ABSTRACT

The global aging population and increasing prevalence of disabilities necessitate innovative solutions to enhance the quality of life for elderly and disabled individuals. This project aims to design, develop, and deploy an assistive robotic system that provides support and assistance to elderly and disabled persons in their daily lives. This work investigates how assistive robotics can address critical challenges in healthcare, including medication compliance, mobility, and emergency response, for elderly and disabled populations. A multifunctional assistive robot is designed to enhance the independence and quality of life for elderly and disabled. It features a medication reminder system that activates alerts at scheduled times, sending SMS notifications if action is taken. Utilizing Bluetooth technology, the robot tracks users by analyzing signal strength, enabling it to assist in transporting items. In emergencies, a panic button on a mobile device triggers alerts and sounds an alarm. With a user-friendly interface and customizable features, the robot adapts to individual needs, reducing caregiver burden while promoting a dignified lifestyle for users.

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CHAPTER 1

INTRODUCTION

The global population is experiencing a significant demographic shift with a rapidly growing elderly population and a rising prevalence of disabilities. This demographic trend necessitates innovative solutions that empower individuals to maintain their independence, safety, and overall quality of life while navigating the challenges associated with aging and disability. Assistive robotics emerges as a promising technological frontier, offering intelligent and adaptable systems capable of providing a spectrum of support, from medication reminders and mobility assistance to emergency response.

This project focuses on the development of an integrated assistive robotic system specifically designed to address the multifaceted needs of elderly and disabled individuals. The system integrates three core functionalities:

Medication Adherence: A robust medication reminder system is incorporated, utilizing a time-based trigger to alert users when it's time to take their prescribed medications. This feature aims to significantly improve medication adherence, a critical concern for the elderly and those with cognitive impairments, and reduce the risk of adverse health outcomes associated with missed doses.

Enhanced Mobility and Assistance: The system incorporates a sophisticated object tracking module that leverages Bluetooth technology. This enables the robot to effectively follow the user, providing valuable assistance with tasks such as retrieving objects, navigating within the home environment, thereby enhancing user mobility and independence.

Emergency Response: A critical safety feature is the inclusion of an integrated emergency alert system. A panic button embedded within the paired mobile phone allows users to quickly summon help in case of an emergency, such as a fall or sudden illness. Upon activation, the system triggers an immediate alert message to designated contacts via a GSM module, simultaneously activating a local alarm to attract the attention of nearby individuals. This ensures timely emergency response and minimizes potential risks to user safety.

This report will delve into the technical details of the proposed system, including its hardware and software architecture, sensor integration, and control algorithms.

CHAPTER 2

LITERATURE REVIEW

To provide a foundation for this research, a review of relevant literature was conducted. This review focuses on key areas related to the development of assistive robotic systems for elderly and disabled individuals.

[1]. W. M. F. W. M. Rosdi, S. A. Suhaimi, N. A. Md Lazam, A. J. Alias, F. Abdullah and S. N. Azemi, "Smart Pill Dispenser with Monitoring System," 2021 IEEE Symposium on Wireless Technology & Applications (ISWTA), Shah Alam, Malaysia, 2021.

This study presents an advanced pill dispenser system that not only reminds users when to take medication but also monitors adherence and provides remote caregiver support. The system uses sensors and wireless communication to track medication intake, alert caregivers in case of missed doses, and provide real-time feedback on medication adherence patterns. This research highlights the potential of integrated medication reminder systems to improve medication compliance and overall health outcomes for elderly and disabled individuals.

[2]. S. Kim et al. "Assistive Robotics for Medication Management in Elderly Care" Journal of Intelligent Information Systems, vol. 72, no. 2, pp. 257 271. April 2023.

The research considers the unique challenges faced by older adults, such as cognitive decline or complex medication regimens, and how robotic assistance can be tailored to their needs. Ultimately, the paper aims to contribute to the growing body of knowledge on how robotics can be effectively implemented to enhance medication adherence, improve patient outcomes, and promote independent living for elderly individuals.

[3] Li, S., Milligan, K., Blythe P.et al. "Exploring the role of human robot in supporting the mobility and wellbeing of older people". Sci Rep 13,6512(2023).

This paper explores how robots can improve mobility, reduce isolation, and enhance wellbeing for older adults. This field holds promise for transforming elder care and promoting independent living.

CHAPTER 3

OBJECTIVES

- To design and develop an integrated assistive robotic system that effectively addresses the diverse needs of elderly and disabled individuals, enhancing their independence and quality of life.
- To improve medication adherence rates among target users through the implementation of a reliable and user-friendly medication reminder system.
- To enhance user mobility and independence by providing robust object tracking and following capabilities, minimizing the risk of falls and facilitating independent movement within the home environment.
- To ensure timely emergency response in critical situations through an integrated alert system, minimizing potential risks and maximizing user safety.
- To contribute to the advancement of assistive robotics technology by exploring innovative solutions and addressing the unique challenges faced by this vulnerable population.

CHAPTER 4

METHODOLOGY

The development of a remotely controlled robot with medication reminder functionality requires careful selection of hardware and software components. The system consists of an Arduino Uno microcontroller, an HC-05 Bluetooth module for wireless communication, an L293D motor driver controlling DC motors, a buzzer and LED for notifications, a push button for medication confirmation, and a GSM module for caregiver alerts. The software is developed using Arduino IDE, with a Bluetooth control app for movement and GSM protocols for messaging. The hardware integration involves connecting the HC-05 module to the Arduino for wireless control, interfacing the L293D driver for motor movement, and implementing the medication reminder system through buzzer, LED, push button, and GSM alerts. Movement control is handled via Bluetooth commands: Command 1 moves forward, Command 2 turns right, Command 3 moves backward, and Command 4 turns left. The robot's movement mechanism is essential for elderly assistance, allowing easy navigation through the environment. The Bluetooth module ensures seamless wireless control, enhancing user experience.

The medication reminder system is designed to help elderly individuals adhere to their medication schedule. Medication reminders trigger the buzzer and LED at predefined times, requiring the user to press the button within set period of time; otherwise, the GSM module sends an SMS to a caregiver. This ensures that caregivers are promptly notified in case of missed doses, minimizing health risks. The push button confirmation mechanism is a simple yet effective solution for verifying medicine intake. The integration of a GSM module expands the system's reach, making it suitable for remote monitoring.

The testing phase is crucial for ensuring system reliability and accuracy. Bluetooth connectivity is tested to verify seamless communication between the robot and the smartphone app. Movement responses are evaluated for accuracy, ensuring that the robot follows the predefined commands correctly. The reminder functionality is assessed by programming different medication schedules and observing buzzer and LED activations. The GSM module undergoes rigorous testing to confirm successful message and call delivery to caregivers. This step-by-step validation ensures the robustness of the system before deployment.

Deployment involves real-world testing with an elderly user and feedback collection for improvements. The system is tested in various real-life scenarios to evaluate usability, efficiency, and effectiveness. The elderly user interacts with the robot to confirm ease of operation. Feedback from caregivers helps refine the system, addressing any usability challenges or potential improvements. This iterative approach guarantees a user-friendly and reliable solution.

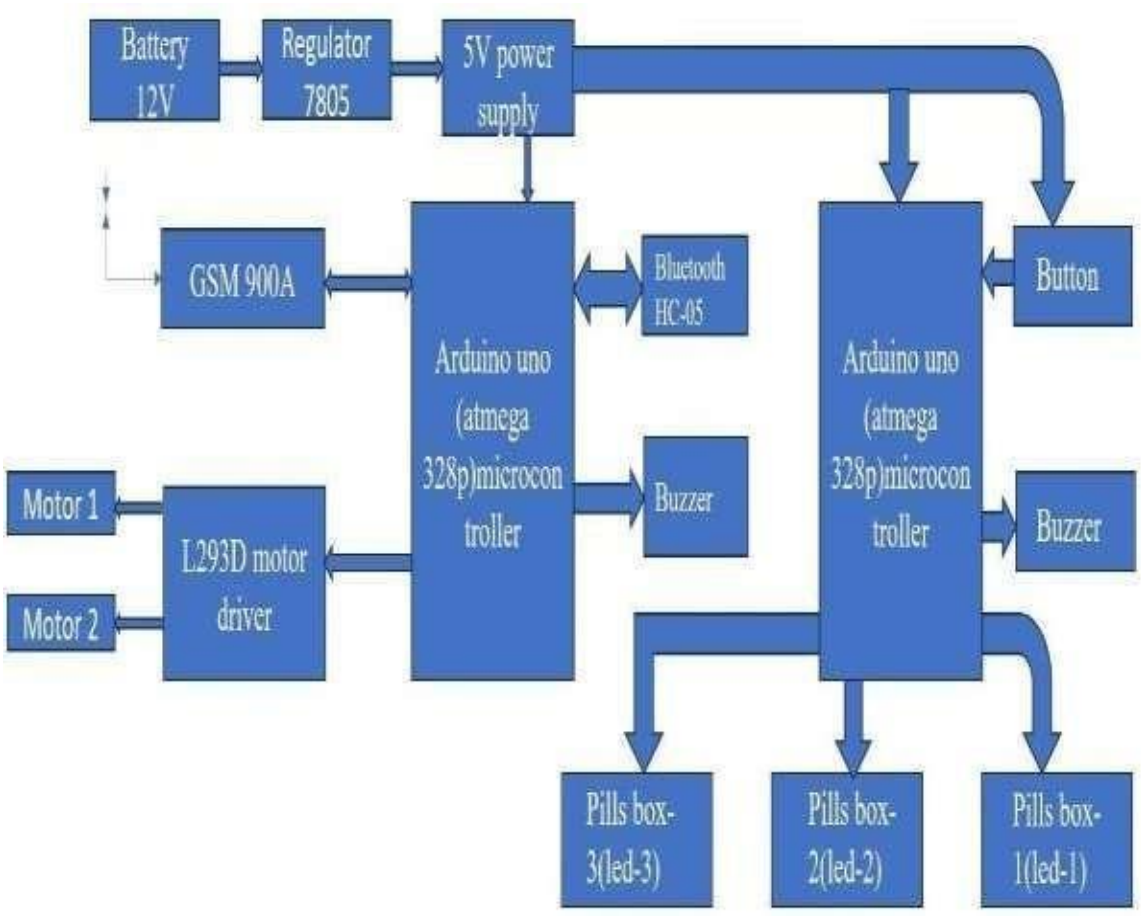

Fig 4.1 Block Diagram of Assistive Robotics For Elderly And Disabled Support

CHAPTER 5

COMPONENTS

5.1 Arduino uno

Fig 5.1 Arduino uno

The microcontroller acts as the brain of the system, executing commands and processing input signals. It provides multiple digital and analog I/O pins for seamless integration with sensors and actuators. The Arduino Uno (as shown in fig 5.1) is programmed using the Arduino IDE, making it efficient for coding and debugging**.**

5.2 GSM module

Fig 5.2 GSM module

This GSM module (as shown in fig 5.2) sends SMS or calls caregivers if a medication reminder is ignored. It works on 2G networks and supports GPRS for data transmission. The system is compact, energy- efficient, and ideal for remote alert systems.

5.3 Motor driver

Fig 5.3 L293D Motor Driver

This driver (as shown in fig 5.3) controls two DC motors, enabling forward, backward, left, and right movements. It uses H-Bridge technology to allow smooth and controlled motor operations. The driver ensures efficient power distribution for reliable robot movement.

5.4 Bluetooth HC-05

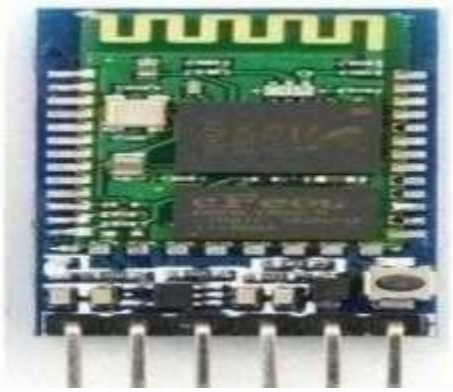

Fig 5.4 Bluetooth HC-05

This module allows wireless communication between the robot and a smartphone for remote control. It operates using serial communication and can function as a master or slave device. The HC-05 module (as shown in fig 5.4) provides a stable connection within a 10-meter range.

5.5 Battery

Fig 5.5 Lead acid Battery

This battery (as shown in fig 5.5) serves as the primary power source for the robot, providing a stable voltage supply for all components. It is rechargeable, durable, and capable of delivering high current output for extended operation. Lead acid batteries are widely used in robotics due to their reliability and cost-effectiveness

5.6 Buzzer

Fig 5.6 Buzzer

The buzzer (as shown in fig 5.6) is an essential component for generating an audible alert during medication reminders. It produces a loud sound to ensure the user is notified at the scheduled time.

CHAPTER 6

ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES

- **Enhanced Safety:**

  The medicine reminder system ensures timely medication, reducing health risks associated with missed doses.

- **Rapid Assistance:**

  Sends immediate alerts to caregivers, family or emergency services in critical situations, reducing response time.

- **Increased Independence:**

  Enables elderly and disabled individuals to manage daily tasks, like medication and object transport, with less reliance on caregivers.

- **User-Friendly Design:**

  Simple controls like button presses make the system accessible for people with limited mobility or limited disability.

- **Cost-Effective Solution:**

  Compared to hiring full-time caregivers, this system offers a one-time investment in assistive technology.

- **24/7 Availability:**

  Unlike human caregivers, the robotic system is always available, ensuring consistent support, reminders and emergency responses.

- **Improves Caregivers Efficiency:**

  While supporting the user independently, it reduces the workload of caregivers, allowing them to focus on more critical or specialized tasks

6.2 DISADVANTAGES

- **High Initial Cost**

  The development and deployment of the robotics system can involve significant upfront expenses for hardware, software, and integration.

- **Initial Resistance:**

  Elderly users might initially resist adopting the technology due to unfamiliarity or distrust in automation

- **Limited Adaptability:**

  The robot might have trouble working in messy or changing spaces, making it less useful in some homes or conditions.

- **Power Dependency:**

  The system relies on consistent power supply, and power outages can disrupt its functionality unless a backup is available.

CHAPTER 7

APPLICATIONS

- **Elderly Living Alone:**
  Provides safety and support for elders living independently, reducing their reliance on external help while ensuring their well-being.

- **Support For Individuals with Disabilities:**
  Beneficial for those with mobility impairments or visual/hearing disabilities, providing medications alerts, and assisting with object transportation.

- **Cognitive Support:**
  Helps individuals with memory-related conditions, like dementia or Alzheimer's, by reminding them of medications.

- **Monitoring Post-Surgery Patients:**
  Enhances post-operative recovery by providing reminders for medications and follow- ups while alerting caregivers of any emergencies.

- **Remote Healthcare Management:**
  Chronic Disease Management: Especially useful for individuals managing diabetes, hypertension, or other conditions requiring regular medication and monitoring.

CHAPTER 8

RESULTS AND DISCUSSION

- **Timely Medication Adherence:** Ensures elderly individuals take their medication on time with automated led and Buzzer alerts.
- **Elders Acknowledgment and Monitoring:** Tracks whether the user has taken their medication, providing feedback to caregivers with the message " Pill Consumed".
- **Emergency Response System:** A panic button enables quick alerts to guardians with message " patient is serious" and nearby individuals with Buzzer sound ensuring immediate assistance during critical situations.
- **Object Transportation Capability**: the robot follows the user using Bluetooth, assisting them by carrying essential small items when needed, reducing physical strain.

Fig 8.1 Model Of Proposed System

Fig 8.2 Remote Control Panel

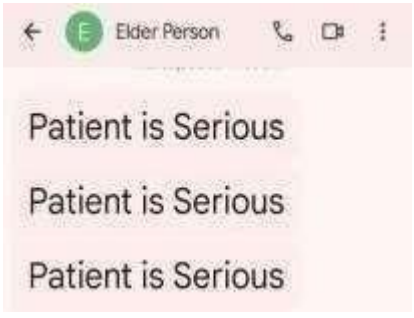

Fig 8.3 Emergency Alert Notification

Fig 8.4 Dose Consumed Notification

CHAPTER 9

FUTURE SCOPE

- **Enhanced Navigation and Human-Robot Interaction:**
  Implement advanced navigation algorithms for robust human-following in complex environments. Integrate natural language processing and voice control for intuitive interaction.

- **Personalized Medication Management:**
  Incorporate smart pill dispensers and medication recognition systems for automated dispensing and adherence monitoring.

- **Fall Detection and Emergency Response:**
  Integrate fall detection sensors (accelerometers, gyroscopes) and automated emergency alerts to ensure timely assistance in critical situations. Connect the robot to telehealth platforms for remote health monitoring.

- **Visual Medication Recognition:**
  Integrate a camera and image recognition software to identify medications. This can cross- reference dispensed pills with prescribed dosages, preventing medication errors and providing an extra layer of safety. Example: The robot visually confirms the user is taking

  the correct medication by comparing the pill's image with a database of prescribed drugs.

- **Telemedicine Capabilities:**
  Integrate telehealth functionalities, enabling remote consultations with healthcare professionals, vital sign monitoring, and secure data transmission for comprehensive care management.

CHAPTER 10

CONCLUSION

This project has successfully demonstrated the development and integration of a multifaceted assistive robotic system designed to address the critical needs of elderly and disabled individuals. The system effectively integrates three core functionalities: a time-based medication reminder system with caregiver alerts via GSM module, Bluetooth-controlled mobility assistance facilitated by object tracking, and a GSM-based emergency response system triggered by a panic button. The implemented prototype showcases the feasibility of leveraging accessible technologies like Arduino, Bluetooth communication, and GSM modules to create a cost-effective and user-friendly assistive solution. Rigorous testing validated the functionality and reliability of each component, from accurate medication reminders and precise motor control to timely emergency alerts. While the current prototype demonstrates core capabilities, future development will focus on enhancing autonomy through SLAM and path planning, personalizing assistance via machine learning, and enriching human-robot interaction through NLP and multimodal interfaces. Integration with smart home ecosystems and telemedicine platforms will further expand the system's potential for comprehensive care management. Ultimately, this project lays a strong foundation for developing advanced assistive robotic solutions that empower elderly and disabled individuals to maintain independence, safety, and an enhanced quality of life. Addressing ethical considerations regarding data privacy and user autonomy will be paramount in the continued development and deployment of this vital technology.