



Sport and artificial intelligence: what policies and perspectives?

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Doi: 10.2478/gssfj-2024-0005

Abstract

In this paper, we will attempt to analyze how and where artificial intelligence affects the world of sports, i.e., how athletes and coaches benefit from the information provided by data analysis. That artificial intelligence is revolutionizing the world of sport is a given, but let us see how and why competitive sport benefits from it, improving competitive performance.

Keywords: sport, artificial intelligence, training

1. Introduction

Through this study, we seek to discover how artificial intelligence is revolutionizing the world of sports. We have many questions and will try to answer some of them. The subject is topical and little studied from the point of view of its application to sport, so here are some questions we should ask ourselves in order to delve deeper into the subject, and here are also some simplified answers to a subject that we will try to explore in the course of this work, thanks to the experience gained in practiced sport and the study of the contributions published so far:

1. What is artificial intelligence in sport?
2. How is artificial intelligence used in sport?
3. What are the benefits of Artificial Intelligence in sport?
4. What technologies are used in artificial intelligence in sport?

We will try to answer these questions; now, we want to better understand how artificial intelligence is used to analyze data, improve athletes' performance and optimize training. It is now a fact that this technology is changing how sport is understood and practiced, not only at the professional level.

We also try to understand the market trend, the increase in the use of artificial intelligence in the world of sport leads to a constantly growing volume of business. By now, athletes and coaches seem unable to do without it, especially at the professional level.

2. First observations on Sport and Artificial Intelligence

In the digital age, Artificial Intelligence (AI) has become an increasingly present tool in various areas of society. The world of sport is no exception, of course, and even proposes and highlights real applications.

Artificial Intelligence has become a fundamental tool for the sporting growth of athletes, an important ally for the world of sport as a whole, where athletes, coaches, and sports analysts can collect and analyse large amounts of data in real time, thereby optimising performance and strategic decision-making, which is necessary in order to develop the sport at the highest level when it comes to competitive activity. It makes no difference whether this is professional or amateur, substantial is the development of performance in the right dimension.

We will explore how artificial intelligence has revolutionized the world of sports and address its applications in the analysis of sports data, such as athlete performance monitoring and injury prediction.

We also look at how artificial intelligence is used in sports training, allowing the customization of 'routines' and training programs according to each athlete's needs and characteristics. In this case, differentiated choices take place. It is also useful to discuss how artificial intelligence has improved the spectator experience through virtual and augmented reality technologies, which provide a unique and immersive perspective during many of today's sporting events.

Implementing real-time data analysis systems improves sports performance. In this sense, artificial intelligence has revolutionized the world of sports, enabling the implementation of systems that significantly improve athletes' performance.

These systems use advanced algorithms and machine learning techniques to process large amounts of information and provide valuable information to coaches and athletes. Thus, they use applied mathematics and statistical tools simultaneously. The system benefits from real-time data analysis in sports.

Real-time data analysis offers numerous advantages to athletes and their coaches and, thus, to the entire analysed sports system.

In summary, we can say that these benefits are mainly:

1. Performance improvement, which, thanks to artificial intelligence, is achieved by analysing the multiple variables and factors that influence sports performance, such as speed, strength, endurance, and technique. This makes it possible to identify areas for improvement and optimize training for more efficient results.
2. Injury detection: here, real-time data analysis systems can continuously monitor the physical condition of athletes and detect potential injuries or injury risks. This helps prevent serious injuries and enables faster recovery.
3. Improved decision-making: Artificial intelligence facilitates decision-making during sports competitions, where data analysis systems can provide real-time recommendations on game strategies, strategic changes, and decisive decisions.

3. The artificial intelligence market in sport

It is immediately clear what we are talking about, which is why we want to understand the size of the artificial intelligence market in the world of sports and the volume of business. From the table shown here (Kb Research, 2017), we see that there has been extensive growth in recent years and that this growth is expected to continue in the years to come, both on the software side and on the services side in general.

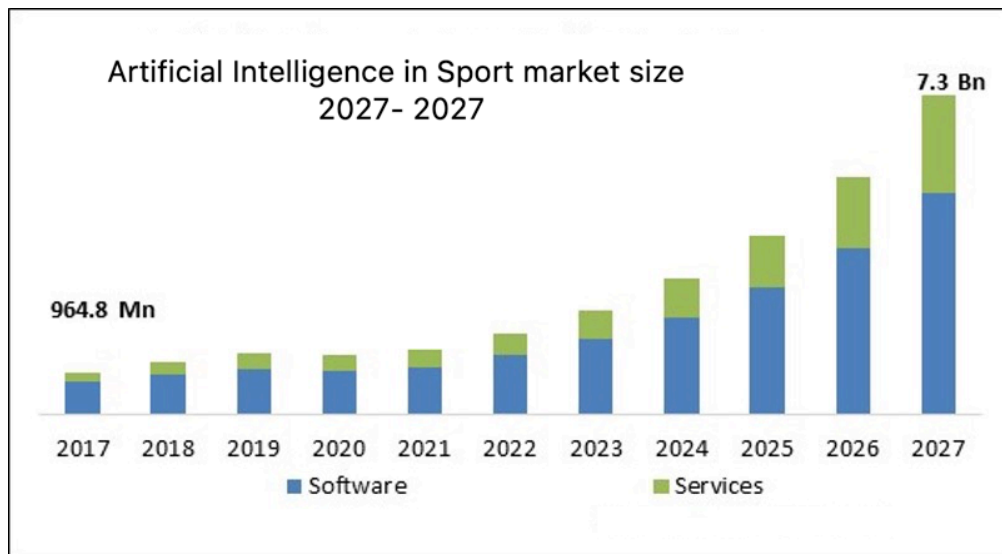


Figure 1.: Artificial Intelligence in Sport market size (2017-2027) [Source: kbvresearch.com]

The global sports technology market is expected to exceed USD 40 billion before 2030, just to give some indicative figures. Sports technology links the playing qualities of sports equipment with product design concepts by combining the best aspects of engineering science, measurement and analysis, and sports science.

Artificial intelligence has had a major influence on improving athletes' performance. Information on an athlete's critical variables, such as heart rate, speed, and movement patterns, is available through wearable technology equipped with sensors and monitoring technologies.

Athletes and coaches can optimize performance by adapting their training plans, identifying potential areas for improvement, and utilizing this wealth of information. In-depth data analysis is performed using advanced analysis software and platforms, revealing insights into opponent analysis, game strategy and player performance. Athletes can then achieve unexpected performance through precisely data-driven decision-making. This is why the market is expanding and is expected to progress. The artificial intelligence market in the sports industry is expected to grow exponentially in the coming years.

The integration of artificial intelligence (AI) into sports is becoming more prominent, particularly as new software and services are developed to support

various aspects of athletic performance and fan engagement. As these technologies mature and economies of scale reduce costs, AI applications are expected to become accessible not only at the professional and competitive levels but also at the collegiate and youth levels across a wide range of sports. The exponential growth of on- and off-field data is driving a need for more sophisticated data management and analysis. This is leading to an increased demand for wearable devices that track performance metrics like heart rate, speed, and acceleration. These devices provide teams and coaches with real-time insights, enabling them to make informed decisions about player fitness and strategy.

An example of AI's broader application in sports can be seen in the collaboration between Loughborough University and Signify Group, who are using AI to combat online abuse in sports. Signify, which has worked with organizations across multiple sports, applies AI to analyse and track abusive behaviour online, underscoring AI's potential for improving the social and digital aspects of the sports experience. Additionally, AI is becoming integral in enhancing fan engagement. Virtual assistants and chatbots are increasingly used to automate responses and maintain communication with fans, while real-time data analysis during games allows teams to adjust their strategies instantly. The growing need for data-driven insights into player performance and fan interactions is fuelling the expansion of AI within the global sports market

4. Applications of artificial intelligence in sport

Artificial intelligence has several applications in sport. Some of the most notable are:

1. **Video analysis:** Artificial intelligence systems help analyse videos of competitions and training sessions to identify patterns, errors, and opportunities for improvement in athletes' technique and to improve specific knowledge for use by coaches.
2. **Performance monitoring:** Artificial intelligence becomes important as it allows real-time monitoring of athletes' performance, collecting data on heart rate, blood oxygen levels, speed, and distance travelled, among other parameters.
3. **Personalised training:** Artificial intelligence systems can design personalized training programs for each athlete, taking into account their individual characteristics and specific goals.

Artificial intelligence has revolutionized the sports world by providing advanced real-time data analysis tools that improve sports performance, prevent injuries, and facilitate strategic decision-making. These applications allow us to look to the future with enthusiasm for an enhancement of sport, where technology and science come together to take athletes to an even higher level both from a competitive point of view and from the point of view of the overall environmental renewal of the sport system.

The sports system uses machine learning algorithms to identify patterns and trends in athletes' performance and enable more knowledge and information for coaches.

Artificial intelligence is revolutionising many aspects of our lives, and sport is certainly no exception. In recent years, artificial intelligence and 'machine learning' algorithms have been used to analyse athletes' performance and improve their training to achieve better performance levels and enable coaches to devise appropriate training systems.

One of the most common uses of artificial intelligence in sport is data analysis. Machine learning algorithms can process large amounts of data collected during training and competitions, finding patterns and trends that coaches and athletes can use to improve their performance. This happens in competitive sport, but is now also frequently used in amateur sport thanks to artificial intelligence and its rapid spread.

Such algorithms can analyse data such as speed, acceleration, reaction time, heart rate, and other factors influencing sports performance. By identifying patterns and trends, algorithms can provide valuable information on athletes' strengths and weaknesses, allowing coaches to design more effective and customised training programmes. In addition to data analysis, artificial intelligence is also used to develop advanced sports training technologies. For example, virtual training systems have been developed that use machine learning algorithms to simulate game contexts and help athletes practice and hone their skills in a controlled environment.

Machine learning (ML) and artificial intelligence (AI) have become increasingly popular in the field of sports performance analysis. These technologies can transform the way athletes and coaches approach competitions and prior to them training, with a focus on injury prevention and game strategy. Artificial intelligence improves sports performance and benefits athletes through technology (Alaguraja k., Selvakumar K., 2024). Artificial intelligence is relevant to sports performance through data knowledge and continuous monitoring, player analysis, prediction and injury prevention. Optimisation of game strategy and talent identification is undisputed as there will be a veritable revolution in sports performance. However, continuous research and development will be needed to realize their full potential. Artificial intelligence has opened up a world of opportunities in sports. Machine learning algorithms can decisively help coaches and athletes identify patterns and trends in performance, improve training, and develop advanced sports training technologies. Artificial intelligence will certainly play an important role in the future of sports.

Artificial intelligence enables the development of customized training programs based on data collected by sensors and smart devices and has revolutionized the way we train and improve our sports performance. With the ability to collect and analyze large amounts of data, customized AI-based training programs have become a valuable tool for athletes and coaches.

These programs use sensors and smart devices to collect real-time data during training. This data includes information on heart rate, gait, distance travelled, speed, and many other parameters. Artificial intelligence analyses this data and uses it to create a customised training programme that suits each individual's needs and goals.

One of the most important advantages of these programmes is their ability to recognise patterns and trends in the overall collected data. This allows athletes and coaches to identify areas for improvement and optimize their performance. For example, artificial intelligence can identify if an athlete's heart rate is too high during certain exercises and recommend adjustments to the intensity or even understand the duration of training.

These programs can also help prevent injuries; in fact, artificial intelligence can detect patterns in the data that indicate an increased risk of injury and recommend strengthening exercises or changes in technique to reduce this risk.

Artificial Intelligence has transformed how we train and improve our sports performance. Dedicated, customized training programs are based on data collected from sensors and smart devices to optimize training, identify areas for improvement and prevent injuries. We can say with certainty that artificial intelligence has opened new doors in the world of sports.

Implementing virtual and augmented reality in sports has revolutionized how athletes train and make decisions on the field. These technologies provide an immersive experience that simulates real-world scenarios, allowing players to practice in specific situations and improve their performance.

Using devices such as virtual reality glasses or even mobile applications with augmented reality and displaying them on smartphones, athletes can recreate game situations in a virtual environment, which is useful to improve the playing conditions during their competitive activity. This allows them to experience different scenarios and make decisions in real time, without the pressure of a real game. Virtual and augmented reality also offers the possibility of analyzing the performance of athletes in real-time, which is useful for both athletes and their coaches. Through sensors placed on the body or sports equipment, information about players' physical and technical performance is collected and transmitted in real-time; this information is displayed visually immediately, enabling coaches and players to identify areas for improvement and allowing them to intervene in sports performance.

Another advantage of virtual and augmented reality in sports is the possibility of personalized workouts, where athletes can practice specific movements and perfect their technique without the need for a training partner. This is particularly useful in individual sports, where the availability of a training partner may be limited or incompatible. Virtual and augmented reality are powerful tools for improving sports performance and decision-making. These technologies allow us to simulate game scenarios, analyze real-time performance, and carry out personalized training. With its implementation, athletes can achieve an even higher level of excellence in their discipline, shortening the application time and making everything more fluid and practical.

Special virtual assistants in sports have revolutionized how coaches and players access instant information about tactics and strategies during matches. These AI tools allow for smooth and efficient communication, providing fast and accurate answers to questions. If we consider the system called "chatbot" this is a useful

program to analyze and process large volumes of data in real time, allowing them to offer personalized advice and suggestions based on the context of competitive races. The system is built around virtual assistants, athletes and coaches benefit immediately and can correct performance in the process. They can also access up-to-date databases with relevant historical and statistical information on the teams and players involved, allowing them to precisely adjust their match preparation. These AI applications can also recognize patterns and trends in the game, enabling them to identify opponents' strengths and weaknesses and generate strategies suited to each situation. Players' actions and movements can be tracked and analyzed in real time, providing real-time information to improve individual and collective performance. In addition to their usefulness during matches, "chatbots" and virtual assistants can also be used in training. These tools can design custom training programs, set specific goals and objectives, and track each player's progress. They can also advise on exercises, training techniques, and health and nutrition tips to optimize sports performance.

Using "chatbots" and virtual assistants in sports has proven to be a valuable tool for analysis, performance improvement, and training. These AI applications provide instant and personalized insights, helping to improve tactical decision-making, optimize player performance, and maximize results on the field. Implementing tracking and monitoring technologies in sports has revolutionized how athletes prepare and train. Artificial intelligence has played a key role in this progress, allowing athletes to analyze their performance accurately and in detail, prevent injuries, and optimize recovery.

Thanks to artificial intelligence, it is now possible to collect and analyze a large amount of data during training sessions and competitions. This data includes information on heart rate, speed, acceleration, movement technique, and many other aspects relevant to sports performance.

Machine learning algorithms can help you gain valuable insight into athletes' performance. For example, you can identify movement patterns that may affect a player's performance or detect muscle imbalances that may increase a runner's risk of injury.

Considering sports performance, we see how artificial intelligence can help develop early injury detection systems. These systems use many algorithms that analyze the data collected to identify abnormal movement patterns or changes in physiological indicators that could indicate an impending accident. All the information provided allows coaches and sports doctors to take preventive measures, such as changing their training schedule or providing specific therapy, to prevent an injury from getting worse or even occurring.

Thanks to algorithms, athletes' recovery is also optimized. Machine learning algorithms can analyze data on fatigue, sleep quality, nutrition, and other factors that influence the recovery process.

Based on these analyses, personalized recovery plans can be created for each athlete, taking into account their individual needs. This allows recommendations to be

included on the duration and intensity of rest, as well as diet and other aspects relevant to the athlete's recovery. Artificial intelligence has revolutionized sports analytics, performance, and training by enabling accurate and detailed data collection and analysis. This helps prevent injuries, optimize recovery, and improve performance.

Artificial intelligence has also revolutionized the way sports events are managed and organized. Thanks to this technology, several key aspects of competition planning, and development can now be optimized and improved, which positively impacts competitive performance, starting from targeted interventions in athlete training.

Artificial intelligence has proved particularly effective in providing continuous and progressive data analysis. Advanced algorithms and machine learning systems allow us to collect and process a large amount of information related to the performance of athletes, the results of races, the environmental conditions, all very useful information, which are analysed accurately and quickly, allowing us to gain insights and models that would be difficult to identify manually

Artificial intelligence is not only used to create personalized training programs, but it is also increasingly used to do so. From the data collected and analyzed, it is possible to design training routines adapted to the needs and abilities of each athlete and train coaches appropriately. Artificial intelligence profoundly revolutionizes our approach to sports, movement, and even health (Dindorf et al., 2024).

There are infinite practical applications and perspectives ready to transform these areas, and there are different perspectives and applications in various disciplines, even if the understanding of the transformative potential of artificial intelligence in sport, movement, and health remains in full evolution. These routine situations may still include specific exercises, nutritional recommendations, and rest guidelines, all aiming to improve performance, prevent injuries, and give the athlete appropriate assistance to improve his performance. A sport, health, and artificial intelligence interweave that is still to be developed and will surely improve competitive performance. In fact, the human body is regulated by man and assisted by technology in system optimization.

5. Conclusion

If we wanted to answer the questions in the introduction, we could say that artificial intelligence in sport refers to applying artificial intelligence techniques and algorithms to analyze and improve athletes' performance and training.

We could also say that artificial intelligence is used in sports to analyze large volumes of data, improve strategic decision-making, predict injuries, and optimize athletes' training.

The benefits of artificial intelligence in sports include real-time data analysis, identification of patterns and trends, performance optimization, and injury prevention.

Certainly, the technologies used in artificial intelligence in sports include machine learning, computer vision, natural language processing, and biometric tracking and tracing devices.

Artificial intelligence has, therefore, had and will significantly impact the sports world; this is the prediction that can be deduced from the results and tactical analysis. Advanced algorithms and predictive models can be used to predict competition results more accurately and identify the most effective strategies for each sport. This allows coaches and teams to make better-informed decisions and optimize their performance on the field.

Artificial intelligence has proven to be a powerful tool in sport. From data analysis to the creation of personalized training programs, this technology has improved the management and organization of sporting events, as well as enhancing performance and training for athletes. It will certainly continue to play a fundamental role in the future of sport, even if it must be governed decisively with the aim of obtaining the best results in the world of sports, especially competitive sports.

In conclusion, artificial intelligence has the potential to radically transform the world of sport, from the way it is played to the consideration of the sports system as a whole, including fans and sportsmen in general. With these tools, teams and athletes can analyze large amounts of data and gain valuable insights that will improve their performance. Similarly, they can be used to personalize experiences by recommending relevant content.

Data analysis and tactical decision-making are areas where artificial intelligence is already successfully used in some sports. Large amounts of information from matches, training sessions, or other factors are analyzed to help technical staff members and athletes make decisions and rethink strategies to be effective through identifying patterns and trends. Think of the evolution of tennis, for example. Professional athletes have a large and well-prepared staff at their service who know the most advanced technological tools. This certainly involves considerable investment and large financial resources.

Improving athletes' physical performance is another area where artificial intelligence can make a big difference. Software is used to allow personalized training, which analyzes the variables and then adapts to the various needs in order to achieve certain objectives. During the monitoring phases, potential problems are detected before they become serious injuries. In short, artificial intelligence offers many opportunities, but significant challenges, such as ethics, security, and data privacy, must be addressed adequately (Nilsson, 2010). The system must necessarily become inclusive in all areas by applying good and fair practices in the implementation of technological tools in sport. Artificial intelligence means that athletes, coaches, and other sports professionals adapt to these tools to improve their performance and remain competitive. Artificial intelligence remains a tool and not a miracle solution in practice; in this sense, it must be governed.

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