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Robotics in Media and Entertainment

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ABSTRACT

Robotics in media and entertainment involves the design, development, and application of robots to create engaging and interactive experiences. It is a dynamic and rapidly evolving field that combines engineering, creativity, and technology to create innovative and immersive experiences. The importance of robotics in entertainment lies in its ability to create immersive experiences, push the boundaries of what is possible, and provide new forms of interaction and engagement for audiences. The entertainment industry is witnessing a revolutionary convergence of technology and creativity through the incorporation of robots. This paper examines the role of robots in media and entertainment.

KEYWORDS: *robots, robotics, space robotics, media and entertainment (M&E), M&E industry*

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INTRODUCTION

The robots are shaped and designed to look like humans and can also be programmed to perform complex tasks and movements. In the ever-evolving landscape of technology, robots are no longer confined to industrial settings. They have seamlessly integrated into our daily lives, offering a myriad of possibilities, including media and entertainment.

Robots are popping up in unexpected places. They are hoisting pop stars over our heads, dancing with pianos, making cameos in blockbuster movies, and creating spectacles of color and light in venues large and small. Put them on the entertainment stage and now you have a performer's best friend. When robots go behind the scenes to help automate stage production, or special-effects photography and videography for commercials and movies, the plot thickens. Because like great performers, robots will keep pushing their limits [1].

Robotic technologies are applied in many areas of media and entertainment. This field leverages advanced robotics to enhance and revolutionize various forms of entertainment, from movies and theme parks to video games and live performances. Precision, repeatability, flexibility, reliability – just a few of the reasons robots are a great fit for the stage and screen. As robot prices continue to drop and integration gets easier, we expect to see more robots in the entertainment industry. From creating immersive experiences and generating realistic animations to personalizing content and enhancing production efficiency, these technologies are transforming how we consume and create entertainment. Robots and AI are transforming film and TV production by automating various aspects, from camera operation and lighting to editing and post-production. These technologies increase efficiency and allow creators to focus on the creative aspects of their projects, resulting in higher quality productions [2].

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 [3]:

- 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. Figure 1 indicates that robotics is one of the branches of artificial intelligence.

Although there are many types of robots designed for different environments and for different purposes/applications, they all share four basic similarities [4]:

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 [5].

MEDIA AND ENTERTAINMENT ROBOTS

Robotics in media and entertainment represents a fascinating intersection of technology, creativity, and engineering. An entertainment robot is a robot that is designed for the sole subjective pleasure of the human. It serves usually the owner or his housemates, guests, or clients. Entertainment robots can also be seen in the context of media arts where artists have been employing advanced technologies to create environments and artistic expression also utilizing actuators and sensors to allow their robots to react and change about viewers. The role of robotics in entertainment is growing at an exponential rate, pushing the boundaries of creativity and innovation. Whether in live performances, movies, theme parks, or interactive gaming, robots are revolutionizing how we experience entertainment. Figure 2 shows robots in media and entertainment [6].

From the Middle Ages to the early 2020s, we trace the roots of entertainment robots. Robots have been serving as marketing devices for the best part of a thousand years. Robotics has been a growing staple across the entertainment industry for some time now. One of the most notable innovations in entertainment robotics is the advancement of robotics technology itself. From robots hosting live shows to autonomous production assistants, robotics is streamlining the entertainment production process. Companies have developed more agile, versatile, and interactive robots that can engage with audiences in a human-like manner. With AI capabilities, robots are becoming smarter, allowing for personalized interactions with users. Virtual reality and augmented reality are revolutionizing the entertainment industry, and their integration with robotics is taking immersive experiences to a whole new level [7]. For example, Sophia is the culmination of a series of robot projects undertaken by Hong Kong-based Hanson Robotics. Sophia is the first "artificial being" to address the United Nations and to be given citizenship of a country.

TYPES OF MEDIA AND ENTERTAINMENT ROBOTS

Most robots are designed for a single purpose that tends to exclusively define their form.

They are designed to appeal to us and to meet us on near-equal terms in our own physical space. Commercial media and entertainment robots include the following types [8]:

- *Collaborative Robot* (Cobot): A cobot is designed to work alongside humans, enhancing live performances and interactive exhibits.
- *Toy Robot:* Relatively cheap, mass-produced entertainment robots are used as mechanical, sometimes interactive, toys that perform various tasks and tricks on command. You do not have to visit a theatre to experience the wonders of modern robotics. Instead, you can have your personal source of robotic entertainment - with robotic toys or pets powered by artificial intelligence.

- *Robotic Dog:* Robot dogs as a fad have been produced with relatively little variation. For example, Teksta is a commercial toy robot dog popular in the 1990s. It was intended to be able to perform card tricks and respond to commands. Figure 3 shows an example of robotic dog [9].
- *Humanoid Robot:* Humanoid robots can interact with guests, provide information, and perform in shows. Despite those humanoid robots for utilitarian uses, some humanoid robots aim at entertainment uses, such as Sony's QRIO. They are usually capable of some advanced features like voice recognition or walking. The humanoid robots for entertainment is expanding with demand for lifelike, interactive experiences in theme parks, events, and media. An example of humanoid robot is shown in Figure 4 [10].
- *Companion Robot:* Robots can serve as companions, providing entertainment and emotional.

APPLICATIONS OF ROBOTICS IN MEDIA AND ENTERTAINMENT

Robotics has a wide range of applications across various industries. It is increasingly used in the media and entertainment industry for a variety of applications, including film and television production, live events, theme parks, and even in the creation of new forms of art. Common applications include the following [6,11,12]:

- *Automation:* Robots can automate tasks, enhance creativity, and create immersive experiences for audiences. They are used to perform tasks autonomously or semi-autonomously, reducing the need for human intervention. Deloitte predicts that more than 40% of tasks in the media and entertainment industry could be automated by 2025. Improved automation could address industry challenges like rising production costs and fluctuating audience demand. Automation can streamline post-production tasks, such as video editing and special effects, freeing up human resources for more creative decision-making roles.
- *Film and Television:* Robots are used extensively in the film and television industry to create lifelike characters and special effects. Animatronics bring creatures and characters to life, while motion capture technology allows actors' movements to be translated into digital animations. Examples include the animatronic dinosaurs in "Jurassic Park" and the motion-captured characters in "Avatar." Robots can control cameras for complex shots and stabilize footage. Robotics can assist with stop-motion animation, making adjustments frame-by-frame. Drone filming has also started to enter the sphere with drone shows famously taking place in Dubai and at special events around the world. Figure 5 shows a typical drone [13].
- *Theme Parks*: Theme parks are embracing robotics in entertainment to elevate visitor experiences and create attractions that were once deemed impossible. Robotic amusement park rides have also become a mainstay at funfairs and carnivals around the world to cater to visitors, as well as robot servers in restaurants and at exhibitions. Theme parks utilize robotics to create immersive and interactive experiences for visitors. Animatronic figures populate rides and attractions, providing lifelike interactions. For instance, Disney's "Pirates of the Caribbean" ride features highly detailed animatronic pirates, while Universal Studios' "Harry Potter and the Forbidden Journey" ride uses robotic arms to simulate flying on a broomstick. Robots can be integrated into rides and attractions, creating more engaging experiences. They can be used to create animatronic characters in theme parks and other venues.
- *Live Performances:* Robots are increasingly being used in live performances, such as concerts, theater productions, and art installations. Robots have started to make a significant impact in live entertainment, captivating audiences with their precision and futuristic appeal. Robotic dancers, musicians, and even actors are appearing in live shows, offering performances that blend human creativity with mechanical accuracy. Robotic systems can control lighting, sound, and stage effects, creating dynamic and engaging shows. For example, the band Muse has used drones and robotic lighting systems in their live performances to create a futuristic atmosphere. Robots can control lighting, camera angles, and sound systems, creating dynamic and immersive experiences.
- *Storytelling:* Robots equipped with artificial intelligence (AI) are transforming the storytelling landscape. These intelligent beings can dynamically adapt narratives based on audience reactions, creating a truly interactive experience. Whether it is a robot-led theater production or an AI-driven storytelling session for children, the possibilities are boundless. The fusion of technology and creativity opens doors to a new era of narrative entertainment.

- *Sports:* Sports enthusiasts are in for a treat as robots enter the arena, showcasing their prowess in physical competitions. From robot soccer tournaments to drone racing leagues, these events not only push the boundaries of technology but also provide a thrilling spectacle for fans. The precision and speed of robotic athletes add a futuristic charm to traditional sports, attracting a new generation of viewers. Figure 6 shows a robot for sports [14].
- *Robo-Comedians*: Laughter is a universal language, and robots are learning to speak it fluently. Robotic comedians are gaining popularity in entertainment circuits, delivering jokes with impeccable timing and a touch of mechanical humor. These comedic bots not only entertain but also challenge our perceptions of creativity and wit in artificial entities.
- *Gaming:* Gaming has evolved from pixels on a screen to immersive experiences, and robots are taking it a step further. Imagine a gaming session where physical robots become an integral part of the gameplay. From real-life robot battles to collaborative gaming experiences, the fusion of robotics and gaming is a testament to the limitless potential of entertainment technology. Robotics technology enhances video games through motion capture and VR/AR systems. Motion capture allows for realistic character animations, while VR and AR provide immersive gaming experiences.
- *Robot Journalism*: Robots are used to generate news articles, freeing up human journalists for more complex tasks.
- *Robotic Musicians:* Robots can play music, even compose their own music. AI-powered robotic bands, such as Compressorhead, are playing instruments with unmatched precision, creating a mesmerizing experience for audiences.

BENEFITS

Robots do not flinch in the face of danger. They can consistently repeat the same movement, ensuring that the risky shots are captured perfectly without endangering human lives. Robotics, with its blend of precision, consistency, and innovation, is undeniably playing a pivotal role in modern film production. Robots can attract larger crowds in entertainment settings, offer unique experiences that set a venue apart from competitors, and reduce labor costs by automating certain services. Other benefits of robotics in media and entertainment include the following [15]:

- *Interactivity*: Robots can be programmed to react to stimuli in their environment. This interactivity is particularly useful in scenes that require real-time feedback. For example, a robotic character could react to an actor's lines or movements, ensuring a dynamic and natural interaction between humans and machines.
- *Precision:* Stop-motion, one of the oldest film techniques, has been given a new life through robotics. Instead of manually adjusting models frame-by-frame, robots can be programmed to make the finest adjustments, resulting in smoother animations. Such precision reduces the margin of error and ensures a higher quality output.
- *Sustainability:* As sustainability becomes an increasingly important factor in consumer decision-making, robotics companies are focusing on creating eco-friendly robots. This includes using sustainable materials and energy-efficient designs, making entertainment robots more environmentally conscious. Robotics, especially when paired with renewable energy sources, can significantly reduce the carbon footprint of film production. Automated systems can manage resources more efficiently, while 3D printed sets often require fewer materials, resulting in less waste.
- *Collaboration:* These mechanical marvels are not merely tools but collaborators, pushing the boundaries of what is possible in the realms of performance, storytelling, sports, gaming, music, film, art, and live events. Collaboration between engineers, artists, and ethicists can help address technical and ethical challenges.

CHALLENGES

In spite of the exciting possibilities, there are several challenges and considerations associated with robotics in entertainment. The use of AI and data collection in entertainment raises concerns about user privacy and data security. Other challenges of robotics in media and entertainment include [11]:

- *Complexity:* Designing and developing advanced robotic systems is complex and requires expertise in multiple engineering disciplines.
- *Cost:* High costs associated with developing and maintaining robotic systems can be a barrier for some applications.
- *Reliability:* Ensuring the reliability and safety of robotic systems, especially in live performances, is critical.

- *Job Displacement*: The increasing use of robots in entertainment may lead to job displacement for certain roles.
- *Regulation:* Developing regulations and standards for the use of robotics in entertainment can ensure safety and ethical considerations are met. The regulatory landscape for humanoid robots in entertainment is still evolving, with key considerations around safety, privacy, and ethical use of AI. Compliance with existing and forthcoming regulations is crucial for companies to navigate to avoid potential legal challenges and to foster public trust in this technology.
- *Research and Development:* Continued research and development can lead to more cost-effective and reliable robotic systems.

CONCLUSION

As the field of robotics continues to evolve, the integration of robotics in entertainment is becoming increasingly sophisticated, offering endless possibilities for innovation and creativity. As robots continue to evolve and become more sophisticated, their role in entertainment is destined to expand. Anticipated advancements include more lifelike and interactive robotic performers, increased use of AI-driven storytelling, integration of robots in virtual and augmented reality experiences, and the development of AI-powered characters for theme parks and live events. Greater advances in artificial intelligence and robotics will lead to more applications of robotics in entertainment along with improvements in the existing applications [16]. More information on robotics in the media and entertainment industry can be found in the books in [17,18] 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*

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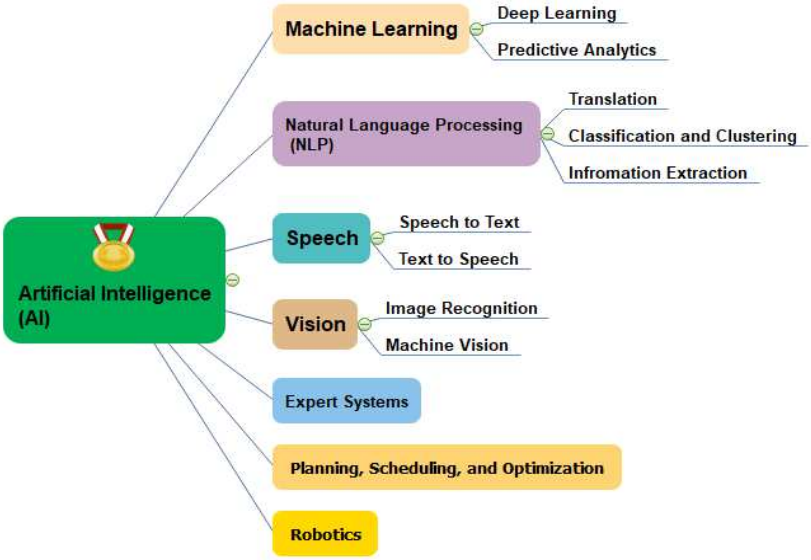

Figure 1 Robotics is one of the branches of artificial intelligence.

Figure 2 Robots in media and entertainment [6].

Figure 3 A robotic dog [9].

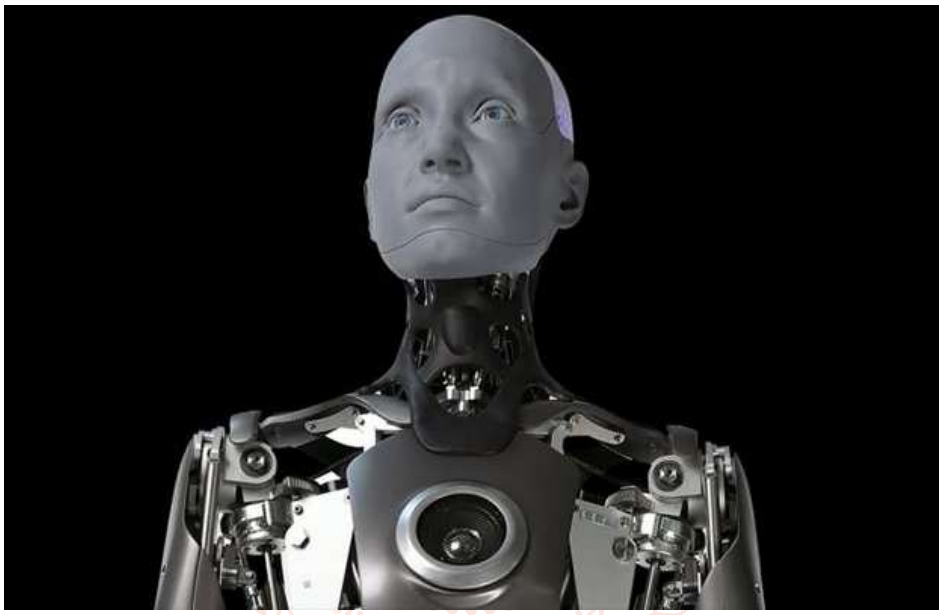

Figure 4 An example of humanoid robot [10].

Figure 5 A typical drone [13].

Figure 6 A robot for sports [14].