Artificial Intelligence in the Field of Physical Education and Sports

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Abstract— The application of artificial intelligence (AI) opens an interesting perspective for predicting injury risk and performance in team sports. A better understanding of the techniques of AI employed and of the sports that are using AI is clearly warranted. The purpose of this study is to identify which AI approaches have been applied to investigate sport performance and injury risk and to find out which AI techniques sport has been using. The AI application coming up with the way to combat the new game play or is it the coach and players? Do the fans know or even care who comes up with it as long as the game is exciting? Boards of sporting codes and teams need to have the appropriate governance arrangements in place to manage the introduction and use of AI into their industry, including strict compliance to any guidance set by the governing bodies to ensure and maintain fair competition amongst teams.The Study discussed the various aspects of AI and techonology innovations in the field of physical education and sports in Particular.

Keywords: Artificial intelligence, Technology, Physical education and sports

I. INTRODUCTION

Introduction In the field of sports, day by day the research has been taking place for obtaining new such things so that human can fulfill their necessities, gain the knowledge to do the things or prove it by using new techniques for the betterment of the society. In sports field also for obtaining something new, researcher, scientist and the fellow person involved in sports are trying to achieve some new techniques for the demands of people involved in sports as well as spectators. Artificial Intelligence is among such things, intelligence or techniques by the use of which human beings in all over the World also have been benefitted. Artificial Intelligence (AI) is the intelligence of machines and the branch of computer science that perceives its environment and takes actions that maximize its chance of success at some goal. It's the capability of computer science that allows technology to imitate intelligent human behavior such as speech recognition, translating languages, interacting with the physical world through visual analysis and decision making. In sports field Artificial Intelligence mean the technology, which evolve in the hopes to bring automation and increased data analysis to business decision, sponsorship activations, ticket sales, athlete training and many more. Artificial intelligence may be software that is capable of making its own conclusions on the way of reaching a goal. Now a days in the sports field it is very popular in the field of marketing, it can autonomously study customer data and generate customer specific context. It operates as Chatbot that carry on any type of communication with the customers. It writes various articles on various topics; also helps to track athletic performance, improve health and prevent fatigue or injury. Artificial intelligence also has a great background of development in sports performance. Artificial intelligence is a disruptive technology with widespread influence that may cause into a creative intuitive smart machine which can improve sports from both the marketing corner and the on-field corner. Artificial intelligence can improve the speed, quality, and cost of available goods and services. The falling prices of Robots, which can operate all day without interruption, make them cost competitive with human workers. Artificial intelligence with the help of machines is very advance than human in case to analyze and record the data. Machine can track players and calculate useful metrics without the need of human labor. Recently much software have been established to gain information about players involved in the game, the distance between them and the time taken for each pass is studied by a computer, which has analyzed video footage of games. The software is used to gain detailed performance assessment after each match. The software produces the best possible outcomes on the playing field from different angle (1).

Artificial intelligence (AI) techniques and methods have attracted considerable attention in the information industry and in society as a whole, due to the large amount of data and the imminent need to transform this data into useful knowledge and practical solutions (2–4). However, the effective use of data in some areas is still under development, as is the case in sports. As in most other areas of society, increasing volume of data has been gathered in all kinds of sports, and automated data analysis became an important and fast developing field. Careful analyses of these large data sets can enhance our knowledge in sport sciences while at the same time assist in the decision-making of the practitioners who work on the optimization of training and competition strategies (5-6). Data science has emerged as a strategical area to exploit knowledge in sports science aiming to fill some gaps left by traditional statistical methods. As a hybrid knowledge area, data science is more than the combination of statistics and computer science as it requires training in how to weave statistical and computational techniques into a larger framework, problem by problem, and to address discipline-specific questions (7). A holistic view of data science requires an understanding of the context of data, appreciating the responsibilities involved in using private and public data, and clearly communicating what a dataset can and cannot tell us about the real world (7), in our case, in the sports world. Based on learning models, the algorithms can be tuned and be optimized in order to produce better results for supporting decisions and provide applied knowledge to athletes and sport professionals. These algorithms are applied as supervised learning (e.g., classification and regression) and unsupervised learning (e.g., clustering). The supervised learning requires input and output data to develop a predictive model whereas the unsupervised learning is based on input data only (8). Data science is an emerging area in both industry and academic ways, leading to more evidence-based decision-making across many walks of life, including social networking services, streaming services, health care,

manufacturing, education, financial modeling, policing, and marketing (9-12). Also, in our area, linking science and technology to increase sports efficiency has been touted as a path with a promising future. For this to happen, the work directed toward the innovation, introduction, and improvement of processes performed by research and development (R&D) departments in the world's largest technology companies has been also suggested in the sport field. Because of its fast-moving environment, sport professionals combine data (e.g., physical, technical and tactical) with their expert opinion to inform decisions on the players (13).

One key issue in the sports industry is the possibility to predict injury risk and performance. Historically, the ability of the coaching staff to prescribe training to achieve optimal athletic performance with low risk of injury can be attributed to many years of personal experience. However, modern approaches aiming in adopting scientific methods for the effective development of optimal training programs are warranted (14). The application of contemporary statistical approaches from AI open an interesting perspective for dealing with injury prevention and for improving the performance models (15, 16).

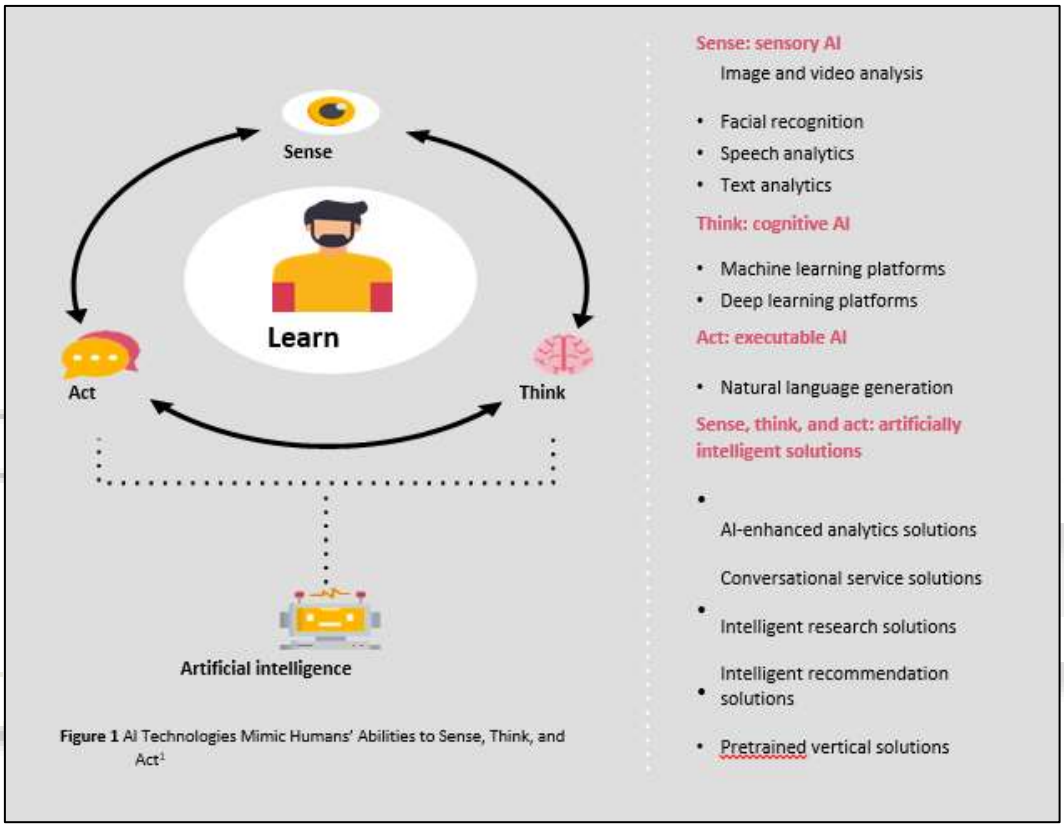


Figure 1 AI Technologies Mimic Humans' Abilities to Sense, Think, and Act[1]

II. WHAT IS ARTIFICIAL INTELLIGENCE?

Artificial Intelligence (AI) is an umbrella term covering a variety of what are called "smart" technologies. What they all have in common is the ability to learn. AI takes information and responds to it, without waiting for humans to step in and tell them what to do. It can take mass amounts of data, and not store it in a regular computer, but analyse it. At the highest level, we're talking about self-driving cars and drones, but in a day-to-day practical way, it boils down to how computers can accumulate information and then apply it – learning, growing and making decisions on what they've learned. AI works in four basic ways, providing:

1) Automated intelligence
2) Assisted intelligence
3) Augmented intelligence
4) Autonomous intelligence

AI can perform automated tasks, help do things better and more quickly, assist with better decisions and ultimately, automate decision-making processes that can be done entirely without people (17).

III. VISUALIZE MOVEMENTS FOR BETTER RESULTS

The secret of champions and generally of sportsmen and sportswomen is certainly constant training. However, what can also play a vital role to improve performance are the scientifically proven techniques like visualization (19).

Visualization techniques to our routine can be a valid support to the athletic preparation at both amateur and professional levels. There are many benefits deriving from this technique which allows us to:

- Improve sports performance
- Promote the learning process (movements, athletic gestures, etc...)
- Control performance anxiety, especially before the race
- Create a general feeling of psychophysical well-being
- Increase concentration
- Focus on the goals.

IV. ARTIFICIAL INTELLENCENCE AND MEDIA

Media outlets are increasingly focused on enhancing the spectator experience through technology and AI is helping to shape the look and feel of the sports enthusiasts' experience (20).

Current applications of AI appear to fall into four major categories:

- Chatbots – Sports teams are using virtual assistants to respond to fan inquiries across a wide range of topics including live game information, team stats and arena logistics.
- Computer Vision (as it pertains to professional auto racing) – Researchers are training deep learning neural networks to achieve accuracy beyond humans in the ability to identify specific cars at high speeds which typically produce photographic images with reduced clarity.
- Automated journalism – Media outlets are leveraging AI-driven automation to expand their sports coverage capabilities and increase revenue.
- Wearable tech – Companies are using AI in conjunction with IoT devices to gather data to attempt to optimize training and performance.

V. AI IN SPORTS INDUSTRY

Next, we will explore some potential future applications of AI in professional sports. It is important to note that is not an exhaustive list. We aimed to provide a high-level view of major applications that emerging from the sports industry, giving readers a sense of technologies that either (a) may become mainstream, or (b) are indicative of an important future trend (20).

A. AI Assistant Coaches

Using AI to help NFL teams develop and/or improve game strategies may not be too far in the distant future. Oregon State University researcher Alan Fern is using videos of games and deep learning to train computers how to understand the game of football and coach plays.

Effective coaching is a skill that requires experience and is developed overtime; it is also an imperfect science. Computers could possibly provide coaches and teams with improved accuracy in analyzing common mistakes and improving plays at a faster rate than humans.

While the ROI on developing virtual assistant coaches may not be readily apparent, the focus is on using deep learning to uncover strategic insights that may not have been previously achievable.

B. Smart Ticketing

The San Francisco Deltas, a new soccer team that debuted in 2017, aspires to use AI to build and increase fan engagement. Among the team's interest is smart ticketing, a technology that allows ticket buyers to change seats, from game to game, based on their backgrounds and interests.

For example, a fan could sit with their family during one match and move to a section with a "louder, more energetic supporters' section." This option follows a

industry-wide trend of enhancing sports fan's experience with their favorite teams.

C. Automated Video Highlights

IBM announced plans to enhance the Wimbledon experience using cognitive computing capabilities through the Watson platform beginning in 2017. Examples, include AI-automated video highlights. CNBC puts together a video explaining how IBM's system picked up "key moments" in the match by drawing data from players, fans, and more:

IBM claims its technology will support a team of research scientists and consultants, to automatically curate game highlights based on game-specific data, such as "analysis of crowd noise, player's movements and match data."

The process of organizing and processing video highlights can normally take hours and IBM aims to significantly accelerate the process. It is not clear from the company's announcement, how much faster they expect their platform to perform this procedure.

D. Computer Vision Referee

Bay Area-based French inventor Grégoire Gentil has designed a $199 pocket-size device that called "Tennis In/Out", which uses computer vision to detect the speed and placement of a tennis shot – including whether the ball was out of bounds:

While the device is currently a novelty application, it demonstrates the increasing accessibility of AI software and camera hardware. Hobbyist AI applications are today still rather novel, but it's unlikely to remain rare as open source AI tools and online education courses flourish. Combinations of IoT and AI are becoming more popular, and we presume that sports (and broadly: Health) will be an industry ripe for innovation of this kind.

E. Scouting and Recruitment

Although humans are far from being available using objective, quantitative metrics, their performances can definitely be subject to quantitative scrutiny. Sports teams, be it baseball, soccer or any other game, are increasingly using players' individual performance data as a measure of fitness and potential. However, the performance data used for scouting potential recruits don't mean just using the openly known stats like home runs, goals, or passes, but using more complex metrics that take into account multiple factors. However, the perceptual limitations of humans can keep them from accurately recording and assessing these metrics. With the entry of big data and artificial intelligence in sports management, the process of recording and measuring these indicators of future success is becoming easier and more reliable (21).

F. Training and Performance Analysis

Like mentioned above, using general metrics such as runs scored passes made, goals scored, etc. arn't the best way to accurately assess performances, both individual and collective. To gauge performances in any sport, analysts and coaches need to analyze a multitude of data points pertaining to individual players and collective performances. This helps them to identify the areas where players excel and those where they lag. Depending on the role of the individual players on a team, the metrics to assess their contribution varies. For instance in soccer, the key performance indicators of forwards or offensive players are different from those of midfielders (creative players) and defenders (defensive players). Although not all aspects of performance can be quantified (as of now), a growing part of a player's game is becoming quantifiable and hence, measurable. This is possible by using artificial intelligence to derive correlations between qualitative traits and quantitative variables, and then measuring those variables to predict the corresponding qualitative value of players.

AI can also be used to identify patterns in opponents' tactics, strengths and weaknesses while preparing for games. This helps coaches to devise detailed game plans based on their assessment of the opposition and maximize the likelihood of victory (21).

G. Maintaining Health, Fitness and Safety

It is a well-known fact that the introduction of AI is transforming the healthcare industry in different ways. The extraordinary predictive and diagnostic capabilities of AI can also be applied in the realm of sports, where physical health and fitness is of prime importance. Since the essence of sports is the maintenance of peak physical condition, sports teams invest heavily in the physical and mental well-being of their players. In the pursuit of ensuring their players' health and fitness, they are increasingly incorporating technological tools in player healthcare. AI has become the latest tool in these teams' medical kits. Players regularly undergo physical tests that use AI to analyze various health parameters and player movements to evaluate their fitness and can even detect early signs of fatigue or stress-induced injuries. This can help the medical teams of sporting organizations to maintain their players' fitness and keep them safe from injuries by taking timely action.

Many leading teams use wearable technology to track players' movements and physical parameters during practice to help them keep track of overall player health. AI systems can be used to constantly analyze the stream of data collected by these wearables to identify the signs that are indicative of players developing musculoskeletal or cardiovascular problems. This will enable sports teams to maintain their most valuable assets in prime condition through long competitive seasons (21).

H. Broadcasting and Streaming:

In addition to revolutionizing sports for the players and sports managers, AI can also revolutionize live broadcasting and impact the way the audience experiences sports. AI is also set to change the way broadcasters monetize sporting events. Based on the events on the field, AI systems can be used for automatically choosing the right camera angle to display on the viewers' screens. It can automatically provide subtitles for live events in different languages based on the viewer's location and language preferences. Artificial intelligence systems can also be used to identify the right opportunities to present ads based on crowd excitement levels in sporting arenas, enabling broadcasters to effectively utilize monetization opportunities through ad sales.

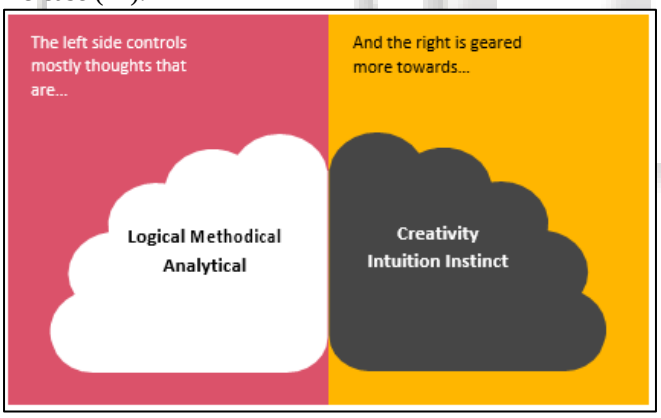
There is no doubt that the use of artificial intelligence in sports will make the prediction of outcomes of competitions more certain and reliable. Regardless of how much we try to bring predictability and certainty into sports, there will always be that element of unpredictability and surprise in it, by virtue of the human element. After all, that is what makes sports exciting and fascinating for audiences from across the world. As long as sports remain a fascination for the masses, businesses will always have the opportunity to profit from it. As long as there is profit to be gained from the world of sports, the investment in and incorporation of technology for sports will continue (21).

VI. Ethical Considerations of AI:

Effective coaching is a skill that requires experience and is developed overtime. It is an imperfect science and at times, relies on intuition. Intuition is the ability to understand instinctively, without the need for conscious reasoning. Why is this important?

The brain is divided into two hemispheres and within each hemisphere, particular regions control certain functions:

There is a theory that people are left-brained or right-brained meaning one side is more dominant than the other. With the increased access to information through big data in everything we do, and now AI, it seems that the use of the left side of our brains is increasing and will continue to increase (17).



VII. Future of AI

The massive use of Artificial Intelligence will bring about strong changes on multiple levels and on multiple fronts and will allow us to (*):

1) Apply the rules in a predictive way, preventing behaviors and attitudes that put at risk the regularity of the competition or that can damage other athletes, identifying in advance the possible risks (e.g. Blatant simulations, use of doping);
2) Provide coaches and technicians with information in real time, thanks to the analysis of data coming from training sessions and their cross-referencing with many other sources of information, directly on the field and at the same time as the athletes are trying a race or performance, in real time and with a level of customization that has been unthinkable until now;
3) Have strategic analyses on a mathematical and statistical basis, which is able to guide the choices of the technicians and to identify exactly the schemes and actions that give the best results (because this happened in the past or in scenario simulations carried out on future opponents and races);
4) Interact better with supporters and the public, offering an increasingly better experience and aligning the offer with their expectations, also in commercial terms (e.g. Proposals for packages and subscriptions in real time if they are exalted by the team or athlete for whom they are cheering, discounts and gifts if they are disappointed, personalised experiences.

VIII. Conclusion

Artificial Intelligence (AI) is an umbrella term covering a variety of what are called "smart" technologies. What they all have in common is the ability to learn. AI takes information and responds to it, without waiting for humans to step in and tell them what to do. It can take mass amounts of data, and not store it in a regular computer, but analyse it. Careful analyses of these large data sets can enhance our knowledge in sport sciences while at the same time assist in the decision-making of the practitioners who work on the optimization of training and competition strategies. In sports from strategy development to coaching everything can be benefited with the use of AI. The various uses of AI are listed herewith:

1) For imparting scientific coaching,
2) Smart ticketing
3) Automated Video highlight
4) Visualising own performance
5) Computer vision referee
6) Scouting and Recruitment
7) Training and Performance Analysis
8) Maintaining Health, Fitness and Safety
9) Broadcasting and Streaming
10) Psychological boosting

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