# APPLICATION ORIENTED FUTURISTIC SCOPE OF HUMANOID ROBOTS

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**Abstract--Due to the Fast evolution of technology, robots are already on par with humans. The fields of manufacturing and research have seen various alterations as a result of technological advancements. Robots were first employed by humans to facilitate their job, but these days they are being designed to mimic people and take over labor in industries where it is challenging for humans to exist at all. Not only is robot manufacturing being developed, but control and optimization of the tasks performed by the robots are also being prioritized. Robots have countless applications in the medical specialties, military, and education. The Robot creation and the systems requirements are determined by the type of application. A humanoid robot requires sensors and actuators in order to learn and acquire human characteristics, such as facial expressions, heads, bodies, and legs. In the past few years, humanoid robots have been developed across all industries; such examples are Sophia, HUBO, KIBO, Robonaut 2, L2TOR, Biorobo, Honda ASIMO, and others. The Backdrop of the humanoid is covered in this study.**

**Keywords:Autism Spectrum Disorder (ASD),Educational Robotics,Humanoid for autism students, Humanoid Nurse Robots,Human–Robot Interactions, Robot Programming.**

## I.INTRODUCTION

Professional robots called humanoid robots are made to resemble humans in terms of speech and movement. They add value by automating jobs that enhance output and cut costs, just like all other service robots do. Professional service robots, or humanoid robots, are a relatively new breed. The humanoid robot is one of the models that Hanson Robotics has created. Sophia speaks like a human and has a wide range of human-like facial expressions [1].

Research and space exploration, education and recreation, education and recreation, search and rescue, production and maintenance, public relations, and health are among areas where human robots are used. With the use of sensors and actuators, human figures may move, speak, and perform other functions. Whereas ginoids resemble feminine humans, an android is a humanoid robot that mimics a person. Certain characteristics allow human figures to function. They have a variety of features, including mobility, law enforcement, and changeable adaptability. They also contain sensors that enable them to sense their surroundings. By guaranteeing their total safety and well-being, the humanoid robot helps humans in the workforce. While humanoid robots, which can conduct repetitive work flawlessly, are not meant to mimic people in form and function, these robots also operate in factories. They are not just a "do it all" helper; they have more specialized tasks [2].

## II. HUMAN–ROBOT INTERACTIONS (HRI) FOR ROBOT PROGRAMMING

Eventually, there have been significant changes in the ways that humans and robots interact. They began with straightforward physical interactions with simple instruments like a mouse or keyboard, and then they progressed to using touch screens as interactive interfaces. In recent years, robots have become increasingly autonomous and new hardware and software capabilities have made it possible for them to communicate with human partners through gestures or voice.

HRI adds value by maintains a favorable production cost and integrates human and robotic skills. Collaborative frameworks benefit from a link between human dexterity, adaptability, perception, and intelligence and robot repeatability and precision. The primary source of inspiration is the reduction of human ergonomic stress and workload coupled with increases in productivity, efficiency, and flexibility. This is accomplished by streamlining the method that robots carry out guided by humans' tasks in the manufacturing sector.

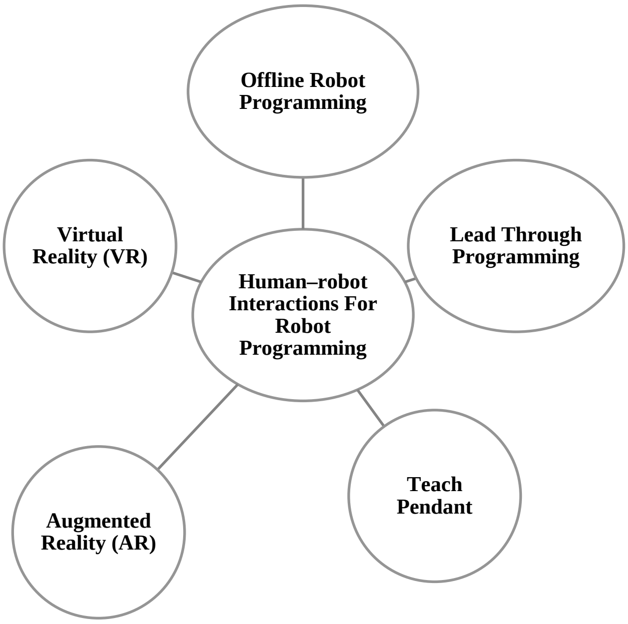


Fig.1. HRI For Robot Programming

A handheld device called a teach pendant is typically fastened to a robot in order to instruct it on particular points, locations, and travel sequences. This method works well in scenarios where the robot's trajectory can be determined with just one controller and that have point-to-point control.The goal of lead through programming, or programming by demonstration (PbD), is to make it possible for robots to pick up new abilities under human supervision. This method makes it easier for non-experts to educate robots without any programming experience because all that is required is for the operator to manually guide the robot into the appropriate position and record the path it took.Offline Robot programming helps to overcome the drawbacks of online techniques. Robot movement design and planning typically require specialized programming and simulation software. Typically, it involves simulating a 3D graphical model of the work cell environment remotely.Robot programming using Virtual Reality (VR) is an offline programming technique where the technology ensures safe and offhand virtual programming. To simulate movement, the operator drags the robot's digital model to the required place in the immersive environment to carry out trajectory planning. To put it briefly, this technology leverages offline software to use online programming capabilities by fusing the best aspects of both offline and online approaches.Augmented Reality (AR) based robot programming has been extensively investigated for telerobotics applications and offers great prospects for HRIs. It enables the employee to perform as if they were in a remote work setting. It is shown in Fig.1. [3].

*A. Future Work*

To improve the precision and realism of overlaying or blocking virtual components, future research must handle noisy real-time monitoring. We'll investigate methods to lessen noise and increase tracking accuracy in order to accomplish more seamless virtual element integration.

## III. ROLE OF HUMANOID ROBOTS IN ENHANCING COMMUNICATION AND SOCIAL SKILLS AMONG AUTISM STUDENTS

Autism is a neurological condition that impairs a person's mental, social, and communication skills. Because of this, it is challenging for them to express themselves and fit in with society at large. Researchers and caregivers worldwide are trying to find a teaching method to aid in the therapy and education of autistic children as the number of autism cases continues to rise. The difficulty of finding such a teaching strategy stems from the sheer amount of resources and experience needed for this process. Children with Autism Spectrum Disorder (ASD) are increasingly using robotics technology as an educational and intervention tool. Numerous therapies aimed at enhancing daily living skills and cognitive functioning, boosting community interaction and engagement, and attempting to lessen symptoms have been created for children diagnosed with ASD. Assistive technology has been utilized, for instance, in therapy sessions. The social need for technology advancements that can complement and enhance the current treatments for the growing number of autistic children is what motivates this initiative. In recent times, robots have been employed in several assistive settings, including fulfilling diverse human requirements and aiding in the recovery of those diagnosed with ASD. The social abilities of children with ASD may benefit from the clinical application of social or interactive robots. The key analysis of the research is Students with ASD experienced less anxiety and sensory overload when humanoids were used in the classroom. Children are better able to accept and learn from robots when humanoids behave consistently and repeatedly repeat instructions. Figure 2 illustrates some of the difficulties associated with robot engagement with children with ASD based on four factors that may affect robotics-based learning therapies [4].

*A. Robots assisting autistic children in learning*

Socially assistive robots are a novel technology that has entered the field of autism therapy research throughout the past 20 years or more. These robots are made to aid with the social, emotional, communicative, and cognitive development of kids with autism. The objective is to enhance the involvement of children with autism by utilizing robots as embodied forms of technology that offer a high degree of simplicity, exaggeration, consistency, and predictability, while still enabling social interaction.

The robot occupies a space between the technological and social human realms as a technological being with a social existence. Children can practice new abilities in a way that is less complicated and dynamic and more akin to interacting with a human when they use a robot. In this instance, it is easier for a youngster to learn skills that they can use in their daily lives when they engage with a robot. Figure 3. Shows Six categories can be used to classify the effects of social robots on autistic children based on research:

- *Improve engagement*

Improvements in involvement and attention are the first effects of robots on children with autism, according to scientific research and real-world applications of robots in homes and schools. More than ten studies demonstrate that while working with robots, autistic youngsters engage more fully and maintain their gaze longer than when dealing with a human caregiver. At first, the robots pique people's interest and cause them to become engaged. Over an extended period, children's involvement is enhanced by the robot's predictable and consistent behavior, as well as its lack of social judgment or demands.

- *Decreased Agitation and Disruptiveness*

Children with autism often experience anxiety due to the unpredictable nature of social contact and the uncertainty of what lies ahead. Children with autism may react to this worry by becoming more stereotyped in their behavior, stimming, or by attempting to avoid the situation that is causing them distress. According to research, children exhibit fewer stereotyped behaviors during instructional sessions when they interact with a social robot than when they undertake the same activity with a human partner. Additionally, while they are learning from a robot, they are able to maintain the interaction for a longer amount of time.

- *Enhanced collaboration with human partners during learning sessions*

Learning requires paying close attention together with a learning partner. Practice of the abilities intended for everyday social interactions requires joint attention with a human partner. Numerous studies show that including a robot into a kid's education can help the youngster and the human caregiver engage in joint attention by acting as a mediator. The child, the human caregiver, and the robots themselves can engage in cooperative and triangular learning interactions. In this manner, the robot helps with learning in a way that may be applied to interactions between people.

- *Improved collaboration and motivation*

Children with autism who interact with robots are frequently very driven to react. The children respond quite well to the robot's reinforcements as well. As a result, we frequently observe a greater drive to learn and give accurate answers in order to receive reinforcement from the robot. Furthermore, compared to human caretakers, many youngsters are more willing to work on difficult subjects when working with robots.

- *Improved access to special needs education and frequent practice*

To acquire new abilities, a lot of kids with autism and special needs schooling need to practice them frequently. To see real growth and results, classes should often be repeated based on the needs of each individual student. Nonetheless, children would frequently not have enough opportunities to practice in an organized and evidence-based manner due to the lack of autism specialists. That's why extended stretches of time between practice opportunities sometimes result in slower growth. Technology has the ability to replicate content in large quantities. Once an autistic robot has been trained by a specialist in the field, it can consistently provide the same kind of sessions. Children will be able to practice frequently and consistently with an autistic robot at home, which will have a direct impact on their growth and progress. Moreover, a robot is never weary, angry, or demoralized. The robot always answers with the same enthusiastic and steady attitude. For kids on the autistic spectrum who become easily distracted by change, this makes regular practice more enticing.

- *Improved educational outcome*

All of the aforementioned factors have an impact on the better educational results that arise from utilizing robots in special needs schooling and assisting autistic youngsters.

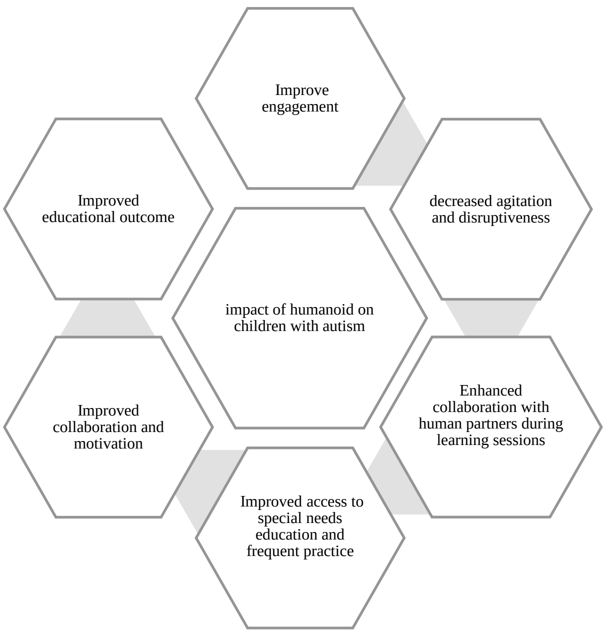


Fig.2.Effects of social robots on autistic children based on research.

- *QTrobot for autism and education for exceptional needs*

A little humanoid robot called QTrobot was created as a teaching aid for students with special needs. QTrobot features exaggerated, basic, and understandable facial expressions. This will make it easier for autistic students to comprehend the robot's feelings and provide them with encouraging feedback when the robot is satisfied with their responses.

QTrobot can practice numerous critical social and emotional skills because of its humanoid physique. For instance, how to take turns, maintain appropriate personal space, and be aware of nonverbal clues during a conversation. Hundreds of instructional units centered upon play-based learning are included with QTrobot. QTrobot focuses on teaching structured, age-appropriate skills. To illustrate, QTrobot engages with kids by playing games, telling tales, and playing a variety of amusing personas that are always scaled to the child's ability. The QTrobot lessons and activities are created using evidence-based techniques. Prompting, error correction, social narratives, social skills training, and visual help and modeling are a few of these.

*B. Future scope*

Further study is needed for long-term clinical evaluations with our clinical collaborators, as well as more sophisticated reinforcement learning algorithms and deep learning frameworks. Long-term interaction and longitudinal analysis are very significant themes in HRI, especially for the robots to work more successfully "in-the-wild."

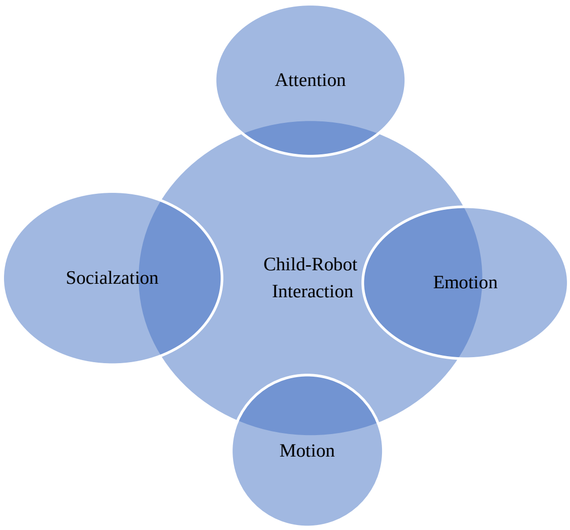


Fig.3. Characteristics of child-robot interaction

## IV. LEARNING WITH EDUCATIONAL ROBOTICS

Robotics is a young discipline in education that blends science, engineering, math, and technology to offer a useful and interesting way to learn. This area encourages a deeper comprehension of subjects by giving students the chance to put classroom abilities to use in a practical situation. Robots can be used in a variety of subjects, grade levels, and school orders based on the needs and age of the kids. They can assist them in learning mathematics, one or more languages, social and interpersonal skills, and sophisticated computer science ideas in a more dynamic and interesting way. Robotics in education has several advantages. It first makes learning enjoyable and engaging. Because technology and robots naturally draw students, incorporating robotics into the classroom can boost student enthusiasm and interest in the subject matter. Secondly, it encourages hands-on learning. Students actively participate in the learning process rather than just being bystanders. They can plan, design, and construct their robots to carry out specific tasks; they must solve problems in order to construct or program a robot; they must think critically in order to comprehend how the robot is to function; and they must cooperate in order to work in groups and communicate in order to share ideas. All of these tasks necessitate the development of soft skills, which are essential for success in the workplace, in the classroom, and in personal and professional spheres. In comparison to their industrial or service counterparts, educational robots are specifically made for educational purposes. These robots are made specifically to be controlled safely, even by very young children, which makes learning entertaining and educational. Several salient characteristics define them:

*Advanced sensorization:* A range of sensors, including as proximity, touch, sound, light, and acceleration sensors, are built into educational robots. These sensors create new opportunities for interactive learning by enabling robots to sense their surroundings and respond appropriately to outside inputs.

*Variations in shape:* Educational robots can be anything from simple wheeled vehicles to intricate creatures like insects, animals, or humanoids. Students can investigate and comprehend design and engineering topics through practical application with this range.

*Programmability:*Students can use procedural or event-based programming languages to program these robots. Through this procedure, students can specify how the robot will react to different stimuli. By making the process of writing syntactically sound programs easier, visual programming languages like Blockly and Scratch let students concentrate on reasoning and computational thinking.

*Accessibility for all ages:* Certain instructional robots are appropriate for pupils in elementary school or younger. These resources provide a steady on-ramp to engineering and programming, tailored to various skill levels and age groups.

*Push-button programmable robots:* Certain robots, like Blue-Bot and Bee-Bot, have buttons on their chassis that they can press to program them. For younger children, these systems offer a hands-on experience that helps them understand the idea of command sequences.

*Modular Robotics:*Students can construct robots in a modular fashion by connecting and assembling different parts using systems like littleBits and Cubelets. Exploration-based learning and creativity are encouraged by this method.

*Use of Arduino and Raspberry Pi boards:*Using Arduino or Raspberry Pi development boards, robots are built as part of several educational programs. Even though these projects are more technical, there are many opportunities for advanced learning.

The European project L2TOR has built a robot that functions as a tutor in softback robotics. They work with students to teach them languages other than English. Children's humanoid robots are being developed to teach them broad sciences, nutrition, storytelling, and spelling. These robots work with human educators. A biorobo robot serves as a teaching tool by connecting to the human body. This robot employs VSMF techniques, such as data sorting and efficient robot operation [5].

### *A. Future Work*

Future research will focus on handling spoken conversations that are more complicated and need a greater range of movements from the robot. Furthermore, research will concentrate on improving the robot's capacity for emotion recognition and efficient long-speech processing.

## V. Humanoid Nurse Robots

Artificially intelligent nurse robots can demonstrate empathy through highly communicative expressions. It will serve as a crucial model for the sentient human being. Nurse robots are currently developing robots for the healthcare sector. Helping patients is the primary duty of certain nursing robots. An experimental nursing robot named ROBEAR was created in Japan by RIKEN and Sumitomo Riko Company Limited. It can assist patients in getting up from a bed and into a wheelchair. Another well-known robot that may be found in hospitals across the globe is called Pepper. This robot was developed by the Japanese company SoftBank Robotics to help with tasks like patient guidance, direction-giving, basic question-answering, and emotional support. Its affectionate and expressive demeanor is intended to engage and welcome patients [6,7].

*A. Future Scope*

Future research will concentrate on making sure Pepper is used appropriately, including safe environmental navigation and the security of people with medical issues. Protocols for tailoring Pepper to each person's requirements, history, abilities, cognitive state, and preferences will also be created and assessed.

## VI. HUMANOID IN SEARCH AND RESCUE (SAR) OPERATIONS

The population density increases rapidly every year, particularly in urban areas. As a result, people are severely and significantly impacted by disasters (such as war, earthquakes, fires, and tsunamis). Human-robot Search and Rescue (SAR) operations will soon be part of helping the affected population. Therefore, in order to save lives, it is imperative that modern technology—such as robotics and cognitive approaches—be integrated with SAR.Recently, there have been efforts to incorporate the futuristic robot and cognitive technologies for SAR operations. These include potential robot designs and concepts, as well as techniques of evaluation in benchmarks for rescue robotics. The Fukushima nuclear accident in 2011 and the Mexico earthquake tragedy in 2017 are two instances of this type of incident. During the emergency response phase, actions are performed to save lives and stop additional harm to individuals. Reaction phase operations consist of the following steps: 1. assessment and search; 2. targeted search; 3. localization and identification; and 4. support. As mentioned in the National SAR Manual, these phases may overlap or differ depending on the kind of emergency, the surrounding conditions, and the resources that are available. Level1: Teleoperation, Level2: Semi-Autonomous, and Level3: Fully-Autonomous are the three stages of automation for the robotic technology used in the response process [8].

A. Future Work

The goal of future research and development in the SAR industry will be to better build an ecosystem that is more responsive and resilient. To improve SAR capabilities and provide greater help for those affected by disasters around the world, innovation is being driven.

## VII. HUMANOID IN CUSTOMER SERVICE

Artificial Intelligence (AI) has gained popularity recently in a number of domains and industries, including customer service. The Human-Robot Collaboration (HRC) area has seen a great deal of use of artificial intelligence, as robots are employed to help humans with a variety of jobs. AI has made tremendous strides as a cooperative tool in job execution in the service sector, with the potential to completely change how businesses offer their clients services.

Human-human relationships (HHR) are under the first level, and relationships between humans and robots are covered by the second level. Sub-levels such as Human-Robot Interaction and Collaboration (HRI-C), Human-Robot Collaboration (HRC), and HRI arise within the latter. In addition, three sub-levels are recognized as part of the third level, which is called Multirobot Systems (MRS) and consists of RobotRobot Interaction (RRI), Robot-Robot Collaboration (RRC), and RobotRobot Interaction and Collaboration (RRI-C). This paradigm contributes to a thorough comprehension of the various interactions and teamwork that occur in the dynamic setting of the service sector between humans and robots [9].

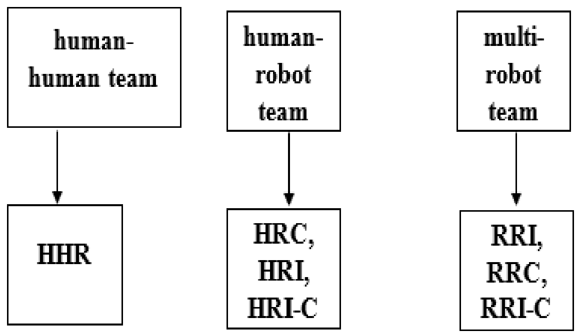


Fig.4. Conceptual framework for relationships between humans, robots, and many robots in the context of the service sector.

*A. Future work*

Future research should investigate how cultural variations affect the dynamics of human-robot interactions in service-related businesses through cross-cultural studies.

Furthermore, in order to crack the short- to medium-term viewpoint constraint, longitudinal research is advised. Over a long period of time, these studies would monitor the growth of relationships between humans and robots, recording shifts in technology and society perspectives.

## VIII. MILITARY HUMANOID

The usage of military robots in the air, land, sea, and cyberspace is growing. A growing number of them are being downsized and assembled into swarms that are managed by a single human operator. Some are modeled after animals. Experts believe that while various scenarios exist for robotic warfare in the future, the most likely one is that robotic devices would function as cobots to assist human soldiers in their tasks rather than taking their place [10].

*A. Future scope*

Future wearable robots will need to be able to assist users precisely when they need it without interfering with their ability to complete other duties, especially in combat situations.

## IX. HUMANOID ROBOTS IN AGRICULTURE

With an emphasis on agriculture, the development of robotic systems is expected to help end hunger and malnutrition in a sustainable way by protecting and replenishing natural resources and ecosystems. As a natural progression of precision agriculture, Agriculture 4.0 is thought to include robots as a fundamental component that allows farmers to apply the least amount necessary for a given region. Agri-robots are part of the large family of Information and Communications Technologies (ICT) that are necessary for the fourth agricultural revolution. These technologies include but are not limited to, cloud computing, big data, artificial intelligence, wireless sensor networks, farm management information systems, and cloud computing. A humanoid is a machine that perceives its surroundings, interprets the data from sensors, and issues a computer command in response. These are artificially created mechanical devices with autonomous motion that require programming to sense, plan, model, actuate, and control. It won't complain when doing its job or functions day or night. Although they never get weary, robots can nevertheless Flaw if maintenance is not done correctly. The logical expansion of automation technology into bio-systems like horticulture, forestry, greenhouses, and agriculture is known as agricultural robotics [11].

*A. Future work*

To assess the significant use and effectiveness of robotic technology advancements in agricultural systems and to determine their potential advantages and economic relevance, feasibility studies must be conducted. It would be beneficial to establish a long-term national policy that would provide guidance on robotics use in agriculture.

## X. CONCLUSION

Humanoid robots are used in several branches, including space exploration, healthcare, knowledge acquisition, and social work. The analysis examined HRI for Robot Programming, humanoid robots for autism students, Educational Humanoids, Humanoid Nurse Robots, Humanoid in SAR, Humanoid in Customer Service, Defense robot, andHumanoid robots in Agriculture.

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