical assessment tool for SRC. This is done in the context of the transition from novel technologies to an integrated clinical assessment tool. In conclusion, they underlined the potential prospects that digital techniques provide in terms of SRC evaluation and management, including digital twinning and the "digital athlete."

DIGITAL SPORTS MARKETING

Over the last several decades, digital technology has significantly influenced the sporting business. In sports, organizations are always looking for new ways to promote their brand or engage with their followers, and technical advancements are often at the center of these new strategies. Despite the widespread usage of such technologies in the sector, there is a shortage of academic studies about the efficacy of scenarios like these in sports marketing (Ratten & Thompson 2021).

In the sports industry, "sports marketing" may be described as a linked set of operations aiming at "planning, pricing, product distribution, and service, or sporting activities that fulfill the requirements and wishes of the beneficiaries or customers, both existing and future." Sports marketing utilizes sports in any form to assist in selling products and services. When it comes to this specific kind of marketing, it is less about using a singular plan and more about utilizing sports content to support marketing efforts. The ability of businesses to identify their brands and goods with the thrill, delight, and admiration consumers have for sportspeople and games is made possible by sports marketing (Jovanovska, 2020).

The term "digital sports marketing" refers to how a business or brand communicates and interacts with customers via the Internet. The marketing of sports has two primary characteristics. A method of marketing sports activity (marketing of sport) and using participant sport as a marketing tool for other goods and services is known as sports marketing (Gaffar et al., 2016).

The use of social media marketing, often known as SMM, has been particularly influential in the realm of sports marketing. The use of social media in sports has essentially produced a new mode of communication, which has significant ramifications for the playing field. The fans' relationship with sports is evolving, and social media is offering a whole new channel for the fans to communicate with one another and participate in the activity. This goes beyond what the fans would expect to accomplish by physically being there at the

stadium or the ballpark. Today's sports organizations are dependent on social media for their continued success and development to compete effectively (Mohammadkazemi, 2015).

The marketing of sports is undergoing profound changes as a result of the rise of the Internet and social media. Throughout much of television's history, the primary income generator for professional sports leagues, federations, and teams has been television broadcasting. This is starting to change due to the new opportunities presented by the Internet regarding the distribution and consumption of athletic events. New channels of contact are being opened between fans, players, teams, and sponsors due to the rise of social media. The way that sports fans consume sports material in general and during live events is also being impacted by technological advancements in mobile devices. These shifts open a wide variety of strategic doors and windows for exploration. Therefore, in sports, sports marketing refers to the social and managerial processes by which fans, sports organizations, and other sports- related companies, such as media and technology companies, create and exchange products and services with each other. These processes are increasingly taking place through digital media such as set-top boxes, the Internet, mobile devices, and social media, in addition, to live sporting events (Holland, 2015).

DIGITAL TECHNOLOGIES FOR DIGITAL SPORTS MARKETING

There are many different uses for artificial intelligence. The fields of gaming and computer vision are both significant application areas. In recent years, the game of chess has shown its excellence in various domains, including video games and quizzes, and has extended its fields within the sporting arena. Computer Vision is the process of giving computers the capacity to differentiate between what they see; it allows computers to perceive and differentiate between items and group them.

The usage of computer vision software during matches enables teams or coaches to organize their strategies more effectively. In addition to that, these systems compile and categorize the data, as well as provide an in-depth analysis of the matches that were played. Using applications of artificial intelligence, they can do assessments that are ordinarily beyond their capabilities. The players' team performance may be evaluated in this manner, allowing coaches to devise game methods that are most effective for their squads.

Analysis based on artificial intelligence is also applied in sports, namely in motorsports races. Follow-ups on fouls are executed with the assistance of artificial intelligence, and opportunities to gain an advantage over the competition by analysing their strategies are looking for as they are uncovered. Artificial intelligence technologies are also being employed to cut down on the risk of fatalities, which is the negative aspect of racing. Artificial neural networks are being utilized to detect malfunctions and malfunctions in automobiles to lessen the danger factor for drivers. The use of artificial intelligence contributes to an improvement in the level of protection provided to motorists.

The public and sporting teams now have easier access to wearable performance gadgets and sensors than before. Because of advances in technology, it is now possible for individual endurance athletes, sports teams, and medical professionals to monitor functional movements, workloads, and biometric indicators to optimize performance and reduce the risk of injury. Pedometers, accelerometers/gyroscopes, and global positioning satellite (GPS) devices are all examples of devices that can measure movement. Monitors for the heart rate, sensors for measuring temperature, and integrated sensors are all examples of physiologic sensors (Li et al., 2016).

Because the games of the twenty-first century are so much more complicated and so much richer than the games of the first generation that came before them, we can't seek to examine their influence correctly, meaning, or effects in a generic fashion. Given the options to manage the game or alter parts of the game surroundings, as well as the potential to be

another person and express oneself, contemporary games cannot be compared to the first generation of electronic games. The diversity of games has also significantly risen in terms of the current aspects of sports that are being merged and translated into virtual gaming settings. This has led to an increase in the number of available options for players. This not only pertains to the simulation of well-known sporting acts (such as tossing a ball or swinging a golf club), but it also contains characteristics of social engagement and being a part of a gaming community, for example, throwing a ball or swinging a golf club. One may argue that the worlds of virtual and non-virtual sports are getting closer and will eventually merge due to the growing number of uses of digital technology in conventional sports (Van Hilvoorde, 2016).

Injuries are prevalent in sports, and they may have significant physical, psychological, and financial repercussions. It may be possible to utilize machine learning (ML) techniques to enhance injury prediction and make it possible to take the appropriate steps to prevent injuries. (Van Eetvelde et al., 2021). Van Eetvelde et al. (2021) researched to carry out a comprehensive analysis of ML techniques utilized in the field of sports injury prediction and prevention.

Athletes and teams are subject to a significant amount of stress when injuries occur. This is notably visible in the professional soccer league, where there is a discernible detrimental influence on the performance of teams and significant expenditures associated with the rehabilitation of players. Existing research give a rudimentary knowledge of which elements are most connected with injury risk; nevertheless, there is still a lack of scientific systematic examination of the capability of statistical models in forecasting injuries. There are aspects that predispose players to sports injuries, but there are other characteristics that elevate the danger of sustaining an injury while participating in a sport. There is a lack of understanding regarding the biochemical mechanisms that are involved in non-contact musculoskeletal soft tissue injuries. There is some evidence that genetic risk factors relate to injury susceptibility and may have a significant impact on the amount of time needed for recovery. Athletes are complex systems that are dependent on both the internal and exterior environments in which they compete to achieve and maintain a level of health and performance stability. When components inside a dynamic system undergo change, the organisms, participants, and features included within that system adapt and undergo change. Scientists often estimate risk in a wide variety of dynamic systems, such as the weather, political forecasting, and the projection of traffic deaths. In addition, the human health business has just recently begun to implement predictive models (Kakavas et al., 2020). Kakavas et al. (2020) argued that the application of artificial intelligence may prove useful in predicting the incidence of sports injuries as well as assisting in the evaluation of risks.

When a person engages in virtual reality, they are whisked away from their actual surroundings and transported into a computer-generated world. This environment contains simulated items of many kinds, such as virtual objects. The visuals and sounds that may be experienced in the virtual world are accurate representations. Virtual reality may be shared with spectacles designed explicitly for the purpose. The gaming industry, the entertainment industry, and the education industry all employ this technology somewhat regularly (Nalbant, 2021b).

The proliferation of digital technologies, including blockchain, fiber optic internet access, and 5G wireless connectivity, to mention just a few examples, has contributed to increased complexity within the sporting goods business. These improvements have caused a change in the quantity of data created and the kind of data accessible for analysis by sporting organizations. Despite this, the front offices of sporting organizations are still a long way behind front offices in other industries (such as retail and communications) when it comes to

handling, processing, and analyzing the amount and diversity of data necessary to accomplish corporate goals (Naraine & Wanless 2020).

From a commercial perspective, "sports" may refer to various activities, including competitive, recreational, and entertainment. Around the globe, the sporting industry is regarded as one of the most important economic sectors (running commentary). The introduction of digital technology has significantly impacted each of these spheres. Over the last three decades, the field of study known as sports informatics has developed into a more prominent area. The usage of wearable technology, big data analytics, social media, and sensor technologies have all altered the way sports are played, evaluated, and improved in today's connected world. Professional athletes may acquire a deeper insight into their performance, enhance their training techniques, and boost their talents by using new technological breakthroughs and mobile applications (Ráthonyi et al., 2018).

Artificial intelligence of things (IoT) technology is seldom applied in most athletic performance improvement methods used today, such as weight training and Bachelor in Medical Laboratory Technology (BMLT) facilities. This is even though AIoT technology may significantly improve accuracy and precision. When designing training techniques and performing analyses, coaches and physicians generally depend on their own previous experiences, which are often imprecise and may lead to improper and unsuccessful instruction or therapy. During the training process, it is common to observe athletes' bodily states being recorded manually, which might result in conflicting data. In addition, the conventional training procedures do not use the predictive analytical power that mathematical modeling offers. An integrated platform that can successfully assist sports informatics and analytics is required if one wants to support the research efforts of AIoT in the field of sports science. Data collection, representation, consolidation, storage, and computation are part of the sports informatics process. Data may be collected either via direct observation of athletes or through sensors. Data visualization, predictive modeling, and machine learning are all methods and tools that may be used to assist in this endeavor. In the realm of athletics, this might include enhancing the performance of athletes or teams, growing the number of people participating in sports, boosting the level of fan involvement, or coming up with novel approaches to recruiting or coaching. This platform combines multimodel intelligence to draw conclusions about prospective injuries or weariness based on data collected from Internet of Things sensors, 3D modeling tools, artificial intelligence, and big data analysis (Chu et al., 2019).

There is an element of artificial intelligence (AI) in many machines. Still, most of their success versus humans comes from brute-force computation—looking at hundreds of thousands of possible places. To be able to defeat a world champion using just brute force and known solid algorithms, you need to have the ability to examine 200 million places every second. The world is made up of three-dimensional things, yet the inputs received by the human eye and by computer TV cameras are only two-dimensional. Some helpful programs are only able to operate in two dimensions. Still, true computer vision needs information that is at least partially three-dimensional and is not just a collection of two-dimensional images. There are now only a few indirect ways of three-dimensional encoding information, and these methods are not nearly as effective as what people seem to employ (McCarthy, 2004).

CONCLUSION

The administration of sports and the sports industry are analysed broadly. After the epidemic, there has been a noticeable shift toward a greater emphasis on digital sports marketing. However, this aspect of sports marketing requires more focus and consideration. Analyses are conducted on various digital technologies used in the sporting industry. Research has been conducted into using technologies such as artificial intelligence, artificial neural networks, the

metaverse, virtual reality, and augmented reality in sports. It has been observed that only a tiny portion of the area of sports management makes advantage of the available tools and technologies. These technological advancements should be given a higher priority, and the number of research conducted in this area should be expanded. Artificial intelligence technology should be the primary focus of investment for businesses, producing various projects.

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