

Automatic Wireless Control Wheel Chair

Prof. Y. P. Sushir¹, Mr. Girish Patil², Mr. Atharv Bhole³, Mr. Mayur Rane⁴, Mr. Jayesh Rane⁵, Jayesh Dhangar⁶, Pratik Patil⁷

¹Professor, Department of Electrical Engg, Dr. V. B. Kolte College of Engineering, Malkapur, India

^{2,3,4,5,6,7}Students, Department of Electrical Engg, Dr. V. B. Kolte College of Engineering, Malkapur, India

DOI: 10.5281/zenodo.19306910

ABSTRACT

The Wheelchair Control System using Wireless Accelerometer is an innovative project designed to assist physically challenged individuals in achieving greater mobility and independence. This system utilizes an accelerometer sensor to detect the tilt and orientation of the user's hand or head movements, which are translated into directional commands for controlling the wheelchair wirelessly. The accelerometer senses motion along multiple axes and transmit corresponding signals via a wireless module, such as Bluetooth or RF, to a microcontroller-based receiver circuit attached to the wheelchair. The microcontroller then drives the motors to move the wheelchair forward, backward, left, or right according to the user's gestures. This hands-free control mechanism eliminates the need for manual joystick operation, making it especially useful for users with limited hand or arm movement. The system offers advantages such as ease of use, low power consumption, and cost-effectiveness. Furthermore, safety features like emergency stop functionality and obstacle detection can be integrated to enhance user security. The proposed wireless accelerometer-controlled wheelchair thus provides a practical, smart, and affordable mobility solution for differently-abled individuals, enabling them to navigate their surroundings with minimal physical effort.

Keywords:- Wheelchair, Accelerometer, Wireless control, Microcontroller, Gesture recognition, Mobility assistance, etc

I. INTRODUCTION

Mobility is a fundamental requirement for human independence and quality of life. For individuals with physical disabilities, spinal cord injuries, neurological disorders, or age-related mobility limitations, independent movement becomes a major challenge. Wheelchairs have long served as essential assistive devices to support mobility; however, conventional manual wheelchairs demand significant physical effort, and even powered wheelchairs typically rely on joystick-based control mechanisms. These traditional control methods are not suitable for all users, particularly those with limited hand strength, involuntary muscle movements, or restricted motor coordination. As a result, there is a growing need for advanced wheelchair control systems that are intuitive, adaptable, and user-friendly. Recent advancements in embedded systems, sensor technology, and wireless communication have led to the development of intelligent wheelchair control systems. Among the various alternative control techniques proposed such as voice recognition, eye tracking, and brain computer interfaces accelerometer-based wireless control has gained considerable attention due to its simplicity, reliability, and cost-effectiveness.

An accelerometer is a motion-sensing device capable of detecting tilt and acceleration along multiple axes. When integrated into a wheelchair control system, it allows users to control movement through natural hand or body gestures, reducing the physical and cognitive effort required for operation. In a wireless wheelchair control system using an accelerometer, the user typically wears or holds a small control unit equipped with an accelerometer sensor. This sensor detects tilt movements along the X and Y axes, which are mapped to directional commands such as forward, backward, left, and right. These commands are processed by a microcontroller and transmitted wirelessly commonly using Bluetooth or similar short-range communication technologies to a receiver unit mounted on the wheelchair. The receiver interprets the commands and drives the wheelchair motors accordingly.

The elimination of physical wiring between the user interface and the wheelchair improves comfort, flexibility, and safety during operation. One of the key advantages of accelerometer-based control is its intuitive nature. Unlike joystick systems that require precise finger movements, accelerometer control relies on simple tilt gestures that can be performed with minimal effort. This makes the system particularly beneficial for users with partial hand movement, muscular weakness, or limited motor control. Additionally, wireless communication ensures that the control unit can be positioned conveniently according to the user's comfort, further enhancing accessibility. The integration of accelerometers also enables smooth and proportional control of wheelchair movement. By adjusting sensitivity thresholds, the system can respond gradually to user inputs, allowing precise manoeuvring in confined spaces. Moreover, accelerometer-based systems can be easily combined with safety

features such as obstacle detection sensors, emergency stop mechanisms, and speed control functions, making them suitable for real-world environments.

Despite its advantages, designing an effective accelerometer-based wireless wheelchair control system requires careful consideration of several factors, including signal noise, unintended movements, calibration for different users, and communication latency. Proper filtering techniques and control algorithms are essential to ensure reliable performance and user safety. Nevertheless, continuous improvements in sensor accuracy, microcontroller processing power, and wireless technologies have significantly reduced these challenges. In conclusion, the wheelchair control system using wireless accelerometer technology represents a promising solution for enhancing mobility assistance. By providing an intuitive, flexible, and cost-effective alternative to conventional control methods, this approach has the potential to greatly improve independence and quality of life for individuals with mobility impairments. With further development and integration of intelligent features, such systems can play a vital role in next-generation assistive healthcare technologies.

OBJECTIVE

- To develop a hands-free wheelchair control system using an accelerometer sensor.
- To enable wireless communication between the accelerometer module and the wheelchair.
- To assist physically disabled users in moving independently and safely.
- To design a cost-effective and user-friendly control system.
- To process accelerometer data for accurate direction control.

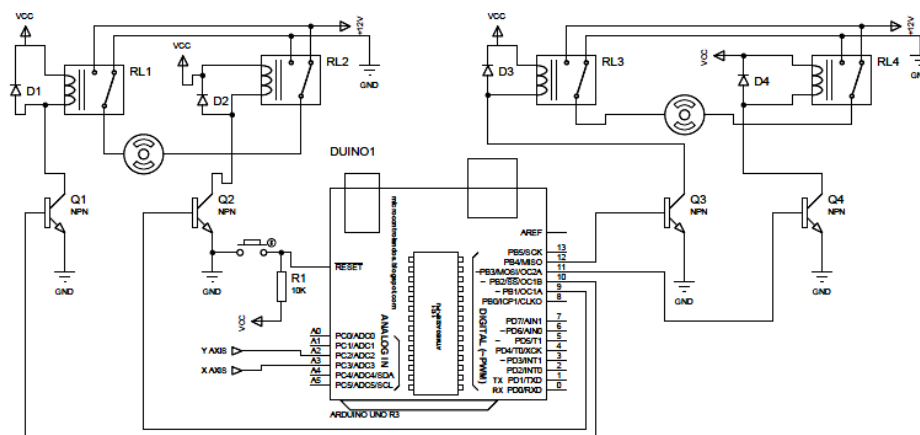
II. LITERATURE REVIEW

- **Ababneh, M., et al.(2018)**, In the paper by author some approaches to assist elderly and wheelchair people are accomplished by employing Socially Assistive Robots (SAR). Few of which are used as assistants while performing specific exercises that improve human health. These robots are used in assisting the elderly people to walk. However, in many cases these robots are expensive choice for the kind of the service they provide. Other approaches include wearable data gloves to provide communication with caregiver or attached inertial sensor for fall detection of elderly people. In many cases, these sensing devices might be annoying to the elderly and wheelchair people as they must be attached or fixed to them.
- **Rajesh Kannan, et al., et al.(2018)** The authors of the paper show the statistics of India i.e. 20.3% of the differently abled people have mobility issues. They have used Android's open platform to develop a mobile application which can pair with the wheelchair's wireless module via the app's Bluetooth so that the caretaker can make use of this technology to help the patient with locomotion. Also, the pairing of the master and the slave requires a password which makes it difficult for unauthorized people with the app to control the wheelchair. Although, they use specific finger movements which could be a task for the disabled to move the fingers in an appropriate angle to have accurate movement of the wheelchair.
- **Shraddha Uddhav, et al. (2022)** In another paper by author, a wheelchair is fitted with sensors like the obstacle, temperature, gas and smoke along with a smart phone to help driver achieve independent mobility. The wheelchair user can navigate himself around in 4 directions by just tilting his smart phone. This approach allows the user to synchronize the movement of his wheelchair with the smart phone's human voice or gesture recognition capabilities. The complexity decreases by using smart phones in order to obtain a compact system.
- **Gao, Xiang et al. (2022)** The research paper, has emphasized on creating a gesture interaction method which is developed to control the mobile service robot. A new detecting method was proposed in this paper which fused skin colour method and deep information. The whole system can identify the user's intention by the gesture interaction system and adjust the speed and direction of the robot according to the result of gesture recognition in real time. They have made use of kinetic cameras for hand gesture recognition.
- **Sunil Karamchandani et al. (2023)** The authors of the research paper, have worked on making the movement of Quadriplegic better with the help of hand gestures as they use the wheelchair. The movement of their hands in the forward, backward, left and right direction will accordingly move the wheels of the wheelchair which use DC motors for the movement of the wheels. Also, the use of RF transmitting unit is used instead of IR because of the accuracy provided by the RF sensors is measured to be better.
- **Megalingam et al. (2023)**, have created an HanGes application which uses the patient's entire palm for movement in any direction. The system HanGes, comprises of a gesture tab that includes sensors like the IR and MCU and a management circuit that are specifically designed to identify and recognize gestures. They have also implemented a controller for driving motors. Placing the hand on the Gesture pad and changing the direction of the palm horizontally moves the wheelchair. The drawback of this system would be the absence of an external mobile application and also lack of obstacle detection capability.

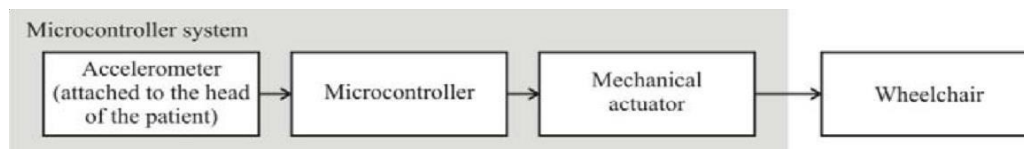
III. WORKING & IMPLEMENTATION

In proposed framework we are getting to screen the elderly individuals controlling wheelchair by utilizing hand signal and voice commands. Conjointly screen debilitated individuals controlling wheelchair and the working of cautions framework to their caretakers. The system consists of major components like ATMEGA328 with 32K Flash memory, accelerometer Sensor, 2 DC Motors and 12V DC supply, Relays, ADC, Crystal oscillator, LED circuitry etc

CIRCUIT DIAGRAM:



BLOCK DIAGRAM:



ACCELEROMETER:

An accelerometer is an integrated device that measures proper acceleration, the acceleration experienced relative to freefall. Single- and multi axis models are available to detect magnitude and direction of the acceleration as a vector quantity, and can be used to sense orientation, acceleration, vibration shock, and falling. Micro machined accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input. It is a capable of measuring how fast the speed of object is changing. It generates analog voltage as the output which is used as an input to the control system. The accelerometer used in this automated system is ADXL335. It is a three axis accelerometer, which senses the tilt in two directions only. The supply voltage ranges from 2 to 3.6v

IV. WORKING

The wheelchair control system using wireless accelerometer operates by translating hand motion into movement commands for the wheelchair. An accelerometer sensor is mounted on a glove or handheld device worn by the user, which continuously detects the tilt of the hand along different axes. When the user tilts the hand forward, backward, left, or right, the accelerometer generates corresponding signals that are processed by a microcontroller. These signals are compared with predefined threshold values to determine the intended direction of movement. The processed command is then transmitted wirelessly, typically using Bluetooth or Zigbee communication, to the receiver unit installed on the wheelchair. The receiver microcontroller decodes the received command and activates the motor driver circuit, which controls the DC motors to move the wheelchair in the desired direction.

If no hand movement is detected, the wheelchair remains stationary, ensuring safe operation. This continuous and real-time process allows smooth, intuitive, and hands-free control of the wheelchair, enhancing mobility and independence for physically challenged users.

ADVANTAGES:

User Friendly, Efficient and Low Cost Design , Fast Response , Low Power Consumption , Helpful for the paralysis stroke people who don't have much stamina in the hands., Reduces the human activity. , Reduces the physical strain. , Easy to operate with least movement required.

V. CONCLUSION

The wheelchair control system using wireless accelerometer technology provides an effective and user-friendly solution for enhancing mobility assistance for physically challenged individuals. By utilizing hand motion as the primary control input, the system eliminates the limitations of conventional joystick-based wheelchairs and offers a more intuitive and natural method of operation. The integration of an accelerometer with a microcontroller and wireless communication enables smooth, real-time control of wheelchair movement with minimal physical effort. The developed system demonstrates reliable performance, low power consumption, and ease of implementation, making it suitable for practical and cost-effective assistive applications. Additionally, the wireless design improves user comfort and flexibility while reducing mechanical complexity. Overall, this project highlights the potential of sensor-based wireless control systems in assistive technologies and serves as a foundation for future enhancements such as obstacle avoidance, voice control, and autonomous navigation, ultimately contributing to improved independence and quality of life for users.

VI. REFERENCES

- [1] Cihan Topal, Atakan logan and Omer NezibGerek, "A Wearable Head Mounted Sensor-Based Apparatus for Eye Tracking Applications" VECIMS 2008 IEEE International Conference on Virtual Environments, Human Computer Interfaces, and Measurement Systems Istanbul, Turkey, 14-16 July 2008
- [2] Y Chen, Application of Tilt Sensors in Human-Computer Mouse Interface for People with Disabilities, in IEEE Transactions Neural Systems and Rehabilitation Engineering. Vol. 9, No. 3. September 2001, pp. 289-295
- [3] P.S. Gajwani and S.A. Chhabria. Eye motion tracking for wheelchair control. International Journal of Information Technology, 2(2):185-187, 2010.
- [4] Ericka Janet Rochy-Ramirez, Huosheng Hu and Klaus McDisnald-Maier, "Head movement based control of an intelligent wheelchair in an indoor environment, Proceeding of the 2012 IEEE, international conference on robotics and biomimetic. December 11-14, 2012, Guangzhou, China.
- [5] Ababneh, M., et al. "Gesture Controlled Mobile Robotic Arm for Elderly and Wheelchair People Assistance Using Kinect Sensor." 2018 15th International Multi-Conference on Systems, Signals & Devices (SSD). IEEE, 2018
- [6] Megalingam, Rajesh Kannan, et al. "Wireless gesture controlled wheelchair." 2017 4th International Conference on Advanced Computing and Communication Systems (ICACCS). IEEE, 2017.
- [7] Khadilkar, Shraddha Uddhav and Narendra Wagdarikar "Android phone voice, gesture and touch screen operated smart wheelchair." 2015 International Conference on Pervasive Computing (ICPC). IEEE, 2015.
- [8] Gao, Xiang, Lei Shi, and Qiang Wang. "The design of robotic wheelchair control system based on hand gesture control for the disabled." 2017 International Conference on Robotics and Automation Sciences (ICRAS). IEEE, 2017.
- [9] Jain, Yash M., Saurabh S. Labde and Sunil Karamchandani. "Gesture controlled wheelchair for quadriplegic children." 2016 3rd International Conference on Systems and Informatics (ICSAI). IEEE, 2016.
- [10] Megalingam, Rajesh Kannan, et al. "IR sensor-based gesture control wheelchair for stroke and SCI patients." IEEE Sensors Journal 16.17 (2016): 6755-6765.
- [11] Lu Tao "A motion control method of intelligent wheelchair based on hand gesture recognition." 2013 IEEE 8th Conference on Industrial Electronics and Applications (ICIEA). IEEE, 2013.
- [12] U. Cortés, C. Urdiales, R. Annicchiarico, C. Barrué, A.B. Martinez, C. Caltagirone: Assistive Wheelchair Navigation: A Cognitive View, Studies in Computational Intelligence Advanced Computational Intelligence Paradigms in Healthcare – 1, Vol. 48, 2007, pp. 165 – 187