

Multi-Purpose Voice Control Patient Assistance Robot

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Abstract

Timely and regular treatment of the physically disabled, bedridden, and elderly is a mandated health requirement. A multi-purpose voice-controlled patient care robot (VCPAR) designed and implemented for on-demand drug, food, and liquid delivery in natural language is presented in this paper. In contrast to conventional button/joystick-based or human-attention-based robotic systems, the approach utilizes Arduino-based control, Bluetooth communication, and speech recognition to facilitate completely hands-free usage. IR sensor-based obstacle sensing and accurate actuating devices ensure safe transport and efficient dispensing of goods. Another of the research's novel contributions is its low-cost, locally manufactured, and multimodal platform for use in resource-constrained settings where advanced healthcare robots are cumbersome. Experimental findings demonstrate agreement with voice instructions from the patient at a distance of 10 m or less from Bluetooth, precise delivery of objects with minimal latency, and greater user control compared to current semi-automatic systems. The project aims to explore the potential of low-cost voice-controlled robots for maximum patient autonomy, caregivers' load reduction, and new opportunities for smart healthcare support systems. Intellectually enabled assistive technology has been in high demand due to the increasing numbers of elderly, bedridden, and physically disabled patients who otherwise need to remain constantly supervised and receive timely interventions.

Keywords: VCR-Voice Controlled Robot, PAR-Patient Assistance Robot, MAR-Multipurpose Assistance Robot, ESS-Elderly Support System.

1. Introduction

Human-centered care solutions utilize a great deal of human effort, thereby adding to the caregiver's workload and restricting the autonomy of patients. In contrast to such constraints, medical science has been ready to step toward robot assistance that is bound to contribute to activities of daily living like medication, feeding, and mobility support. Recent robots are expensive in terms of finances, bulky in nature, or based on advanced infrastructures, and hence not affordable for resource-limited hospitals. Microcontroller, wireless communication, and speech recognition technologies have enabled low-cost, user-friendly aid systems to become an affordable reality.

Voice-controlled systems also have the advantage of being used without hands, which is extremely useful for physically disabled patients. Medication robots have been studied with different uses from telepresence robots to robotically controlled medication carts, but they are largely operated manually or semi-automatically, at the expense of patient autonomy. The majority of the solutions are also dependent on internet connectivity or cloud speech-to-text, which has the drawbacks of delay, expense, and privacy. To this aim, in this paper, a multi-purpose voice-controlled patient care robot (VCPAR) using Arduino microcontrollers, Bluetooth transmission, and offline speech recognition modules is proposed to realize the objective of an inexpensive, fault-tolerant, and completely hands-off system.

The technological advance in the presented solution is the use of low-cost hardware together with real-time voice processing to manage mobility, obstacle detection, and object distribution in a single system. Compared to typical methods, the robot shown does not require manual control or constant monitoring by caregivers and thus presents increased patient autonomy with a low caregiver burden.

2. Related Works

Robotics are also envisioned for multi-view services in health care solutions such as patient care, surveillance, and mobility assistance. Multi-dimensional care-oriented features have been proposed by Kodur et al. [1] using an adaptive robotic nurse assistant, and

HirakRanjan et al. [2] have developed a robotic sensor platform using AI, IoT, and ML-based pandemic health care services. Customization and flexibility are also considered; Ponnuru et al. [3] created a flexible robot that can potentially deliver round-the-clock care and assistance based on the patient's needs, while Akram et al. [4] designed multi-purpose robots that can be deployed in hostile environments outside of the hospital. Yoshimitsu et al. [5] also attributed mobility and patient support in hospitals by service robots to being caused by more convenient transportation and movement.

Physical support aside, interactive and conversational features are tailored. Aggarwal et al. [6] proposed a general NLP-based architecture for chatbots, and Harini et al. [7] proposed a hospital companion with voice support and a dispensing system. González-González et al. [8] proposed a systematic review of social robots in hospitals to ascertain their impact on patient engagement and quality of care, with a modular architecture. In hospital settings, Kodur and Kyrarini [9] tested patient-robot co-navigating systems in an attempt to enact crowd control. Addressing elderly care, Cooper et al. [10] tested robots specifically for facilitating independent living among the elderly population, while also utilizing them to create the multidisciplinary aspect of robot aides in hospital settings. All these studies envision creating multi-purpose, interactive, and adaptive robots with clinical, logistical, and emotional caring abilities for more efficient patient care and health care efficacy. Current patient-assistive health technology is either rooted primarily in customary care or expensive robot-based systems, both of which have their disadvantages.

3. Existing System

Such customary care relies heavily on day-and-night human monitoring, and mobilization, medication, and diet are all part of attendants' routines. As good as it may be, it remains inadequate when it comes to providing high attendant-to-patient ratios in institutions and is highly stressful for attendants. Care robots and autonomous systems have also been utilized in the recent past to cope with such demands. They are robots that utilize wheels and robotic arms with software to manipulate objects or oversee patients. They are remotely or attendant-controlled semi-automatics. They are not patient-independent and scale workload to very low levels. The second type consists of networked or Wi-Fi devices and IoT-based care systems. They may blend patient monitoring with pre-programmed alerting but use cloud services and internet connectivity to carry out instructions. This introduces latency, privacy

intrusion, and costly maintenance. All the robots in healthcare IoT also possess cloud-based voice assistants (Google Assistant, Amazon Alexa), exhibit low performance in areas with poor connectivity, and make the systems inappropriate for real-time emergency support. Robot-based cell phones that use Bluetooth have also been researched as an option.

They are inexpensive and sufficient for local actuation but cannot be utilized without hands, which mobility-impaired patients require. They must be commanded multiple times from a controller or phone, which is difficult for bedridden or elderly patients. Existing products today are off-the-shelf items, either single-function (robotic way-finding aids) or mobility aids (voice-controlled wheelchairs, medicine dispensers), but never realized multiple functions on an inexpensive platform. Most systems also incorporate expensive sensors or high-end hardware packages, and these are beset by cost and installation complexity, making deployment to small hospitals, rehabilitation centers, or home-care settings impossible.

4. Proposed Methodology

By combining robot-based medical support assistance with Arduino-based automation, the system offers a unique and efficient solution for hospital and patient assistance. Three areas of improvement are included in the solution: image processing, robot navigation, and Arduino-based service modules.

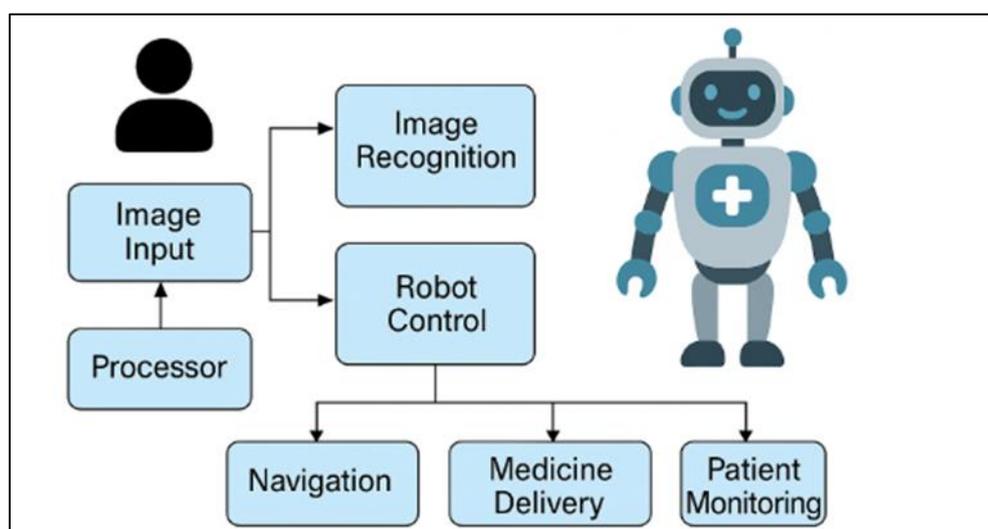


Figure 1. System Architecture

The architecture of the proposed system is illustrated in Figure 1. Step 1 provides enhanced facilities through the processing of patient or environmental data gathered utilizing

an image input module. The robot control module is provided with pre-processed input from the image understanding unit in the event of object recognition, motion, or patient needs. The robot is made to execute tasks such as patient guidance, medication delivery, and movement to hospital departments by the control system. This allows patients to make autonomous decisions and receive rapid treatments with minimal human intervention.

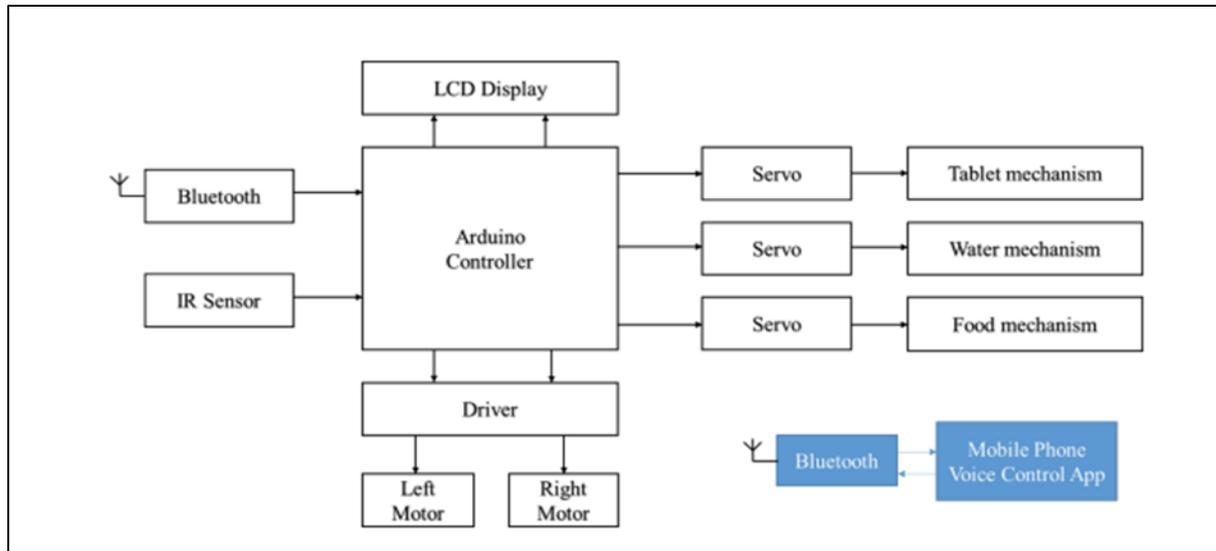


Figure 2. Block Diagram of the Proposed System

An Arduino-based controller serves as the stage two microprocessor. The Arduino drives servo motors of various sizes on food, water, and tablet modules to assist in retrieving patient needs and atmospheric properties via the command input channel from modules like infrared and Bluetooth modules. The left and right motors are driven by the motor driving circuit for robot movement. The Arduino output is also fed to an LCD module to notify the status. The usage of cellular phone voice command programs through Bluetooth enables other inputs from the user, allowing patients or caregivers to verbally request actions.

The system provides a safe replacement for healthcare environments using Arduino-driven delivery units and image perception for autonomy and monitoring. The two-pronged approach proposes sensor-actuator-based automation for adaptive feedback and AI-based sensing for decision-making. This approach minimizes response time, enhances performance, and provides 24-hour patient care with less dependency on human attendants.

5. Materials and Methods

5.1 Hardware details

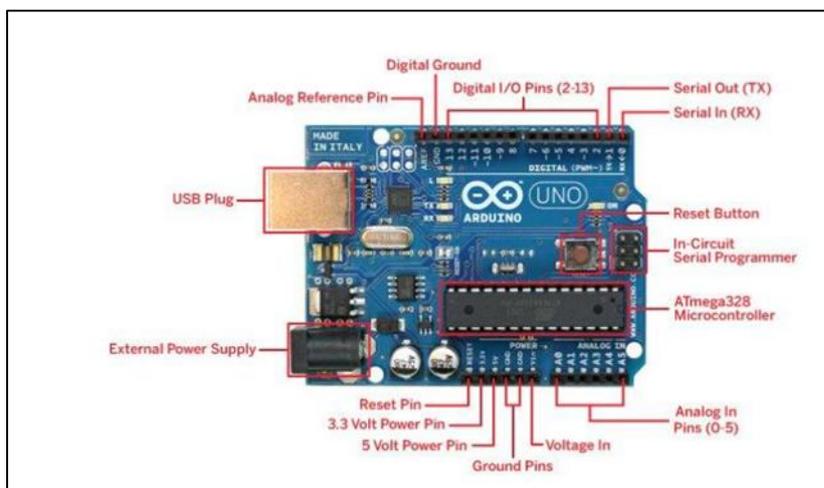


Figure 3. Arduino

The patient assistance robot is based on the ATmega328P microcontroller and is controlled by the Arduino Uno (Fig 3). It controls outputs to actuators (servos, relays, and motors) and handles sensor inputs (such as Bluetooth and infrared). It makes navigation, medication dispensing, and food/water delivery systems dependable with its digital/analog I/O pins, serial communication capability, and steady power regulation. It serves as the processing center in this work, deciphering commands and effectively coordinating all system elements.



Figure 4. ATMEGA 328

The Arduino Uno board's main microcontroller, the ATmega328P (refer fig 4), responsible for carrying out all program instructions and directing system functions. It can handle simple and moderately complex tasks thanks to its 32 KB of flash memory, 1 KB of EEPROM, and 2 KB of SRAM. The ATmega328P in the suggested patient assistance robot processes sensor inputs, including those from the Bluetooth module and infrared sensor, and produces control signals for actuators, including servos, motors, and relays. It is ideal for real-

time healthcare assistance applications due to its low power consumption and effective performance.

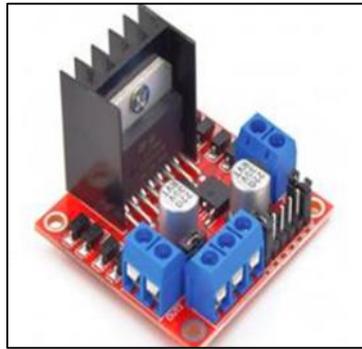


Figure 5. Motor Driver L298D

The dual H-bridge motor driver integrated circuit (IC) L298D is used to regulate the speed and direction of stepper and DC motors. It enables the Arduino to communicate with high-current motors that the microcontroller cannot directly drive. The L298D controls the left and right motors of the suggested patient assistance robot, allowing for precise and seamless movement while performing tasks such as medication delivery, patient monitoring, or navigation in a hospital environment.



Figure 6. Servo Motor

A small, highly accurate actuator for controlling angular position is the servo motor. It works by using Pulse Width Modulation (PWM) signals, which enable precise shaft position adjustment for the motor. Servo motors are used in the proposed patient assistance robot to control mechanisms like the food mechanism, water dispenser, and tablet dispenser. They are an essential part of the automation process because of their precise control, which guarantees that the patient receives the necessary items in a dependable and accurate manner.

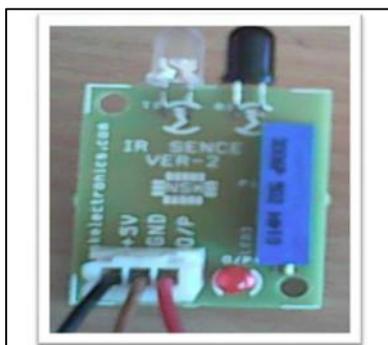


Figure 7. IR Sensor

The infrared (IR) sensor (see fig 7) emits and receives infrared light to detect objects and measure proximity. The IR sensor in the suggested patient assistance robot is essential for obstacle detection and navigation, allowing the robot to move around its surroundings safely. The IR sensor increases the robot's dependability in healthcare applications by detecting objects or patients in its path and ensuring smooth operation while averting collisions.



Figure 8. Bluetooth HC05

The robot can connect external devices like a computer or mobile phone to the Bluetooth HC-05 module (refer to fig 8), a wireless communication device. This makes it easier for the user and the Arduino controller to exchange data and receive voice commands in the suggested patient assistance robot. Using a smartphone app, patients or caregivers can give voice commands through the HC-05 module, and the robot will carry them out. This guarantees smooth communication, hands-free use, and enhanced accessibility for patients who need help.



Figure 9. LCD Display

The proposed patient assistance robot uses a 16x2 LCD display (refer to fig 9) as its visual output unit. By showing sensor readings, received commands, and system status, it offers real-time feedback. This enables patients and caregivers to monitor the robot's operations, including task confirmation, obstacle detection alerts, and movement instructions. By providing instantaneous visual confirmation of actions taken, the clear display guarantees user-friendly interaction and improves system reliability.

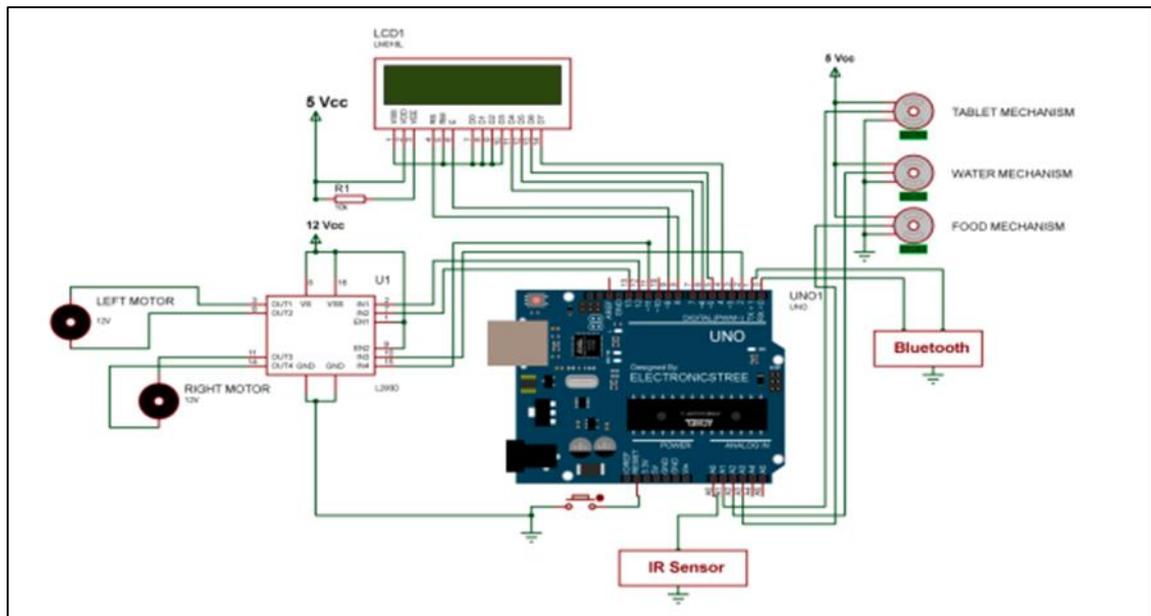


Figure 10. Circuit Diagram

Figure 10 shows the circuit diagram of the proposed system.

5.2 Software Details

The Arduino IDE, an open-source development environment that is freely available for download from the official website (<https://www.arduino.cc/>), is the software used to program

the microcontroller. This platform allows users to create programs, or sketches, that specify the functions and actions the microcontroller must carry out. Following development, these sketches are assembled and transferred to the microcontroller through a USB interface, allowing the hardware to execute the instructions that have been programmed. This methodology offers a straightforward, adaptable, and effective way to create embedded applications.

6. Results and Discussion

The Voice-Controlled Mobile Assistant presents an innovative approach to assistive healthcare by combining Bluetooth-based voice commands with Arduino-controlled mobility and dispensing mechanisms. It enables users, particularly the elderly and physically challenged, to receive medicine, water, and food with minimal physical effort. The integration of IR sensors allows for basic obstacle detection for safer navigation, while servo motors ensure precise dispensing. The system's LCD display provides real-time feedback, enhancing usability and trust in the device's operation. Despite its effectiveness, the system has certain limitations such as a restricted Bluetooth range and basic obstacle detection. However, it sets a strong foundation for future enhancements. Adding IoT capabilities could allow for remote scheduling and monitoring, while implementing advanced sensors and autonomous navigation would improve adaptability in dynamic environments. These upgrades could transform the prototype into a fully autonomous healthcare assistant suitable for smart homes and hospital settings. Figure 11 shows the hardware kit of the proposed model.



Figure 11. Output of the Proposed Model

7. Conclusion

The Voice-Controlled Mobile Assistant for Medicine, Water, and Food Dispensing successfully demonstrates an innovative solution to assist individuals who require timely care and support. By integrating Bluetooth-based voice control with an Arduino-driven mobile platform, the system ensures user-friendly operation, efficient delivery of essential items, and safe navigation using IR sensing. The use of servo mechanisms allows precise dispensing, enhancing reliability and functionality. This project not only improves the quality of life for elderly and physically challenged individuals but also reduces the dependency on constant human assistance. With further advancements such as IoT integration and autonomous navigation, the system holds great potential for future development in healthcare automation and smart living environments.

References

- [1] Kodur, Krishna Chaitanya, Kaustubh Rajpathak, Akilesh Rajavenkatanarayanan, Maria Kyrarini, and Fillia Makedon. "Towards a Multi-purpose Robotic Nursing Assistant." arXiv preprint arXiv:2106.03683 (2021).
- [2] HiraKranjan, Das, Bhatia Dinesh, Ajan Patowary, and Animesh Mishra. "Multi-Purpose Robotic Sensing Device for Healthcare Services." *Enabling Healthcare 4.0 for Pandemics: A Roadmap Using AI, Machine Learning, IoT and Cognitive Technologies* (2021): 237-250.
- [3] Ponnuru, Sudhakiran, Gnanesh H. Nayak, Maruthu Pandi, Sai Rishitha Ambati, and Siddeshwar S. Kode. "Creating an Adaptive Robot for Personalized Health Monitoring and Assistances." In *2025 IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS)*, IEEE, (2025): 1-9.
- [4] Akram, Maouchi, Bouadi Abdelmounim, and Aidoudi Abdeldjalil. "Design of a Multi-Purpose Robot for Risky Areas." PhD diss., *Faculté des Sciences et Technologies*, 2021.
- [5] Yoshimitsu, Kitaro, Yasuto Shiigi, Etsuko Kobayashi, Kenta Kuwana, Kaori Kusuda, Kaoru Hoshide, Yoshihiro Muragaki, and Ken Masamune. "Exploring the potential of service robots in guiding patients and assisting mobility in medical facilities." *Advanced Robotics* 38, no. 24 (2024): 1758-1769.

- [6] Aggarwal, Shivom, Shourya Mehra, and Pritha Mitra. "Multi-purpose NLP chatbot: Design, methodology & conclusion." arXiv preprint arXiv:2310.08977 (2023).
- [7] Harini, A., S. Thejasvi, Varshini U. Abinaya, and S. Sumathi. "Curie–A Smart Voice Assistant Based Hospital Companion with Medicine Dispenser." In 2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS), IEEE, (2023): 01-05.
- [8] González-González, Carina Soledad, Verónica Violant-Holz, and Rosa Maria Gil-Iranzo. "Social robots in hospitals: a systematic review." Applied Sciences 11, no. 13 (2021): 5976.
- [9] Kodur, Krishna, and Maria Kyrarini. "Patient–robot co-navigation of crowded hospital environments." Applied Sciences 13, no. 7 (2023): 4576.
- [10] Cooper, Sara, Óscar Villacañas, Luca Marchionni, and Francesco Ferro. "Robot to support older people to live independently." arXiv preprint arXiv:2104.07799 (2021)