The Robosport: The Emerging Role of Artificial Intelligence and Robotics in Sports Physiotherapy

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Abstract: *With the updating of computer processing capabilities and the deep learning network models, artificial intelligence technology based on computer software and hardware has developed rapidly. As a physical carrier of artificial intelligence technology, robots, as a comprehensive technology that integrates multiple disciplines, have also rapidly developed and applied in multiple fields. Meanwhile, sports science studies are no longer limited to the study of sports and training, gradually introducing engineering techniques. This improves the traditional sports moving towards smart sports and increases the fun of physical education. By consulting literature and materials, this paper reviews the application of robots in the field of sports and lists some common robot cases. In addition, the robot technology of different sports projects is analysed and the relative positive significance for each sports project is explained. Finally, a summary and suggestions for the future trends were provided.*

Keywords: Interdisciplinary; Information technology; Intelligence science; Robotic application; Sport

1. Introduction

AI is a vague phrase that can give rise to certain important misperceptions. It is crucial to define it to prevent this, at the very least differentiating AI as autonomous systems from AI as machine learning. The use of artificial intelligence in day - to - day activities is growing. Contrary to popular belief, sport is not an exception. Athletics is most likely the industry where AI applications are growing wildly and dramatically. AI systems are the ideal instrument to help with data storage, coaching, training, and many other duties.[1]

Sports carry the dream of national prosperity and national rejuvenation, and the self - reliance and self - improvement of technology is an important strategic support for national development. Currently, the integration, collaboration, and innovation of sports and technology are accelerating and digital and intelligent means have become an important part of promoting national fitness and high - quality development of the sports industry. The effective combination of artificial intelligence and sports can promote more possibilities.[2] Robots are carriers of embodied intelligence which represents the latest technology.[3] Introduction robots into sports increase the entertainment value.[4]

2. Various Technologies of Robotics in Sports

2.1 Table Tennis Robots in Sports

The robotic table tennis is a research hotspot because of the introduction of imaging processing technique and robot control theory. These tasks need accurate control of the fast moved robot arm and precise state estimation of the flying ball. Tebble et. al. designed a robot which used an industrial KUKA Agilus R900 and four cameras to play table tennis with human beings. Figure 1 (a) shows the 6 DOF robot system which combines color and background threshold to predict the ball's trajectory using curve fitting and extended Kalman filter.[5]
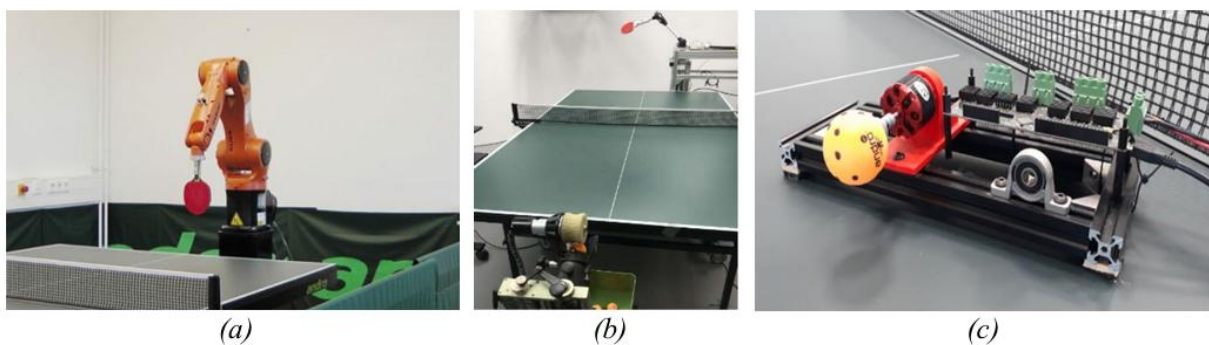

Figure 1: Table tennis robots in sports.

2.2 Badminton Robotics in Sports

Another dynamic ball sport that needs high accuracy is badminton. Due to the lightweight of the shuttle and racket, the agility of badminton sport is essential. Many badminton robots are designed to play games with human athletes. Mori et. al. designed the pneumatic - electric hybrid actuators to simulate high speed humanoid robot arm which is shown in figure 2 (a). The mechanism and prototype of the pneumatic - electric hybrid actuators is shown in figure 2 (b). This research focuses on the flexibility and rapid response of the robotic arm part.[6] The shuttlecock detection is also an important task for a badminton robot that refers to the accuracy and computational efficiency. When the visual system detects the shuttlecock, a trajectory is fitted and the ball is hit to the opponent by the moving robot.
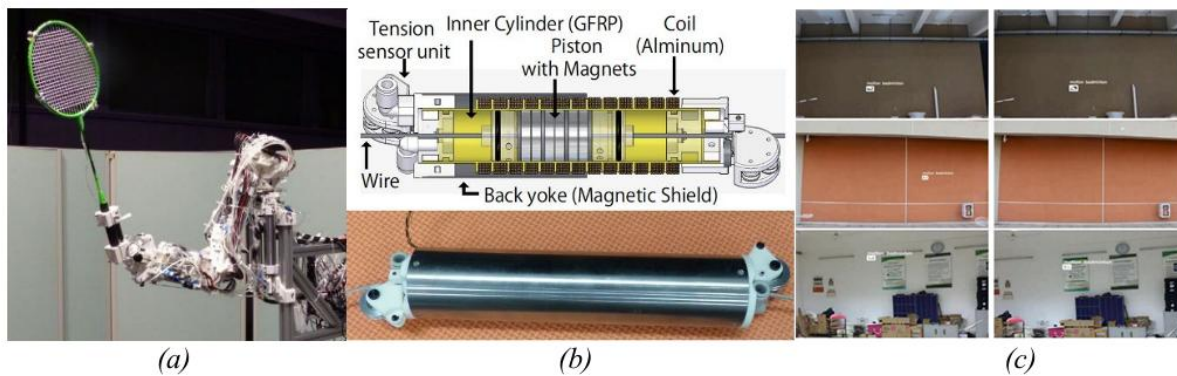
Figure 2: Badminton robots in sports

2.3 Basketball Robots in Sports

As one of the most popular sports in the world, basketball sport has sufficient fun and sportiness. Some high - tech companies are also participating in related research, for example, the basketball robot developed by Toyota Motor Company has a high successful shooting rate.[7, 8] The basketball robot named Cue is shown in figure 3 (a) and has a humanoid appearance.
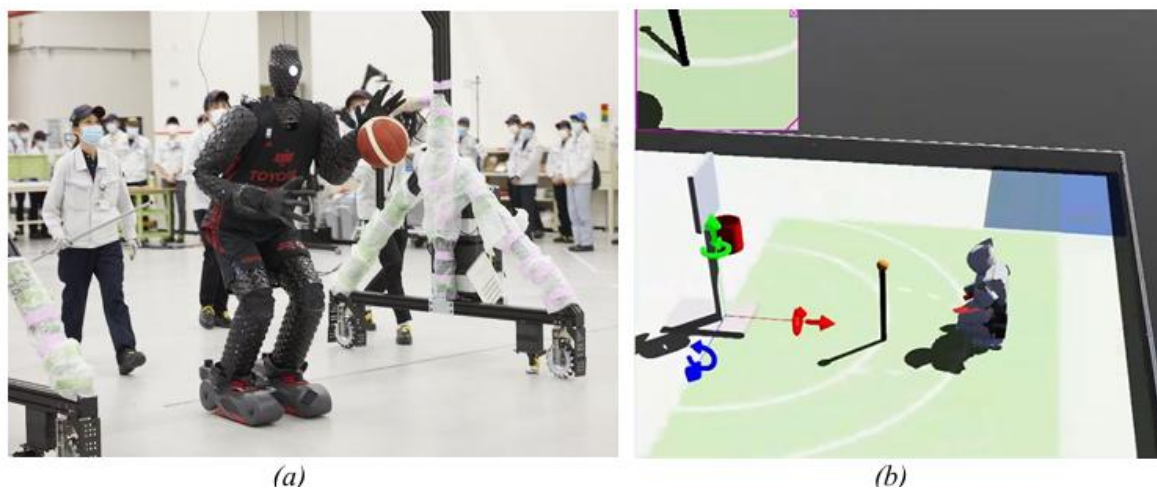

Figure 3: Basketball robots in sports

2.4 Football Robots in Sports

Football is one of the most popular ball games in the world, with over 3.5 billion fans worldwide. This exciting ball game has gained a large following due to its thrilling gameplay and fast - paced movements. Tian et. al. [20] designed a football goalkeeper robot as shown in figure 4 (a).[9] Liu et. al. Found that the learning - based methods are useful for complex movement, multi - agent coordination and long - term planning.[10] they trained physically simulated agents to play football in virtual environment. Zhou et. al. Proposed to use deep learning approaches to help strength training for football players. In addition, the visual detection of field line for football robots is also an interesting application.[11]
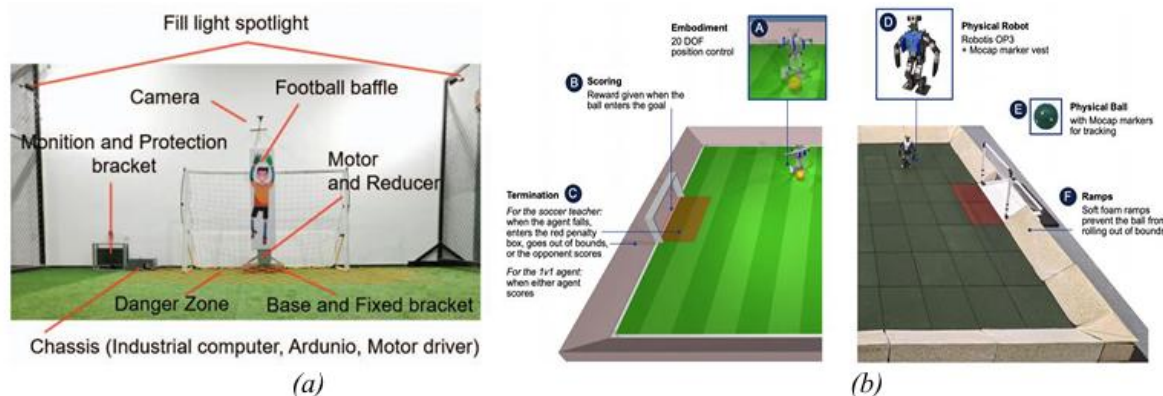

Figure 4: Football robots in sports

3. Other Applications of Robots in the Field of Sports

In the 2022 Winter Olympics, we saw that robots could serve, protect, and help people excel in many aspects of their lives.[12] With the rapid development of artificial intelligence, the new technologies are used in the virtual and real soccer robots. Actually, the robot world cup (RoboCup) was started as early as the year 1997. From 2018, an AI World Cup has been founded and figure 6 (a) shows an AI Soccer game which is displayed in a simulation.[13] When the soccer robots are matching with each other, an AI commentator observes the match and gives real - time commentary. In the meanwhile, an AI reporter gives a summary article. In addition, the robot news reporter used in sports news or events is not a novelty anymore.[14]

In the robot - aided sports rehabilitation training filed, there are also many researches and applications. Tsai et. al. designed a lower limb rehabilitation system by using a pneumatic artificial muscle structure In the robot - aided sports rehabilitation training filed, there are also many researches and applications. Tsai et. al. designed a lower limb rehabilitation system by using a pneumatic artificial muscle structure.[15]
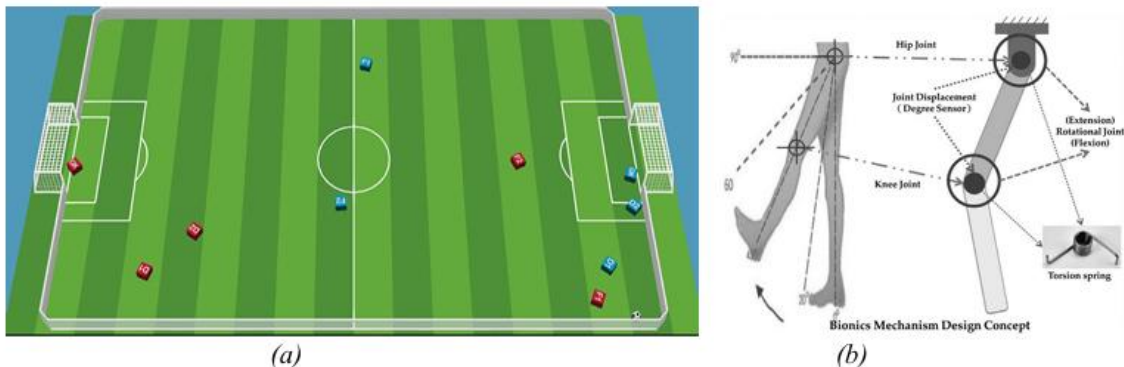

Figure 6: Other robots in sports

4. Conclusion and Suggestion

With the development of artificial intelligence, machine learning, computer vision and intelligent sensors techniques, robotics research is popular in many fields such as sport. The robots act as practice partners for professional players or competitive team members in sports events. The shape of the robots may be humanoid, wheeled, flying or with fixed position. Most of the applications are ball sports that the robots mimic human is motion and showing intelligence like a human. In the meanwhile, other sports related robots are designed and applicated. Consequently, the research and teaching work of sports majors should shift from traditional methods to an era of interdisciplinary integration. High tech sports equipment and instruments need to be introduced into physical education and training. These not only enhance more scientific of sports training, but also increase its fun. Students with interdisciplinary knowledge will open their minds and develop better in their future career development.

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