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Wheelchair for Differently Abled People: A Survey

Vanishri Sataraddi
PhD Scholar, Dept of CSE.
REVA University
Bengaluru, India
vanishrisataraddi@gmail.com

Dhanraj
PhD Scholar, Dept of CSE.
REVA University
Bengaluru, India
draj148@gmail.com

Dr Raje Siddiraju Upendra
Associate Professor, School of Electronics and Communication Engineering REVA UNIVERSITY|Rumini Knowledge Park | Kattigenahalli | Yelahanka | Bengaluru | Karnataka 560 064

Goverdhan P V
PhD Scholar, Dept of CSE.
REVA University
Bengaluru, India
goverdhanpv@gmail.com

***Abstract*— The present survey paper explores the landscape of voice-controlled wheelchairs, focusing on advancements and trends in supportive technology proposed for users with flexibility challenges. The study reviews various voice recognition techniques and their integration into wheelchair systems, highlighting the evolution of user interfaces and control mechanisms. The incorporation of Bluetooth streamlines cordless connectivity between the voice control interface and the wheelchair, delivering a versatile and user-centric interaction. Additionally, the paper investigates the incorporation of obstacle detection technologies for enhanced safety during navigation. By summarizing key findings from existing research, this survey will help the researchers to bring in new technology to make the differently abled people use. This endeavour seeks not only to elucidate the present advancements in smart wheelchairs but also to lay the foundation for upcoming breakthroughs that hold the potential to redefine the landscape of assistive technology.**

Keywords— ***Assistive Technology, Voice recognition module, Voice control, Bluetooth module, Obstacles detection.***

I INTRODUCTION

Access to assistive technologies, crucial for upholding the human rights and fundamental freedoms of individuals with disabilities, remains limited in numerous nations, with the World Health Organization (WHO) [1] estimating that only 5–15% of those in need have such access in low- and middle-income countries. Compliance with the Convention on the Rights of Persons with Disabilities (CRPD)[2] necessitates measures to ensure the provision of assistive technology, underscoring its importance in facilitating equal opportunities and inclusion.

The advent of voice-controlled wheelchairs marks a significant breakthrough in the realm of assistive technology, particularly for individuals facing physical challenges. Survey papers in this field have played an integral role in systematically documenting and analysing the evolution of voice-controlled wheelchair technology. These innovative mobility solutions are designed to cater to the distinct requirements of people with physical disabilities, aiming to offer a more accessible and intuitive means of navigating their environments.

Voice-controlled wheelchairs leverage cutting-edge technologies, and survey papers have meticulously explored the incorporation of these advancements. One such pivotal aspect is the execution of advanced speech recognition systems. These systems are designed to interpret a diverse range of voice commands, enabling users to maneuver their wheelchairs with unparalleled ease. The synthesis of artificial intelligence and machine learning techniques in these systems, as outlined in survey papers, underscores the adaptability and responsiveness of voice-controlled wheelchairs to individual user needs.

Moreover, the incorporation of obstacle detection mechanisms has been a focal point in the evolution of these wheelchairs. Survey papers elaborate on the assimilation of detector and cameras that enable real-time detection of obstacles, contributing to a safer and more autonomous navigation experience. This critical feature not only enhances user safety but also fosters a greater sense of confidence and independence among individuals facing mobility challenges.

Wireless communication approaches, such as Bluetooth, Survey papers have extensively examined these technologies, fostering a smooth and intuitive connection between the voice control interface and the wheelchair. This wireless connectivity not only eliminates the requirement for cumbersome physical connections but also adds a layer of convenience, enabling users to remotely operate their wheelchairs.

As we delve into the insights derived from survey papers, a compelling narrative emerges—one of continual innovation and a collective commitment to enhancing the lives of mobility-impaired individuals. The synthesis of technologies in voice-controlled wheelchairs represents a harmonious convergence of engineering, artificial intelligence, and user-centric design. This introduction sets

the stage for a deeper exploration of the review papers, where we unravel the intricate facts of the methodologies, findings, and future prospects that shape the landscape of voice-controlled wheelchairs for those in need.

II LITERATURE REVIEW

The smart system [3] designed and the study conducted a mobility experiment of the automatically moving robot intended for the elderly with voice control through wireless smartphone devices by allowing test participants to speak through the application on the wireless smartphone devices with 4 commands, such as go forward, go backward, turn left, and turn right based on 3 patterns of testing [3].

The smart system proposed in paper addresses the requirements of disabled individuals by incorporating therapy facilities into a wheelchair. This paper is centered around the configuration of a solitary wheelchair equipped
with various facilities. The system includes a therapy unit specifically tailored for limb rehabilitation, executed through the utilization of a vibrator, Figure 1. Powered by an ATmega328/P microcontroller, the system offers the capability to control its speed [4]. This research underscores the incorporation of multiple functionalities into a unified wheelchair system, demonstrating a commitment to providing a comprehensive solution to improve the maneuverability and well-being of disabled individuals. [4], [5]. The design of a smart, powered, voice command, and push button-controlled wheelchair utilizing an embedded system is described in this article. The proposed design has a voice activation system for physically disabled people, sick patients, and the elderly. This article depicts a "speech and push button-controlled Wheel chair" for physically disabled people, in which the motions of the wheelchair are controlled by a voice command or a switch command. The voice command or switch command is supplied via a Bluetooth-enabled cellular device, and the command is transmitted and translated to string by the smart phone app or switch Control for Arduino and is transferred to the Bluetooth Module linked to the Arduino board for Wheelchair control [5] [8].

The Voice Operated Wheelchair with Obstacle Identification [6] introduces a system engineered to function based on users' voice commands, empowering them to manage the wheelchair autonomously. Responding to simple vocal instructions, this wheelchair operates through voice control initiated by the user, facilitating a user-friendly interface. Moreover, the mobility device is outfitted with a camera mounted on its frame, strategically positioned to supervise the surroundings.

The Optic Controlled Wheelchair Using Transfer Learning [7] the wheelchair is operated through a combination of eye movement and voice commands, providing an inclusive and accessible solution. To enable precise eye control, researchers introduced a Recursive Circular Hough Transform (RCHT) scheme for pupil detection. Pupil images, captured using a low-resolution cell phone camera, underwent sophisticated image processing procedures to
accurately detect visual tracking. The system, running on Raspberry Pi computer, interprets the corresponding output signals and directs the wheelchair's movement through motor control. [12] Furthermore, voice assistance enhances user interaction, allowing for additional control through vocal commands. This all-encompassing approach not only attends to the mobility requirements of people with physical impairments but also exemplifies the capacity of cutting-edge technology to forge inclusive solutions, fostering enhanced accessibility and autonomy [9] [10].

The Smart Wheelchair Controlled by Head Gesture Based on Vision [9] introduces a pioneering system designed to control a wheelchair through voice recognition and head movements. The system utilizes a MEM sensor to detect and interpret head movements, providing a streamlined and intuitive interface for users. The MEM sensor adeptly captures nuanced gestures, transmitting corresponding signals to a microcontroller and providing meticulous control over the wheelchair's movements [14] [15] [16].

II RESEARCH GAP

The critical literature review reveals that there is a potential to improve the wheel chair so as to help the differently abled people. Following are the gaps found through literature survey

- User-Centered Design Lack of research involving differently abled individuals in the design process, hindering understanding of their unique needs and preferences for more effective wheelchair designs.
- Cultural and Socio-economic Factors Insufficient exploration of how cultural beliefs, societal attitudes, and economic constraints influence wheelchair accessibility and acceptance across different communities.
- Long-Term Outcomes Limited focus on long-term effects of wheelchair use, including its impact on physical health, psychological well-being, social participation, and quality of life over time.
- Customization and Personalization Inadequate research on customizable and personalized wheelchair features tailored to specific disabilities, body types, and functional requirements for improved user experience.

  Environmental Accessibility Lack of attention to how environmental factors such as infrastructure design, transportation systems, and urban planning affect wheelchair accessibility and usability in different settings.
- Technology Integration Limited exploration of integrating advanced technologies like robotics, artificial intelligence, and smart sensors into wheelchair design to enhance mobility, autonomy, and safety.
- User Training and Support Insufficient research on optimal training programs, education strategies, and rehabilitation interventions to maximize independence and skill development among wheelchair users.

  Psychosocial Impact Inadequate understanding of the emotional, social, and cultural implications of relying on a wheelchair for mobility, hindering the development of holistic support strategies.

VI PROPOSAL

Proposed system integrates cutting-edge technologies, including smart sensors and a DC motor to ensure steadiness and efficient manoeuvrability. By incorporating an obstacle detection system and customizable voice commands, alongside wireless communication via Bluetooth, the system offers user-friendly controls and personalized navigation, enhancing safety features.

This revolutionary wheelchair technology aims to empower users, enabling them to navigate environments with confidence and dignity while promoting inclusivity and accessibility worldwide.

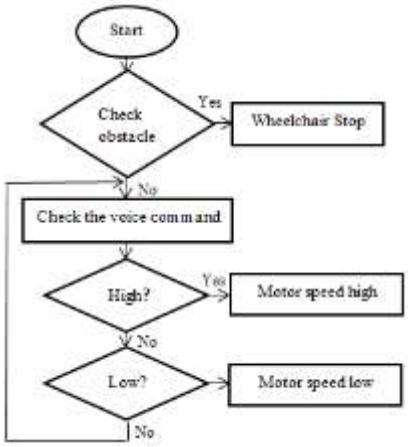

Figure Flow diagram for Wheel chair

Critical literature review is given in Table 1.

Study	Key Findings
Phillips, et al. (2020)	Explored user perspectives on wheelchair design, emphasizing the importance of involving differently abled individuals in the design process.
Smith and Patel (2019)	Investigated the impact of socioeconomic factors on wheelchair accessibility and usage patterns.
Ahmed et al. (2021)	Investigated the psychosocial impact of wheelchair use on individuals' self-esteem, identity, and social participation.
Zhang et al. (2020)	Investigated the integration of advanced technologies, such as robotics and smart sensors, into wheelchair design to enhance mobility and user experience.

V METHODOLOGY

The methodology employed in evolving the voice-controlled wheelchair, as revealed in the survey paper, entails a multi-faceted approach. Initially, the implementation centres around deploying an advanced speech recognition system capable of interpreting diverse vocalization commands. The incorporation of a sophisticated motor control mechanism follows, allowing seamless translation of recognized voice commands into precise wheelchair movements. The wheelchair's hardware configuration involves a careful setup with four wheels independently controlled by DC motors to maintain steadiness and efficient manoeuvrability. Additionally, the incorporation of an obstacle detection system, customizable voice commands, and wireless communication approaches, such as Bluetooth, contributes to the overall functionality.

- Upon recognizing voice commands, the wheelchair responds by aligning itself according to the user's instructions. Electric signals are employed to transmit these commands, regulating the activity of the mobility aid’s left or right motors. To maintain stability, four wheels are employed, each governed by DC motors linked to the mobility aid. One motor oversees the left wheels, and an-other controls the right wheels. The parallel ports, specifically the communication port, enable the precise transmission of electrical commands to the motors, ensuring accurate regulation over the mobility aid's movement in accordance with the user's spoken instructions.

VII CONCLUSION

In conclusion, the survey paper highlights the evolving landscape of voice-controlled wheelchairs, emphasizing their potential to significantly Augmenting both mobility and autonomy for individuals facing physical challenges. The synthesis of various technologies, including advanced speech recognition, obstacle detection, and wireless communication, underscores a promising trajectory in assistive skill. The reviewed literature indicates a growing trend toward user-centric designs, incorporating customizable voice commands and safety features. As the field progresses, it becomes evident that voice-controlled wheelchairs not only offer practical solutions for users but also embody a symbol of empowerment and inclusivity. The insights gathered from this survey pave the path for continued innovation and development in the quest to deliver accessible and personalized mobility solutions for persons with diverse mobility needs.

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