Assistive Robot for Elderly Care and Disabled People

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Abstract. Robots are better equipped to communicate through movement than through spoken language. Herein we propose a method of specifications of tasks for disabled people in terms of robotics service. This helps to implement an automatically working system that will replace the efforts of human so disabled people could afford their activities on their own. Our assistive robot finds all end users to be determined about the situations that they can do things on their own without other human interference. The proposed module depends on different phases with an economically reasonable solution that is implemented as a semi-autonomous control system. The user interface incorporates several functions that include navigation of the robot, target selection for picking and placing an object, obstacle detection and self-following assistive robot. This method evaluates the usability of end-users and gets to know about the user's interaction and awareness. Assistive robot ensures that no environmental assessments were affected and makes sure of this robot being user-friendly.

Keywords: Assistive Robotics, Elderly Care, Disabled Support Systems, Human–Robot Interaction, Raspberry Pi, Sensors, Automation, Embedded Systems.

1 INTRODUCTION

In recent years, assistive robotics has gained significant attention in healthcare and elderly care applications due to its potential to enhance independence and quality of life. Socially assistive robots are increasingly being used to support individuals with cognitive impairments, mobility limitations, and age-related challenges, enabling them to perform daily activities with minimal human assistance [1], [2]. Studies have shown that such robots can improve emotional well-being, reduce loneliness, and assist in rehabilitation and therapy processes [4], [9]. Furthermore, advancements in artificial intelligence, sensor technologies, and human–robot interaction have enabled the development of intelligent systems capable of adapting to user needs and environments [6], [33]. These developments highlight the growing importance of assistive robotic systems in modern healthcare and smart living environments.

A key research area in robotics is Human–Robot Interaction (HRI), which studies how machines behave around humans in real-world environments [6], [17].

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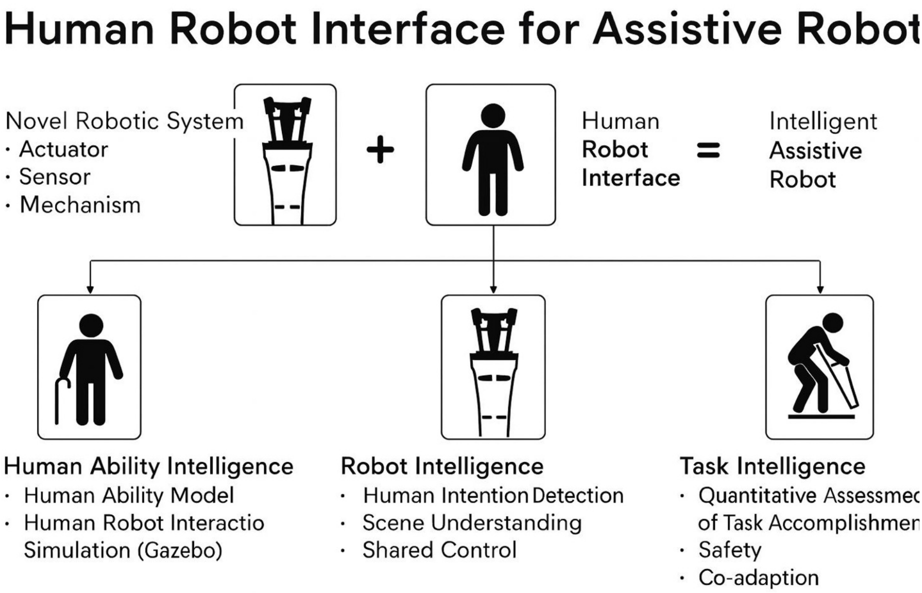


The Overall System Architecture of the proposed assistive Robot is shown in Fig. 1

2 METHODOLOGY

The proposed assistive robot system is designed using multiple interconnected modules responsible for sensing, pro- cessing, communication, and actuation [3], [5].

3 ELEMENTS

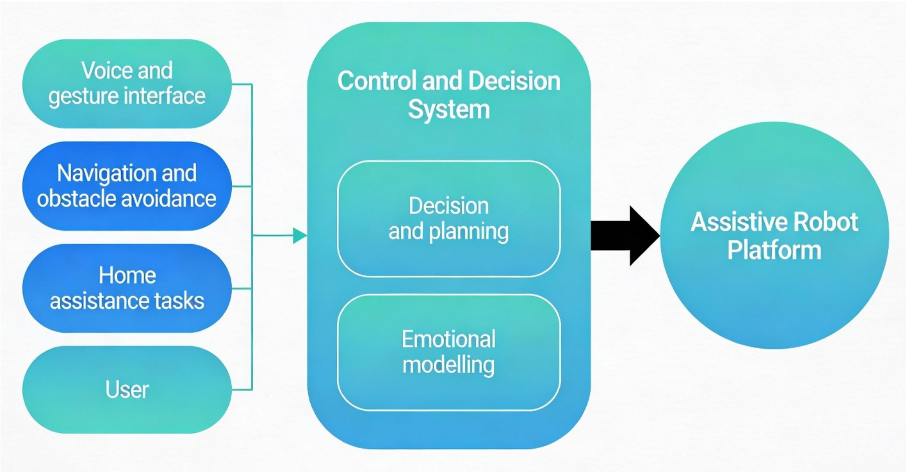
The proposed assistive robot system consists of integrated hardware and software components that enable sensing, processing, communication, and actuation. The Raspberry Pi 4 acts as the central controller, while microcontrollers such as ESP32 and ESP8266 handle wireless communication and real-time control tasks. Sensors including ultrasonic sensors and camera modules are used for obstacle detection and visual recognition, whereas actuators such as motors and motor drivers enable movement and task execution. The system is supported by algorithms for navigation, human–robot interaction, and voice control, ensuring efficient and user-friendly operation [3], [5], [29].

3.1 Boards

1. **Raspberry Pi 4:** The Raspberry Pi 4 serves as the primary controller.
2. **ESP32:** The ESP32 microcontroller handles wireless tasks.
3. **ESP8266:** The ESP8266 is used for extra wireless communication.

3.2 Actuators and Sensors

1. **Magnetometer:** The magnetometer detects magnetic fields.
2. **Camera Module:** Used for facial recognition and video.
3. **Ultrasonic Sensor:** The ultrasonic sensor detects obsta- cles.
4. **L298N Motor Driver:** Controls the motors.
5. **Speaker**: Speakers provide audio output.



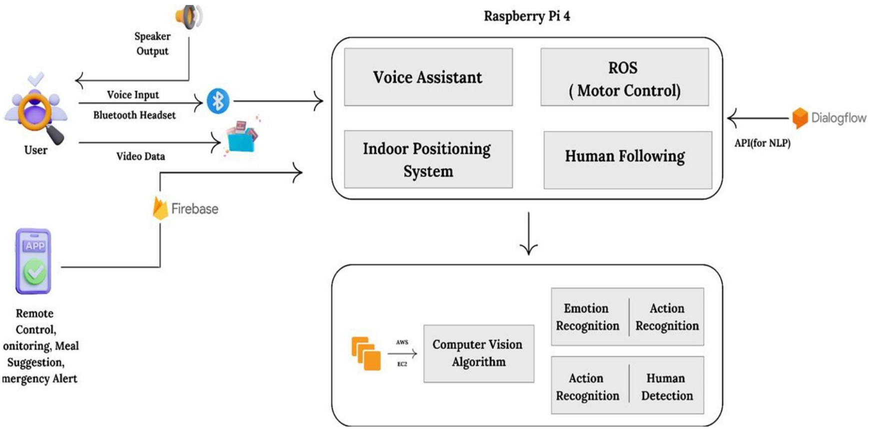
The System Block Diagram is illustrated in Fig. 2.

The diagram illustrates the high-level architecture of an intelligent assistive robot system designed to interact naturally with users and perform autonomous tasks. The system is divided into three major functional layers: User Interaction, Control and Decision System, and the Assistive Robot Platform. Overall, the system block diagram illustrates a modular and scalable design that integrates sensing, processing, communication, and actuation to deliver a reliable and user-friendly assistive robotic platform.

4 MODULES AND WORKING PRINCIPLE

4.1 Collision Avoidance

The ultrasonic sensor continuously scans for nearby ob- stacles. When a n object is detected within a critical range, the robot reduces speed, stops, o r changes direction to avoid collisions.



The complete system architecture is depicted in Fig. 3.

The diagram represents the complete architecture of an intelligent assistive robot system built around a Raspberry Pi 4 as the central processing unit. The system integrates voice interaction, computer vision, cloud services, and mobile applications to provide real-time assistance and monitoring

4.2 Line Following

Line-following sensors detect predefined tracks or path- ways. The robot adjusts its wheel movement to maintain alignment with the line, enabling autonomous navigation.

4.3 Human Following

Using sensing and tracking algorithms, the robot identifies a moving person and adjusts its movement to follow them accurately

4.4 Facial Recognition

The camera captures the user's face and compares it with pre-stored data. If a match is found, the robot grants access or initiates personalized functions.

4.5 Voice Control

Bluetooth-based voice commands from a mobile device allow the user to control the robot hands-free. The ESP32 processes these commands and forwards the corresponding instructions to the controller.

4.6 Gesture Control

A transmitter–receiver setup captures specific hand gestures. These gestures are translated into directional or functional commands for robot movement.

5 RESULTS AND DISCUSSION

Assistive robots have the potential to significantly improve the daily lives of individuals with mobility challenges or age- related limitations.

As society becomes increasingly dependent on automation, such robots offer safe and reliable support. This project integrates multiple technologies—ranging from sensing and wireless communication to machine learning and control systems—to create a functional assistive solution capable of operating in real environments [25], [36].

6 FUTURE SCOPE

In the future, the system can be expanded to develop a semi-humanoid robot capable of performing advanced tasks. Improvements in artificial intelligence, sensor fusion, and adaptive learning will allow the robot to understand user habits, personalize responses, and operate more autonomously. Ultimately, such developments can transform the robot into a highly capable companion that assists users in diverse and dynamic environments.

REFERENCES

1. M. Ghafurian, J. Hoey, and K. Dautenhahn, "Social robots for the care of persons with dementia: A systematic review," *ACM Transactions on Human-Robot Interaction*, vol. 10, no. 4, pp. 1–31, 2021.
2. A. Asgharian, A. M. Panchea, and F. Ferland, "A review on the use of mobile service robots in elderly care," *Robotics*, vol. 11, no. 6, p. 127, 2022.
3. K. K. Santhanaraj, M. M. Ramya, and D. Dinakaran, "A survey of assistive robots and systems for elderly care," *Journal of Enabling Technologies*, vol. 15, no. 1, pp. 66–72, 2021.
4. C. Yu et al., "Socially assistive robots for people with dementia: A systematic review and meta-analysis," *Ageing Research Reviews*, vol. 78, p. 101633, 2022.
5. G. Nejat, N. Liang, and Y. Sun, "Assistive robots in health care settings," *Home Health Care Management & Practice*, vol. 21, no. 3, pp. 177–187, 2009.
6. M. Matarić and B. Scassellati, "Socially assistive robotics," in *Springer Handbook of Robotics*, Springer, 2016, pp. 1973–1994.
7. K. Johansson-Pajala et al., "Care robot orientation: What, who and how?" *International Journal of Social Robotics*, vol. 12, no. 5, pp. 1103–1117, 2020.
8. A. Scerri, R. Sammut, and C. Scerri, "Formal caregivers' perceptions of pet robots for dementia care," *Journal of Advanced Nursing*, vol. 77, no. 1, pp. 83–97, 2021.
9. N. Gasteiger, K. Loveys, M. Law, and E. Broadbent, "Friends from the future: A scoping review of robots to combat loneliness," *Clinical Interventions in Aging*, vol. 16, pp. 941–971, 2021.
10. C. Getson and G. Nejat, "Socially assistive robots helping older adults through COVID-19," *Robotics*, vol. 10, no. 3, 2021.
11. T. Vandemeulebroucke, K. Dierckx de Casterlé, and C. Gastmans, "Older adults' perceptions of socially assistive robots," *Archives of Gerontology and Geriatrics*, vol. 95, p. 104399, 2021.
12. R. H. Wang et al., "Robots to assist daily activities: Views of older adults with Alzheimer's disease," *International Psychogeriatrics*, vol. 29, no. 1, pp. 67–79, 2017.

13. A. J. Scoglio et al., “Use of social robots in mental health and well-being research,” *Journal of Medical Internet Research*, vol. 21, no. 7, e13322, 2019.
14. F. Yuan et al., “Cognitive exercise for persons with Alzheimer’s disease using a social robot,” *IEEE Transactions on Robotics*, 2023.
15. M. Shao et al., “Long-term exercise assistance using social robots,” *Robotics*, vol. 12, no. 1, 2023.
16. E. Torta et al., “Evaluation of a socially assistive humanoid robot in intelligent homes,” *Journal of Intelligent & Robotic Systems*, vol. 76, no. 1, pp. 57–71, 2014.
17. A. Henschel, G. Laban, and E. S. Cross, “What makes a robot social?” *Current Robotics Reports*, vol. 2, no. 1, pp. 9–19, 2021.
18. W. Q. Koh et al., “Barriers and facilitators to the implementation of social robots,” *BMC Geriatrics*, vol. 21, p. 351, 2021.
19. N. Liang and G. Nejat, “Remote vs in-person HRI: A meta-analysis,” *Sensors*, vol. 22, no. 19, 2022.
20. L.-C. Lu et al., “Effectiveness of companion robot care for dementia,” *Innovation in Aging*, vol. 5, no. 2, 2021.
21. H.-Y. Yen et al., “Effect of social robots on depression and loneliness,” *Journal of the American Medical Directors Association*, vol. 25, no. 6, 2024.
22. X. Wang et al., “Effect of PARO robot therapy in elderly care facilities,” *International Journal of Nursing Knowledge*, vol. 33, no. 1, 2022.
23. Z. Salimi et al., “Are social robots ready for autism care?” *Neuroscience & Biobehavioral Reviews*, vol. 129, pp. 1–16, 2021.
24. S. Rasouli et al., “Applications of social robots in anxiety interventions,” *International Journal of Social Robotics*, vol. 14, no. 5, 2022.
25. C. Gumus et al., “Social robot interventions in healthcare,” *Sensors*, vol. 23, no. 15, 2023.
26. A. Kubota and L. D. Riek, “Robot behavior adaptation for neurorehabilitation,” *Annual Review of Control, Robotics, and Autonomous Systems*, vol. 5, 2022.
27. M. Rabinowitz and B. Scassellati, “Integrating socially assistive robots into mental healthcare,” *Clinical Psychology Review*, vol. 35, pp. 35–46, 2015.
28. A. Triantafyllidis et al., “Social robot interventions for child healthcare,” *Computer Methods and Programs in Biomedicine Update*, vol. 3, 2023.
29. R. Santos et al., “Systematic mapping of robotics in human care,” *Robotics and Autonomous Systems*, vol. 144, 2021.
30. H.-M. Gross et al., “Home robot companion for mild cognitive impairment,” in *Proceedings of IEEE SMC*, 2012.
31. G. Zhang and J. P. Hansen, “Telepresence robots for people with special needs,” *International Journal of Human-Computer Interaction*, vol. 38, no. 7, 2022.
32. Y. Guo et al., “Medical robotics: Opportunities in healthcare,” *Annual Review of Control, Robotics, and Autonomous Systems*, vol. 5, 2022.
33. K. Denecke and C. Baudoin, “AI and robotics in health ecosystems,” *Frontiers in Medicine*, vol. 9, 2022.
34. S. Woods et al., “Social robots for dementia: Challenges and future directions,” *Lecture Notes in Artificial Intelligence*, 2021.
35. Y. He et al., “Technology acceptance in socially assistive robots,” *Journal of Healthcare Engineering*, 2022.
36. B. Ma et al., “Artificial intelligence in elderly healthcare,” *Ageing Research Reviews*, vol. 83, 2023.
37. G. Thangavel et al., “ICT interventions for social isolation in older adults,” *JMIR Mental Health*, vol. 9, no. 3, 2022.
38. R. Latikka et al., “Loneliness and ambient assisted living,” *Journal of Medical Internet Research*, vol. 23, no. 12, 2021.

39. C. Yu, G. Livingston, and A. Sommerlad, "Feasibility of socially assistive robots for dementia," *Ageing Research Reviews*, 2022.
40. W. Moyle et al., "Therapeutic use of humanoid robots with older adults," *Assistive Technology*, 2024.
41. C. Riches et al., "Robot-assisted psychological interventions," *Clinical Psychology & Psychotherapy*, 2022.
42. M. Harris-Gersten et al., "Usability of social robot pets in dementia care," *American Journal of Alzheimer's Disease*, 2023.
43. E. Lee et al., "Human–robot interactions in home care," *Clinical Gerontology*, 2024.
44. S. Mukherjee et al., "Humanoid robots in healthcare: A systematic review," in *Proceedings of COM-IT-CON*, 2022.
45. L. Ragno et al., "Application of social robots in healthcare," *Sensors*, vol. 23, no. 15, 2023.
46. S. Raje et al., "Healthcare robots during COVID-19," *Applied Bionics and Biomechanics*, 2021.
47. D. Woods et al., "Challenges in social robots for dementia," in *International Conference on Social Robotics*, 2021.
48. A. Yoganandhan et al., "Robots and AI in global pandemics," *Vacunas*, vol. 22, no. 2, 2021.
49. C. Youssef et al., "Survey on recent advances in social robotics," *Robotics*, vol. 11, no. 4, 2022.
50. United Nations Population Division, *World Population Prospects*, United Nations, 2022.

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