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Robotics in Sports

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ABSTRACT

Robotics has become an important part of modern technology, influencing industries such as manufacturing, healthcare, transportation, education, and entertainment. A robot is a programmable machine capable of performing tasks automatically or semi-automatically, often using sensors, artificial intelligence, cameras, and mechanical systems. Sports is a field in which robots are becoming increasingly useful. In sports, robots are used for training, officiating, equipment handling, broadcasting, research, rehabilitation, and even competition. Although robots are not likely to replace the human qualities that make sports exciting, they can improve performance, safety, accuracy, and efficiency. Artificial intelligence is making sports robots more capable. Traditional robots generally follow predetermined instructions. AI-enabled robots can use information from sensors and cameras to recognize objects, interpret their surroundings, and select appropriate actions. Robotics is not only changing how athletes train and compete but also how fans engage with sports, making it a pivotal element in the future of athletics. This paper investigates the current role of robots in modern sports.

KEYWORDS: *robots, robotics, sports, sports industry, entertainment.*

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INTRODUCTION

The world of sports is undergoing a significant transformation, driven by advancements in technology. Among these innovations, robotics has emerged as a game-changer. Robotics represents a fascinating and rapidly evolving field in engineering. Although robots are commonly associated with manufacturing, healthcare, and transportation, they are also becoming valuable tools in sports. They can assist athletes during training, improve performance analysis, support rehabilitation, enhance safety, maintain sporting facilities, and create new opportunities for spectators and researchers.

In recent years, robots have also gained increasing importance in sports. Advances in artificial intelligence, computer vision, sensors, machine learning, and mechanical engineering have made it possible to develop robots that can perform sophisticated physical tasks and interact intelligently with athletes. Although robots are unlikely to replace the human qualities that make sports exciting, they can assist athletes, coaches, officials, medical professionals, and sports organizations. Their value lies primarily in their ability to perform repetitive tasks consistently, collect precise data, operate in difficult environments, and work alongside intelligent computer systems [1]. Robotics is transforming the sports industry in various ways. From enhancing training to improving performance and safety, robotics plays a crucial role in modern sports.

WHAT IS A ROBOT?

The word "robot" was coined by Czechriter Karel Čapek in his play in 1920. Isaac Asimov coined the term "robotics" in 1942 and came up with three rules to guide the behavior of robots and later added the zeroth law [2]:

- Law 0: A robot may not injure humanity or through inaction, allow humanity to come to harm.
- Law 1: Robots must never harm human beings,
- Law 2: Robots must follow instructions from humans without violating rule 1,
- Law3: Robots must protect themselves without violating the other rules.

Robots are becoming increasingly prevalent in almost every industry, from healthcare to manufacturing.

Although there are many types of robots designed for different environments and for different purposes/applications, they all share four basic similarities [3]:

1. All robots have some form of mechanical construction designed to achieve a particular task;
2. They have electrical components which power and control the machinery;
3. All robots must be able to sense its surroundings; a robot may have light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), etc.
4. All robots contain some level of computer programming code.

Programs are the core essence of a robot since they provide intelligence. There are three different types of robotic programs: remote control, artificial intelligence, and hybrid. Some robots are programmed to faithfully carry out specific actions over and over again (repetitive actions) without variation and with a high degree of accuracy.

Robotics is an interdisciplinary field that involves the design, construction, operation, and use of robots. It is a branch of engineering and computer sciences that includes the design and use of machines that are capable of performing programmed tasks without human involvement. The field develops machines that can efficiently carry out various tasks, can automate tasks, and do various jobs that a human might not be able to do. Robots could someday be our drivers, companions, collaborators, teachers, specialists, and exploration pioneers [4]. Figure 1 shows a cloud word for robots [5], while Figure 2 shows a typical robot [6].

ROBOTICS IN SPORTS

Robotics in sports is an emerging and rapidly evolving field within the broader domain of robotics in engineering. It is rapidly transforming many areas of modern society, and the world of sports is no exception. The integration of robotics into sports encompasses a wide range of applications, from enhancing athletic performance and ensuring fair play to improving fan engagement and optimizing training methodologies. Robots are increasingly being used in athletic training, performance analysis, rehabilitation, officiating, stadium operations, and sports entertainment. As technologies such as artificial intelligence, machine learning, computer vision, advanced sensors, and autonomous systems continue to improve, robots are expected to play an even greater role in sports. The future of robots in sports will likely involve closer cooperation between humans and machines, with robots helping athletes improve performance, reduce injuries, recover faster, and experience new forms of competition. Athletes will continue to provide creativity, determination, personality, and competitive spirit. Robots will contribute precision, consistency, data analysis, physical assistance, and automation. The greatest benefits are likely to emerge when these different strengths complement one another. When responsibly designed and regulated, robotics can make sports safer, more inclusive, more scientifically informed, and more engaging. The future of sports may therefore not be a competition between humans and robots, but a partnership in which technological innovation helps human beings reach new levels of athletic performance and participation [1]. Over the next decade, robots will likely become more agile, more robust and better able to operate in complex environments. Tasks that robots currently find difficult, such as running on uneven terrain and catching or throwing balls, will become increasingly achievable. Rather than replacing athletes, robots are more likely to become part of the sporting ecosystem [7].

APPLICATIONS OF ROBOTICS IN SPORTS

Robotics has become an important emerging technology with applications in many areas of society, including manufacturing, healthcare, education, transportation, and entertainment. Robots have numerous applications in modern sports. They can assist athletes during training, analyze performance, support rehabilitation, contribute to injury prevention, assist officials, improve broadcasting, maintain sports facilities, transport equipment, support athletes with disabilities, and create entirely new forms of robotic competition. Common applications of robots in sports therefore include the following [1,8-10]:

- *Athlete Training:* One of the most important applications of robots in sports is athlete training. Robots are increasingly being integrated into training regimens across various sports. They can simulate real-game scenarios, allowing athletes to practice their skills in controlled environments. Traditionally, athletes depend on coaches, teammates, and specialized equipment to practice their skills. Robotic systems can provide another form of training partner by repeatedly performing the same action with great consistency. For example, robotic machines can deliver tennis balls, baseballs, table-tennis balls, soccer balls, or volleyballs at controlled speeds, angles, and

frequencies. Robotic training systems can also be combined with artificial intelligence. Cameras and sensors can observe an athlete's movements while computer algorithms analyze speed, posture, timing, balance, and technique. The system can then provide feedback that helps the athlete identify weaknesses and improve performance.

- *Sports Officiating*: Robotic and automated technologies are also influencing sports officiating. Referees and umpires sometimes have to make decisions within fractions of a second. Human vision and judgment are valuable, but mistakes can occur, especially when athletes and balls are moving at very high speeds. Camera systems, sensors, computer vision, and artificial intelligence can assist officials in determining whether a ball crossed a line, whether an athlete committed a violation, or where an object landed.
- *Sports Competitions*: Robots can themselves participate in sporting competitions. Robot soccer is one of the best-known examples. Teams of autonomous robots can be programmed to locate a ball, move around opponents, cooperate with teammates, and attempt to score goals. Such competitions are not simply entertainment; they provide opportunities for scientists and engineers to test developments in artificial intelligence, machine vision, navigation, communication, and autonomous decision-making. Other robotic competitions involve racing, combat-style contests, basketball, running, and various obstacle challenges. Figure 3 shows a sports competition involving a robot [11].
- *Sports Broadcasting*: Robotics is also changing how sporting events are recorded and presented. Robotic cameras can follow athletes and capture events from positions that would be difficult or unsafe for human camera operators. Automated camera systems can pan, tilt, zoom, and track movement according to programmed instructions or artificial-intelligence algorithms. Robotic technology can therefore help broadcasters capture more detailed and dynamic footage. It can also reduce the number of personnel required for certain routine camera operations. When combined with drones and computer vision, automated systems can provide spectators with perspectives that were once difficult to obtain. Figure 4 shows a robot for sports broadcasting and recording [12].
- *Sports Equipment*: Robots can assist with routine equipment-related activities. Machines may retrieve balls, transport equipment, clean sporting facilities, maintain playing surfaces, or perform repetitive support tasks. Golf facilities, for example, can use automated equipment to collect balls or maintain large areas. The advantage of these machines is their ability to perform repetitive tasks for long periods. Human workers can then concentrate on responsibilities that require communication, supervision, problem-solving, or specialized expertise.
- *Injury Prevention*: Injuries are a major concern in professional and recreational sports. Robotics can contribute to injury prevention by helping researchers and coaches study human movement more precisely. Sensors and robotic motion-analysis systems can monitor how athletes run, jump, land, throw, or change direction. Abnormal movement patterns may indicate excessive stress on particular joints or muscles. Coaches and sports medicine professionals can use this information to modify an athlete's technique or training program before a serious injury develops. Robotic testing systems can also repeatedly test sports equipment under controlled conditions. Helmets, shoes, protective padding, rackets, artificial playing surfaces, and other equipment can be evaluated for durability and performance without exposing human athletes to unnecessary risks.
- *Athlete Rehabilitation*: Robotics has particularly significant potential in sports medicine and rehabilitation. Injured athletes often need carefully controlled and repetitive exercises to restore strength and movement. Robotic rehabilitation devices can assist limbs through prescribed movements while monitoring progress. Robotic exoskeletons and related technologies may also support individuals experiencing mobility limitations. Sensors can measure force, joint movement, range of motion, and other indicators. Such information can help rehabilitation professionals evaluate progress and adjust treatment.
- *Sports Research:* Robots are valuable research tools in sports science. Researchers can use robotic systems to reproduce movements with a level of consistency that may be impossible for human participants. For example, a robot can repeatedly strike a ball using exactly the same force and angle while researchers change only one variable, such as the material of the ball or playing surface. This makes it possible to investigate sports equipment and physical interactions under controlled experimental conditions. Robots can also be designed to imitate

particular human movements. Researchers can then investigate biomechanics, equipment design, aerodynamics, and other factors influencing athletic performance.

- *Fan Engagement*: Robots are being deployed to enhance the fan experience at sporting events. Autonomous drones and robots are being used to deliver merchandise, snacks, and beverages directly to fans in the stands. Robots can also contribute to the entertainment surrounding sporting events. Some venues use robots for demonstrations, promotional activities, information services, and interactions with spectators. Robots may greet visitors, provide directions, answer basic questions, or participate in halftime entertainment. As AI develops, interactive robots may provide increasingly personalized experiences for spectators. They could potentially help visitors locate seats, obtain information about teams, navigate large stadiums, or access services within sporting venues.
- *Performance Analysis*: Robots can also contribute to sports performance analysis. Robotic cameras, sensor-equipped devices, drones, and automated tracking systems can collect large amounts of information about athletes during training and competition. Computer vision systems can analyze body position, movement, acceleration, speed, balance, and technique. Coaches can use this information to identify weaknesses that may be difficult to detect through ordinary observation. For example, a robotic camera system could follow an athlete automatically while recording movements from appropriate angles. The collected information can also be analyzed using AI. Coaches may then compare an athlete's current performance with previous performances or established technical standards. This combination of robotics, sensors, and data analytics can support evidence-based coaching decisions.
- *Robots as Athletes*: Training a robot to play sport is fundamentally different from training a human athlete. A humanoid robot recently made headlines around the world for running a half-marathon and beating the human world record. Robots are also helping athletes train in gridiron football. Robots help a Japanese volleyball team practice their attacks, and this robot has a pretty killer jump-and-hit motion for the sport. The challenge is to eventually create an all-robotic team of humanoid soccer players to take on the World Cup champions. For fast-paced sports such as table tennis, the challenge is extreme. The soccer robot has gained much popularity in this new-age world of sport. Figure 5 shows robots playing soccer [13], while Figure 6 shows some humanoids hitting the track [14].

BENEFITS

Robotics is increasingly influencing the world of sports. The integration of robotics in sports is transforming the industry, offering innovative solutions that enhance training, performance, and fan engagement. As robotic technology continues to advance, its benefits to sports are likely to become even more significant. Robots can provide precision, repetition, measurement, and automation. Other benefits of robots in sports therefore include the following [1]:

- *Improved Athletic Training*: One of the major benefits of robots in sports is their ability to improve athletic training. Robots can repeatedly perform the same movement with a high degree of consistency. This makes them useful as training partners for athletes. For example, robotic systems can deliver balls to tennis, table tennis, baseball, soccer, and other players at controlled speeds, angles, and frequencies. An athlete can therefore practice a particular skill hundreds of times without requiring another person to continuously provide the ball. Coaches can also adjust the machine to simulate different playing conditions. Robotic training systems can help athletes develop reaction time, accuracy, coordination, endurance, and technical skills. Because the robot does not become physically tired in the same way as a human training partner, athletes can conduct long and highly repetitive practice sessions when appropriate.
- *Precision:* Robots are particularly valuable because of their precision. Human training partners may unintentionally vary the speed, direction, or timing of their actions. A properly programmed robot can repeat a movement under controlled conditions. This consistency allows coaches to evaluate an athlete's response to the same challenge repeatedly. If a tennis player is practicing a backhand return, for example, a ball-delivery system can repeatedly send the ball toward a predetermined location. The coach can then observe whether the athlete's technique and accuracy are improving. Such controlled repetition can make sports training more systematic and measurable.
- *Personalized Training*: Another important benefit is the possibility of personalized training. Athletes differ in their abilities, physical characteristics, weaknesses, and training requirements. Robotic

systems can be programmed or adapted to meet individual needs. A beginner may need slower and more predictable exercises, while an elite athlete may require faster and more challenging drills. Advanced systems can potentially adjust the difficulty of exercises according to an athlete's performance. Personalization can make training more efficient because athletes spend more time working on the areas in which they need improvement rather than following exactly the same routine as everyone else.

- *Injury Prevention*: Injuries are a major concern in competitive and recreational sports. Robotics can contribute to injury prevention by helping athletes and professionals examine movement patterns and physical workloads. Robotic and sensor-assisted systems can help detect unusual or inefficient movements that might place excessive stress on muscles or joints. When such problems are identified early, coaches, trainers, and appropriate health professionals can modify training techniques or workloads. Robots may also perform some repetitive or physically demanding training tasks that would otherwise require coaches or support personnel to expose themselves to unnecessary physical strain.
- *Rehabilitation*: Robotics has important applications in sports rehabilitation. After an injury or surgery, an athlete may need to repeat carefully controlled movements as part of a rehabilitation program. Rehabilitation robots and robotic exoskeletons can assist movement while allowing resistance and support to be adjusted according to the person's needs. Such systems may also collect information about progress during rehabilitation. Measurements of movement, strength, or range of motion can help qualified professionals assess how the athlete is responding to a rehabilitation program.
- *Increased Safety*: Robots can improve safety in sporting environments by performing tasks that may expose humans to unnecessary risk. For example, robots and remotely operated machines can inspect difficult-to-reach areas of large stadiums, assist with security operations, or perform certain maintenance activities. Robotic technology may also be useful in motorsports and other high-risk sporting environments. Machines can potentially inspect dangerous areas or assist personnel without immediately exposing workers to the same hazards.
- *Athletes With Disabilities*: Robotics can also promote greater participation in sports among people with physical disabilities. Robotic prostheses, exoskeletons, adaptive devices, and related technologies can support mobility and physical activity. These technologies may allow some individuals to participate in sporting and recreational activities that would otherwise be difficult or impossible. Advances in adaptive robotics therefore have implications beyond competitive performance; they can contribute to inclusion, independence, physical fitness, and quality of life. Robotic technologies can also inspire the development of new forms of adaptive competition and encourage engineers to design more accessible sporting equipment.
- *Reduced Workload:* Coaches perform many repetitive tasks during training. They may repeatedly throw, kick, feed, retrieve, or position balls and equipment. Robots can automate some of these activities. When routine tasks are automated, coaches can devote more attention to observing athletes, correcting technique, developing strategy, and communicating with players. Robotics therefore does not necessarily eliminate the role of the coach. Instead, it can serve as a tool that allows coaches to concentrate on tasks requiring human judgment, leadership, motivation, and interpersonal understanding.
- *Facility Maintenance:* Sports facilities require extensive maintenance. Fields, stadiums, courts, and training centers must be cleaned and maintained regularly. Autonomous or semi-autonomous machines can assist with activities such as mowing grass, cleaning floors, marking fields, transporting equipment, and inspecting facilities. Automating some of these tasks can reduce labor demands while helping organizations maintain consistent standards. This can be particularly valuable in large stadiums and sports complexes where maintenance involves extensive areas.
- *Scientific Research*: Sports robotics also contributes to scientific research. Researchers can use robots to reproduce movements under controlled conditions and investigate questions concerning biomechanics, equipment design, human performance, and human-machine interaction. Because a robot can repeat a movement precisely, researchers can change one variable at a time and observe the resulting effects. Findings from this research may contribute to better training methods, safer equipment, improved prosthetic technologies, and a deeper understanding of human movement.
- *Improved Experience*: Robots may also enhance the experience of sports spectators. Robotic and

automated camera systems can capture events from unusual or difficult angles, while autonomous technologies can assist with broadcasting and event operations. Some sporting venues may also use service robots for information, delivery, hospitality, or other customer-support functions. As these technologies improve, robots could help make large sporting events more efficient and interactive.

CHALLENGES

In spite of their many benefits, the use of robots in sports presents significant challenges. These challenges include high costs, technical limitations, safety concerns, employment issues, ethical questions, reliability, fairness, privacy, cybersecurity risks, employment, maintenance, and the preservation of human participation. Other challenges of robots in sports therefore include the following [1]:

- *High Cost*: One major challenge is the high cost of robotic technology. Advanced robots require sophisticated sensors, cameras, processors, artificial intelligence software, motors, and control systems. Developing and maintaining these systems can be expensive. Professional teams and wealthy sports organizations may be able to afford them, while schools, community organizations, amateur athletes, and teams in developing countries may not. This creates the possibility of technological inequality in sports, where athletes with access to advanced robotic training systems gain advantages over those without them.
- *Ethical Concerns*: Robotics also raises important ethical and legal questions. If an autonomous robot causes an injury, responsibility may not always be obvious. Liability could potentially involve the manufacturer, software developer, sports organization, operator, or another party. Similarly, decisions made by artificial intelligence systems may contain errors or biases. Clear legal frameworks will be necessary as autonomous machines assume increasingly important roles in sports.
- *Privacy Concerns*: There are also privacy and data protection concerns. Sports robots and intelligent training systems can collect enormous amounts of information about athletes, including movement patterns, reaction times, physical performance, injuries, and physiological measurements. Such information can be extremely valuable to coaches and medical teams, but it can also be sensitive. Unauthorized access to an athlete's data could reveal weaknesses, injuries, or competitive strategies. Sports organizations must therefore establish strong policies concerning data ownership, storage, access, and consent.
- *Fairness:* Fairness and competitive integrity also present serious challenges. If robotic systems provide athletes with highly advanced training, recovery, or performance assistance, sporting authorities must determine what forms of assistance are acceptable. The distinction between legitimate technological support and unfair technological enhancement may become increasingly difficult to establish. Governing bodies may need new regulations to ensure that robotic technologies do not undermine fair competition.
- *Reliability:* Another challenge is technical reliability. Sports environments are highly dynamic and unpredictable. Athletes move rapidly, balls change direction suddenly, weather conditions vary, and unexpected events frequently occur. A robot that works effectively in a controlled laboratory may perform differently on a crowded football field, basketball court, running track, or other real-world sporting environment. Sensors can malfunction, batteries can fail, communication systems can lose connectivity, and software can contain errors. A technical failure during training or competition could disrupt an event or even create a dangerous situation.
- *Safety:* Safety is especially important because many sports involve rapid movement and physical contact. Robots operating close to athletes must recognize human movement and react almost instantly. A malfunctioning robotic training partner, ball-delivery machine, or rehabilitation robot could injure an athlete. As robots become faster, stronger, and more autonomous, designers must develop reliable emergency-stop systems, collision-avoidance mechanisms, and other safeguards. Safety standards will therefore need to develop alongside robotic technology.
- *Complex Human Behavior*: Robots also face the challenge of understanding complex human behavior. Athletic performance involves much more than physical movement. Coaches consider confidence, motivation, fatigue, fear, teamwork, leadership, emotional condition, and psychological pressure when working with athletes. Artificial intelligence can analyze measurable information, but a robot may not fully understand what an athlete is experiencing

emotionally. Consequently, robots may support coaches, trainers, and therapists, but completely replacing human judgment would be difficult and potentially undesirable.

- *Cybersecurity:* Closely connected to privacy is the problem of cybersecurity. Many modern robots depend on computer networks, wireless communication, cloud computing, and artificial intelligence systems. This connectivity creates opportunities for cyberattacks. Hackers could potentially interfere with robotic equipment, steal confidential performance information, or manipulate connected systems. As robots become more deeply integrated into sports, cybersecurity must become an important part of sports technology management.
- *Specialized Expertise:* Another difficulty is maintenance and the need for specialized expertise. Robots contain complex mechanical, electrical, and software components that require regular servicing. Sports organizations adopting robotic systems may therefore need engineers, programmers, technicians, and cybersecurity specialists. A sophisticated robot that cannot be repaired quickly may become useless during an important training session or sporting event. Organizations must consider not only the purchase price of robots but also their long-term maintenance and operating costs.
- *Overdependence:* Perhaps one of the deepest concerns is the possibility that excessive dependence on robots could reduce the human element of sports. Sport is valued not merely because of physical performance but because it demonstrates courage, discipline, creativity, teamwork, perseverance, leadership, and human achievement. Fans often connect emotionally with athletes because they understand the struggles and sacrifices behind their accomplishments. If technology becomes too dominant, sports could gradually become more focused on technological superiority than human ability. For this reason, overdependence on robotic systems should also be avoided.

FUTURE OF ROBOTICS IN SPORTS

The future of robotics in sports will likely be closely connected with developments in artificial intelligence, computer vision, wearable sensors, machine learning, and advanced materials. As these technologies become more capable, robots may become increasingly personalized training partners and support systems for athletes and coaches. The role of robots in sports will expand as artificial intelligence continues to advance. Future robots may become more mobile, intelligent, affordable, and responsive. Athletes could train against robotic opponents capable of adapting to their playing styles. Coaches may use robotic systems that automatically reproduce specific game situations. The most promising future is therefore not one in which robots replace athletes, coaches, and officials, but one in which robotics strengthens human performance and makes sports safer, more accurate, and more accessible.

Instead of robots merely assisting human athletes, robots could compete against one another. Robotic soccer, racing, combat competitions, and other technology-centered sporting events could become more sophisticated as autonomous robots improve. These competitions would test not only physical capabilities but also engineering, programming, artificial intelligence, and strategic decision-making. Universities, technology companies, and research institutions could use robotic sports as laboratories for developing technologies that later have applications beyond sports. The fan experience will also be affected by robotics. Stadiums of the future may employ service robots to provide food, merchandise, information, security assistance, cleaning, and transportation. In the long term, the relationship between athletes and robots will probably be based more on collaboration than replacement. Coaches will continue to provide leadership, motivation, emotional understanding, and strategic judgment [1].

CONCLUSION

Robots are transforming sports by supporting training, officiating, broadcasting, rehabilitation, safety, equipment management, and technological research. Their ability to perform repetitive tasks, collect precise information, and respond intelligently to changing conditions makes them valuable tools for athletes, coaches, officials, researchers, and sporting organizations. At the same time, their use raises important questions about cost, fairness, privacy, reliability, and the appropriate balance between human and machine decision-making. When used responsibly, robots can become powerful partners in the continuing evolution of sports. By addressing the technical, ethical, and social challenges associated with this field, we can unlock the full potential of robotics in sports and create a future where technology and athletics work hand in hand to achieve new heights of excellence. More information about robotics in sports can be found in the books in [15-22] and the following related journals:

- *Robotica*
- *Robotics*
- *Robitics and Autonomous*
- *Robotics and Computer-Integrated Manufacturing,*

- *Advanced Robotics*
- *Autonomous Robots*
- *Automation in Construction*
- *Journal of Robotics*
- *Journal of Robotic Systems*
- *Journal of Robotic Surgery*
- *Journal of Robotics and Mechatronics*
- *Journal of Intelligent & Robotic Systems*
- *Journal of Mechanisms and Robotics-Transactions of the ASME*
- *Journal of Automation, Mobile Robotics and Intelligent Systems*
- *Journal of Future Robot Life*
- *IEEE Robotics and Automation Letters*
- *IEEE Transactions on Robotics*
- *International Journal of Robotics Research*
- *International Journal of Social Robotics*
- *International Journal of Humanoid Robotics*
- *International Journal of Advanced Robotic Systems*
- *Science Robotics*
- *Soft Robotics*
- Cognitive Robotics
- *Journalism*
- *Journalism and Media*

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Figure 1 A cloud word for robots [5].



Figure 2 A typical robot [6].



Figure 3 A sports competition involving a robot [11].



Figure 4 A robot for sports broadcasting and recording [12].



Figure 5 Robots playing soccer [13].



Figure 6 Some humanoids hitting the track [14].