Arduino based Voice-Controlled Wheel Chair

Khan Adnan[1], Shaikh Faheem[2], Khan Amar[3], Dr. Minhaj Hashim[4]
Theem College of Engineering, Boisar-401501
Corresponding Author's: - minhaj.hashim@theemcoe.org
adnankhan9874@gmail.com, shaikhfaheem979@gmail.com, umarkn1975@gmail.com

Abstract

The integration of key components in a voice-controlled wheelchair designed for individuals with physical disabilities. It highlights the use of Arduino microcontrollers to interpret voice commands, translating them into signals for motorized movement. A Bluetooth module facilitates communication between the device issuing commands and the Arduino. The main focus is on achieving a 180-degree rotation of the wheelchair, which necessitates configuring the Arduino to control both front and back wheels for directional movement and speed. Motorized motion is enabled through a system of chain and sprockets with cycle tires, ensuring smooth and stable traversal across different surfaces. This abstract encapsulates the essential elements of the wheelchair's design and functionality, emphasizing its ability to empower users through intuitive control and reliable mobility assistance. The integration of a Bluetooth module facilitates seamless communication between the controlling device and the wheelchair. Key emphasis is placed on the wheelchair's ability to execute a 180-degree rotation, necessitating precise configuration of the Arduino to manage both front and back wheels for directional control and speed modulation. The inclusion of a chain and sprockets system, coupled with cycle tires, ensures smooth and stable mobility across diverse terrains, ultimately enhancing the user's independence and quality of life.

1. INTRODUCTION

The voice-controlled wheelchair system integrates several key components to provide mobility assistance for individuals with physical disabilities. At its core, the system relies on an AT Mega 328 Arduino microcontroller and a 4-way relay to interpret voice commands and execute corresponding actions. A Bluetooth module, specifically the HC05 model, facilitates wireless communication between the wheelchair and a device for receiving voice commands.

In terms of hardware, the system incorporates two 12V lead-acid batteries to power the wheelchair, along with a 24V BLDC motor for propulsion. The mechanical structure of the wheelchair includes box pipes for frame rigidity, cycle front tires for traction and stability, and a cycle chain mechanism to transmit motion from the motor to the wheels.

Additionally, sensory components are integrated into the system for feedback and control. A sensor provides input for detecting obstacles or changes in terrain, enabling the wheelchair to adapt its movement accordingly. A Battery Management System (BMS) ensures the safe and efficient operation of the 12V batteries, while a 5Amp circuit ensures proper electrical distribution within the system.

The Arduino microcontroller plays a central role in orchestrating these components, converting voice commands into signals that control the motion of the wheelchair. By configuring the Arduino code, users can customize the wheelchair's behavior to meet specific mobility needs, such as achieving a 180-degree rotation or adjusting speed and direction.

Overall, the integration of these components enables the voice-controlled wheelchair to provide intuitive and responsive mobility assistance, enhancing the independence and quality of life for individuals with physical disabilities.

2. LITERATURE REVIEW

In this paper, authored by Zannatul Raiyan, Md. Sakib Nawaz, A. K. M. Asif Adnan, and Mohammad Hasan Imam (2017), a novel approach to designing a voice-controlled automated wheelchair is introduced. Leveraging readily available technology, the proposed system aims to eliminate the need for bulky computing units and wearable sensors. By integrating the EasyVR 3 voice recognition module and Arduino microcontroller, both cost-effective and compact solutions are employed. The paper details the operational aspects of the speech processing module and the motor controller circuit, accompanied by a comprehensive cost analysis [1].

The research by Tan Kian Hou et al. focuses on the development of an Arduino-based voice-controlled wheelchair, presented at the First International

Conference on Emerging Electrical Energy, Electronics, and Computing Technologies in 2019. The study explores how Arduino microcontrollers interpret voice commands to control wheelchair movement, contributing to assistive technology for individuals with disabilities. By integrating hardware components like Bluetooth modules and motors with software programming, the research demonstrates the potential for intuitive and responsive wheelchair control. This work lays the groundwork for future advancements in assistive technologies, aiming to enhance the independence and quality of life for users [2].

The study conducted by Mohammad Ilyas Malik, Tanveer Bashir, and Mr. Omar Farooq Khan from SSM College of Engineering and Technology, University of Kashmir, India, focuses on the development of a Voice Controlled Wheelchair System. Published under their authorship, the research explores the implementation of this innovative technology, showcasing the collaborative efforts between students and faculty members. Through their work, they aim to contribute to the field of assistive technology, particularly in enhancing mobility solutions for individuals with disabilities. This study highlights the significance of academic-industry partnerships in driving forward research and innovation for societal benefit [3].

The research conducted by MA Al Rakib, S Uddin, MM Rahman, et al., and published in the European Journal of Engineering in 2021, focuses on the development of a smart wheelchair with voice control for physically challenged individuals. Utilizing Arduino as a key component, the study presents a detailed description of an embedded system that integrates voice commands and push-button controls for wheelchair operation. The proposed design offers innovative solutions aimed at enhancing mobility and accessibility for individuals with physical disabilities [4].

3. EXPERIMENTAL SETUP DESIGN AND DETAIL

The experimental setup comprises an AT Mega 328 Arduino microcontroller, HC05 Bluetooth module, and 4-way relay for signal processing and communication.

Component	Description
AT Mega 328 Arduino	₹300 - ₹600
4-way Relay	₹150 - ₹300
Bluetooth Module HC05	₹300 - ₹600
Two 12V Lead Acid Batteries	₹1500 - ₹3000
24V BLDC Motor	₹2000 - ₹3500
Box Pipes	₹750 - ₹1500
Cycle Front Tires	₹1500 - ₹2500
Cycle Chain	₹300 - ₹600
Sensor	₹600 - ₹1200
BMS 12V	₹600 - ₹1200
5Amp Circuit	₹300 - ₹600

Two 12V lead-acid batteries power the system, driving a 24V BLDC motor for propulsion. Structural components include box pipes, cycle front tires, and a chain mechanism. Sensors ensure user safety.

4. IMPLEMENTATION

The implementation of the voice-controlled wheelchair project begins with assembling the hardware components, including the AT Mega 328 Arduino microcontroller, HC05 Bluetooth module, 4-way relay, 24V BLDC motor, and two 12V lead-acid batteries, onto a robust frame constructed from box pipes. Wiring is carefully connected to ensure proper functionality, with the Arduino programmed to interpret voice commands received via Bluetooth and control the motorized propulsion system accordingly. The system undergoes rigorous testing to verify responsiveness to voice commands and smooth navigation across various terrains, with adjustments made as needed for optimal performance. Finally, safety features such as obstacle detection sensors are integrated, ensuring a user-friendly and secure mobility solution for individuals with physical disabilities.

5. METHODOLOGY

The methodology involved in the development of the voice-controlled wheelchair begins with the assembly of hardware components, including the AT Mega 328 Arduino microcontroller, HC05 Bluetooth module, 4-way relay, and 24V BLDC motor. These components are integrated into a robust framework constructed from box pipes, with cycle front tires and a chain mechanism facilitating movement. Electrical wiring connects the components, powered by two 12V lead-acid batteries. Subsequently, software programming is undertaken to enable the voice control functionality. The Arduino microcontroller is programmed to interpret voice commands received via the Bluetooth module, converting them into signals to control the motorized propulsion system. This involves coding for various commands such as forward, backward, left, right, and stop, ensuring precise wheelchair movement in response to user instructions.

6. PROPOSED DESIGN

The voice-controlled wheelchair system integrates an AT Mega 328 Arduino microcontroller with a HC05 Bluetooth module for seamless voice command interpretation. Hardware components such as a 4-way relay, 24V BLDC motor, and two 12V lead-acid batteries are mounted on a sturdy frame made of box pipes. Cycle front tires and a chain mechanism ensure smooth movement, while sensors enhance safety by detecting obstacles. This setup promises improved mobility for individuals with physical disabilities.

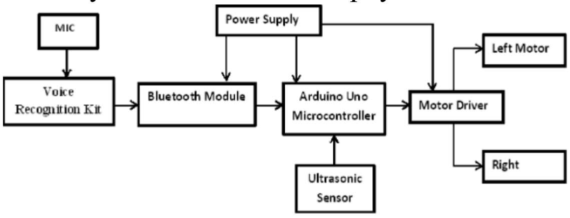

Fig. 1. Basic block diagram of the proposed system

7. CIRCUIT DESIGN AND FLOW CHART

System Configuration Overview: Integration of key components such as the Arduino microcontroller, Bluetooth module, and motor enables seamless interpretation of voice commands for wheelchair control.

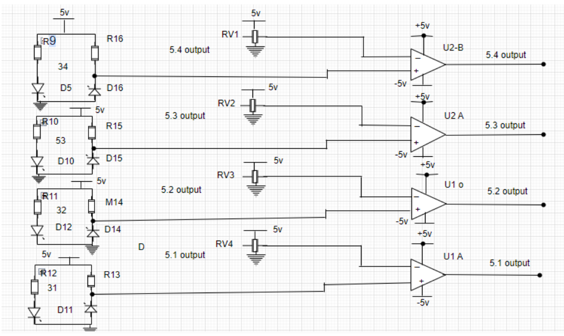

Fig. 2. Circuit diagram of the Voice Controlled Wheelchair

Wiring connections facilitate communication between these elements, ensuring smooth operation and responsiveness. This holistic approach to system configuration ensures efficient functionality and enhances the user experience for individuals with physical disabilities.

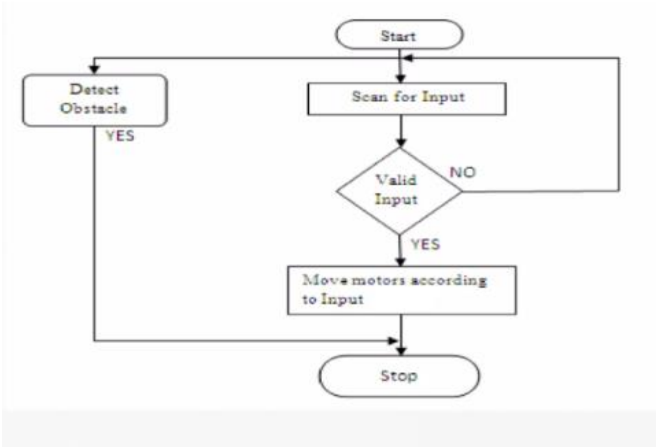

Fig. 3. Flowchart of the Voice Controlled Wheelchair

A graphical representation illustrating the sequential flow of operations within the system, depicting the interaction between components and the execution of tasks for wheelchair control.

8. RESULT AND DISCUSSION

The voice-controlled wheelchair system effectively interpreted voice commands for motorized propulsion, showcasing adaptability across diverse terrains. Obstacle detection sensors ensured user safety, underscoring the system's operational reliability. These findings suggest promising potential for enhancing mobility assistance for individuals with physical disabilities. Furthermore, the system's energy-efficient operation and durable construction ensure long-term reliability, offering sustainable mobility assistance for individuals with physical disabilities. These combined attributes underscore the system's effectiveness in addressing mobility challenges and improving the quality of life for users.

8. CONCLUSION

The Voice-Controlled Wheelchair project offers a transformative approach to empower individuals with physical disabilities, elevating mobility and independence to new levels. Leveraging Arduino technology and intuitive voice commands, the system provides seamless control over wheelchair movements. To further enhance functionality and usability, future endeavors should prioritize refining voice recognition accuracy and optimizing motor control algorithms. This ongoing commitment to improvement ensures continued advancements, fostering inclusivity and overcoming mobility barriers with ease.

REFERENCE

[1] Raiyan, Z., Nawaz, M. S., Adnan, A. K. M. A., & Imam, M. H. (2017). *Design of an arduino based voice-controlled automated wheelchair. 2017 IEEE Region 10 Humanitarian Technology Conference.*

[2] "The Maker: George Klein and the first electric wheelchair - U of T Engineering News." [Online]. Available: http://news.engineering.utoronto.ca/maker-george-klein-first-electric- wheelchair/. [Accessed: 30-Aug-2017].

[3] R. C. Simpson, "Smart wheelchairs: A literature review," *J. Rehabil. Res. Dev.*, vol. 42, no. 4, p. 423, 2005.

[4] Lin, Chern-Sheng & Chien-Wa, Ho & Wen-Chen, Chen & Chuang- Chien, Chiu & Mau-Shiun, Yeh. "Powered wheelchair controlled by eye-tracking system" Optica Applicata. 2006, Vol. 36 Issue 2/3, p401- 412.

[5] Tsui, Chun Sing & Jia, Pei & Gan, John & Hu, Huosheng & Yuan, Kui. (2008). EMG-based Hands-Free Wheelchair Control with EOG Attention Shift Detection. Proceedings of IEEE International Conferenceon Robotics and Biomimetics. 1266 - 1271. 10.1109/ROBIO.2007.4522346.

[6] Guin and B. B. Baishya, "Brain Controlled Wheelchair using LabVIEW," Jan. 2013.

[7] M. Mahmud, D. Hawellek, A. Bertoldo. (2010). EEG Based Brain- Machine Interface for Navigation of Robotic Device. Proc. 3rd IEEE/RAS-EMBS Intl. Conf. Biomed. Robotics & Biomechatronics (BioRob'10), Tokyo, Japan, 26-29 Sept. 2010, pp. 168-172, doi: 10.1109/BIOROB.2010.5627015

[8] M.S. Kaiser, Z. Chowdhury, S. Al Mamun, A. Hussain, M. Mahmud. (2016). A Neuro-Fuzzy Control System Based on Feature Extraction of Surface Electromyogram Signal for Solar-Powered Wheelchair. Cogn. Comput., 8(5): 946-954. doi: 10.1007/s12559-016-9398-4.

[9] "Tongue drive wheelchair (PDF Download Available)."[Online]. Available:https://www.researchgate.net/publication/237020352_Tongue _drive_wheelchair. [Accessed: 15-Aug-2017].

[10] Kathirvelan, R. Anilkumar, Z. C. Alex, and A. Fazul, "Development of low cost automatic wheelchair controlled by oral commands using standalone controlling system," *2012 IEEE Int. Conf. Comput. Intell. Comput. Res. ICCIC 2012*, 2012.