American Journal of Electronics & Communication

Soumyadeep Pal et. al., American Journal of Electronics & Communication, Vol. IV (4), 1-8

DEVELOPMENT OF ASSISTIVE HUMANOID ROBOT

Soumayadeep Pal[1], Avrajeet Ghosh[1]

[1]B. Tech Student, Department of Electronics and Instrumentation Engineering

Rupsa Bhattacharya[2], Atreyee Saha[2], Ankit Kar[2]

[2]B. Tech Student, Department of Electronics and Computer science

Susmita Das[3]

[3]Assistant Professor, Department of Electronics and Instrumentation Engineering 81, Nilgunj Road, Jagrata Pally, Deshopriyo Nagar, Agarparā, Kolkata, West Bengal 700109

*{*Email – susmitad2k17@gmail.com}*

Abstract – A dream of humanoid robot researchers is to develop a complete "human-like" (whatever that means) artificial agent both in terms of body and brain. It represents a significant breakthrough in the field of robotics, aiming to mimic and replicate human-like characteristics and functionalities. On the other hand, brain research has begun to produce computational models such as LIDA. In this paper, we propose an intermediate approach for body-brain integration in a form of a scenario-based distributed system. Busy hospital Emergency Departments (ED) are concerned with shortening the waiting times of patients, with relieving overburdened triage team physicians, nurses and medics, and with reducing the number of mistakes. It enhances the learning experience through interactive tutoring and educational support. Humanoid robotics can collaborate with human workers in industrial settings and serve as receptionists, guides and assistants in public spaces. Advances in humanoid robotic design, in sensor technology, and in cognitive control architectures make such a system feasible, at least in principle. As technology advances, these robots are poised to play an increasingly prominent role in various aspects of our lives, from healthcare and education to entertainment and industry. However, addressing challenges related to cost, safety, and ethics will be essential to unlocking their full potential.

Keywords – humanoid, human-like, technology, healthcare, industrial.

1.0 INTRODUCTION

Ever since the dawn of civilization, we as humans have been fascinated with machines and devices that can replicate aspects of biology, in particular of ourselves. Some are created for our entertainment, some to facilitate us in our daily lives, and historically speaking some were even created for imitating the power of gods (religious relics). The themes of these developments have gone in and out of trends in various forms, but the most fundamental issues were to explore points toward the eventuation of robotics as we know it today.

Humanoid may be defined as something that resembles or looks like a human being and has certain human characteristics like it has a similar shape as that of a human body. In general, a humanoid robot has a torso, a head, two arms, and two legs, and are categorized as male humanoids and female humanoids [1]. These robots are designed to simulate human-like appearance, movement, and behaviour, and they represent a fusion of mechanical engineering, artificial intelligence, and cognitive science. But in some applications, partial body parts are designed to perform specific work or research, such as only the lower part of the body to perform research operations on the gait of the robot [2]. These have the complex structure and design when compared with other robots, so more and more attention is drawn in this area to improve the design and control parameters of humanoids [3-5]. The humanoid robot can mimic the human expressions with eyes and mouth either by using mechanisms or display screen to express the gestures [6]. Apart from the research in this field, humanoids are being developed to use as an assistant robot and also to perform dirty and dangerous tasks. Applications of humanoid robots are well established in the field of Health care Defence, Education, and Entertainment.

2.0 OBJECTIVES

The objective of a humanoid robot is to develop a machine that can mimic or replicate human-like physical characteristics and behaviour and coexist and collaborate with humans in a manner that is safe, efficient, and beneficial to society.

Here are some common objectives associated with humanoid robots:

Human-Like Appearance: One of the primary objectives of humanoid robots is to mimic the human form. They are designed to have a head, torso, arms, and legs, resembling the physical structure of a human being. This allows them to interact with humans in a more natural and intuitive manner.

Humanoid Interaction: Humanoid robots aim to facilitate seamless interaction with humans. They are equipped with sensors and actuators that enable them to perceive and interpret human gestures, speech, and expressions. By understanding and responding to human cues, they can engage in effective communication and collaboration.

Task Automation: Humanoid robots can be programmed to perform a wide range of tasks, both complex and repetitive. They can be used in industries such as manufacturing, healthcare, and logistics, where they can take over tasks that are dangerous, physically demanding, or require high precision. By automating repetitive or physically demanding tasks, they enhance productivity and improve quality of life.

Research and Development Platform: Humanoid robots serve as valuable research platforms for studying human locomotion, cognition, and interaction. By mimicking human capabilities, they allow scientists and engineers to explore and understand human

behaviours in a controlled environment. This knowledge can further drive advancements in robotics and artificial intelligence.

Personal Assistance: Humanoid robots can assist individuals with disabilities or elderly people in their daily activities. They can help with tasks like fetching objects, providing reminders, monitoring vital signs, or offering companionship and emotional support.

Industrial and Manufacturing Assistance: In industrial settings, humanoid robots may assist in tasks that require precision and dexterity, such as assembly, quality control, and material handling.

Education and Entertainment: Humanoid robots can be used in educational settings to engage students in STEM (science, technology, engineering, mathematics) subjects or provide personalized tutoring. They can also be employed in entertainment industries, such as theme parks or museums, to entertain and engage visitors.

Versatile Mobility: Humanoid robots are designed to move and navigate in environments designed for humans. They possess the capability to walk, run, climb stairs, and even perform complex movements. This mobility allows them to operate in various settings, such as homes, offices, hospitals, and disaster stricken areas.

Social and Emotional Interaction: Humanoid robots aim to establish emotional connections with humans. Through advanced algorithms and artificial intelligence, they can recognize and respond to emotions, engage in empathetic conversations, and provide companionship. This aspect of human-robot interaction holds promise for applications in healthcare, therapy, and education.

3.0 METHODOLOGY

Technological Advancement: The development of humanoid robots pushes the boundaries of robotics and AI technologies. By addressing challenges related to balance, dexterity, and perception, researchers strive to enhance the capabilities of humanoid robots. This leads to breakthroughs in robotics, such as improved sensor technologies, advanced control algorithms, and more robust machine learning techniques.

Safety: Ensuring the safety of both the robot and humans is a primary objective. Humanoid robots must be equipped with mechanisms and sensors to avoid collisions, mitigate potential hazards, and protect users from harm. Besides that, it has been proposed for use in exploration missions to other planets or disaster response scenarios, where they can navigate complex environments and perform tasks that are challenging for human.

Overall, the objective of humanoid robots is to create versatile and interactive machines that resemble and interact with humans, aiming to assist in various tasks, foster social connections, and advance the field of robotics and artificial intelligence.

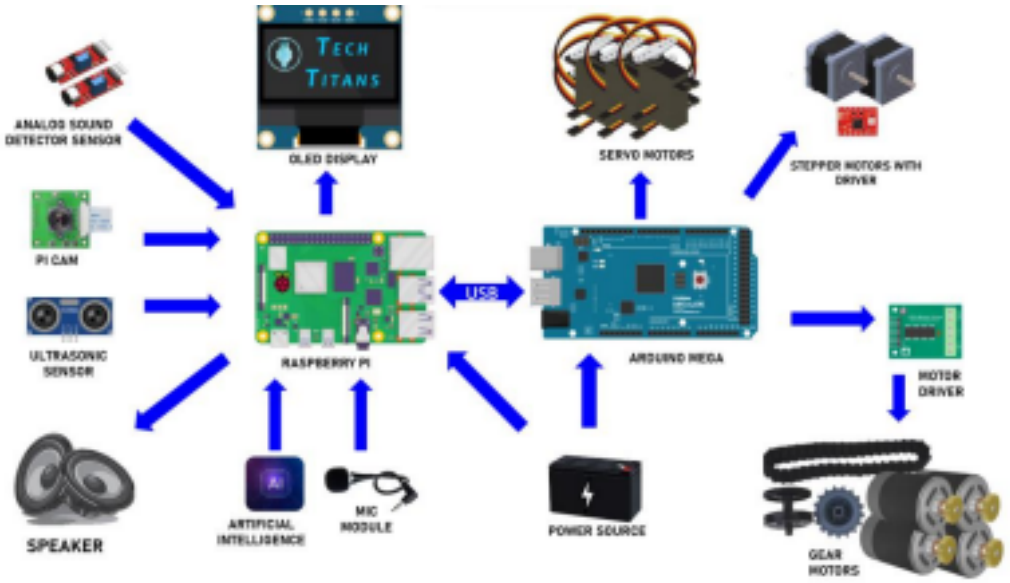

Fig.1: Schematic Diagram

Fig.2: Flowchart of the work

Our total system is dividing in two parts. At first there is a microprocessor which is controlled the microcontroller. A mic and a speaker are connected with the microprocessor which is used to answer the basic question.

In the second, using the mic all the instructions process in the microprocessor and control the microcontroller to move the body parts according to the instructions. All the motors are connected with the microcontroller and according to the used instructions the motors rotate to change the location of the system and to carry any heavy loaded things.

The development and methodology behind humanoid robots involve a combination of engineering, robotics, and artificial intelligence (AI) techniques. Here's an overview of the typical methodology used

in creating humanoid robots:

Purpose: Determine the specific tasks and functions the humanoid robot should be capable of performing. This could range from simple actions like walking and grasping objects to more complex tasks such as interacting with humans or performing specific jobs.

Design and Mechanical Engineering: Design the physical structure of the humanoid robot, considering factors like size, weight, range of motion, stability, and durability. Mechanical engineering principles are applied to create joints, limbs, and overall body structure that mimic human capabilities.

Sensing and Perception: Incorporate sensors and perception systems into the robot to enable it to perceive and understand its environment. Common sensors include cameras, depth sensors, touch sensors, and force/torque sensors. These sensors provide data that helps the robot understand the surrounding world and react accordingly.

Actuation and Motion Control: Implement actuators and motion control systems to enable the robot's movements. Electric motors, hydraulic systems, or pneumatic systems may be used to control the joints and limbs of the humanoid robot. Sophisticated algorithms are employed to ensure smooth and coordinated motion.

Artificial Intelligence and Control Systems: Develop AI algorithms and control systems to enable the robot to process sensor data, make decisions, and execute tasks. Machine learning techniques, such as reinforcement learning or deep learning, can be used to train the robot's AI systems. These algorithms enable the robot to learn from its interactions with the environment and improve its performance over time.

Human-Robot Interaction: Design the interface and communication methods for the humanoid robot to interact with humans effectively. This may involve natural language processing, gesture recognition, facial expression analysis, or other means of communication.

Safety and Ethical Considerations: Ensure that the robot is designed with safety measures to prevent accidents or harm to humans. Implement fail-safe mechanisms, collision detection, and emergency shutdown procedures. Ethical considerations, such as privacy, consent, and accountability, should also be taken into account.

Testing and Iteration: Conduct rigorous testing to validate the robot's performance, reliability, and safety. Iteratively refine and improve the design based on testing results and user feedback.

Deployment and Real-World Application: Once the robot passes all necessary tests and meets the desired requirements, it can be deployed for real-world applications. This could include use in industries, healthcare, research, or even personal assistance.

It's important to note that the methodology may vary depending on the specific goals, constraints, and resources available for developing a humanoid robot. Various research

institutions and companies employ different approaches and techniques to achieve their objectives.

4.0 CONCLUSION

In this dynamic and rapidly evolving field, the possibilities for humanoid robots are limited only by our imagination and technological advancements. As we navigate the complex terrain of robotics ethics, safety, and societal integration, it is essential to approach the development and deployment of humanoid robots with careful consideration and responsibility.

Humanoid robotics represents not only a testament to human ingenuity but also a testament to our enduring desire to push the boundaries of what is possible. As these robots continue to evolve, their potential to enhance our lives, drive economic growth, and transform industries is undeniable. The journey of humanoid robots is far from over, and the path ahead promises to be one of continued innovation, discovery, and collaboration.

5.0 APPLICATIONS

Humanoid robotics systems have a wide range of applications across various fields due to their versatile ability. Here are some notable applications of humanoid robotics systems:

I. Healthcare:

- **Assisting Patients:** Humanoid robots can assist patients with mobility issues by helping them stand up, walk, or transfer between beds and wheelchairs.
- **Rehabilitation:** They can aid in physical therapy by guiding patients through exercises and monitoring their progress.
- **Mental Health Support:** Some humanoid robots are designed to provide companionship and emotional support to patients, particularly those in long-term care facilities.

II. Education:

- **Personalized Tutoring:** Humanoid robotics systems can serve as interactive tutors, providing personalized lessons and feedback to students.
- **Language Learning:** They can help individuals learn new languages through conversation and language exercises.
- **STEM Education:** In STEM (science, technology, engineering, mathematics) fields, humanoid robots can engage students in hands-on learning experiences and experiments.

III. Customer Service:

- **Front Desk and Concierge Services:** Humanoid robots can work as receptionists or concierges in hotels, offices, and other public spaces.
- **Information and Assistance:** They can provide information about products, services, and directions, improving customer service and reducing wait times.

IV. Entertainment:

- **Theme Parks:** Humanoid robots are used in theme park attractions, providing interactive and entertaining experiences for visitors.
- **Performing Arts:** They can perform in theatres, dance performances, and live shows, bringing characters to life with human-like movements and expressions.

V. Manufacturing and Industry:

- **Collaborative Manufacturing:** Humanoid robotics systems can collaborate with human workers on assembly lines, handling tasks that require dexterity and precision. • **Quality**

Control: They can be used for quality inspection and testing of products in manufacturing environments.

• **Logistics:** They can also be used in logistics to transport goods and materials. **VI. Research and Development:**

• **Human-Robot Interaction Studies:** Researchers use humanoid robotics systems as platforms to study human-robot interaction, cognitive science, and artificial intelligence. • **Innovation:** Robotics researchers and engineers utilize humanoid robots to push the boundaries of robotics technology, leading to advancements in the field.

VII. Search and Rescue:

Disaster Response: Humanoid robots can navigate through disaster-stricken areas, assess damage, locate survivors, and provide support when human access is limited or unsafe.

VIII. Retail and Hospitality:

Inventory Management: In retail, humanoid robotics systems can assist with inventory management by scanning shelves for stock levels and discrepancies.

Room Service: In hotels, they can deliver items to guest rooms, improving efficiency and convenience.

be used as teaching assistants, providing instruction in military and industrial training, simulating real-world scenarios.

III. **Hazardous environments:** Humanoid robots can be used in hazardous environments, such as nuclear power plants and oil rigs, where it is too dangerous for humans to work. They can also be used in search and rescue operations.

IV. **Space exploration:** Humanoid robots can be used to explore space, where they can perform tasks that are too dangerous or difficult for humans. They can also be used to build and maintain space stations.

6.0 FUTURE SCOPES

The future scope of humanoid robots is vast and promising. They are expected to play a major role in many different industries and aspects of our lives.

I. **Companionship and caretaking:** Humanoid robots can be used as companions for the elderly and disabled, providing them with companionship and assistance with daily tasks. They can also be used as nurses and doctors, performing routine tasks and providing emotional support.

II. **Training assistant:** Humanoid robots can

References:

1. Ambrose RO, Savely RT, Goza SM, Strawser P, Diftler MA, Spain I, and Radford N (2004). Mobile manipulation using NASA's robonaut. In the IEEE International Conference on Robotics and Automation (ICRA '04), IEEE, New Orleans, USA, 2: 2104-2109. https://doi.org/10.1109/ROBOT.2004.1308134

2. Asfour T, Regenstein K, Azad P, Schroder J, Bierbaum A, Vahrenkamp N, and Dillmann R (2006). ARMAR-III: An integrated humanoid platform for

sensory-motor control. In the 6th IEEE-RAS International Conference on Humanoid Robots, IEEE: 169-175. https://doi.org/10.1109/ICHR.2006.321380

3. Behnke S (2008). Humanoid robots-from fiction to reality?. In the Künstliche Intelligenz Heft, 4, 5–9. Available online at: https://www.ais.unibonn.de/papers/KI08_Behnke.pdf

4. Bluethmann W, Ambrose R, Diftler M, Askew S, Huber E, Goza M, and Magruder D (2003). Robonaut: A robot designed to work with humans in space. Autonomous Robots, 14(2): 179-197.

5. Butterfass J, Grebenstein M, Liu H, and Hirzinger G (2001). DLR-Hand II: Next generation of a dextrous robot hand. In the IEEE International Conference on Robotics and Automation (ICRA), IEEE, Seoul, South Korea, 1: 109-114. https://doi.org/10.1109/ROBOT.2001.932538

6. Calinon S and Billard A (2007). Incremental learning of gestures by imitation in a humanoid robot. In the 2nd ACM/IEEE International Conference on Human-Robot Interaction (HRI), IEEE: 255-262. https://doi.org/10.1145/1228716.1228751

7. Chestnutt J, Michel P, Kuffner J, and Kanade T (2007). Locomotion among dynamic obstacles for the Honda Asimo. In the IEEE/RSJ International Conference on Intelligent

8. Robots and Systems (IROS), IEEE, 2572-2573. https://doi.org/10.1109/IROS.2007.4399431

9. Chua PY, Caldwell DG, Bezdicek M, Gray JO, and Davis S (2006). Tele-operated high speed anthropomorphic dextrous hands with object shape and texture identification. In the IEEE/RSJ International Conference on Intelligent Robots and Systems, IEEE, Beijing, China: 4018-4023. https://doi.org/10.1109/IROS.2006.281861

10. Collins S, Ruina A, Tedrake R, and Wisse M (2005). Efficient bipedal robots based on passive-dynamic walkers. Science, 307(5712): 1082-1085.

11. Cypher A and Halbert DC (1993). Watch what I do: programming by demonstration, MIT press, Cambridge, UK.

12. Dahiya RS, Valle M, and Metta G (2008). System approach: A paradigm for robotic tactile sensing. In the 10th IEEE International Workshop on Advanced Motion Control (AMC '08), IEEE: