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RESEARCH ARTICLE OPEN ACCESS

HAND GESTURE WHEELCHAIR

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Abstract:

Hand Gesture Controlled Wheelchair (HGWC) to enhance mobility for individuals with physical disabilities. The system integrates vision-based hand gesture recognition and voice command processing to provide intuitive and accessible control. Sensors and a camera detect gestures for navigation (forward, backward, left, right, stop), while voice commands enable additional features like opening doors or seat adjustment. Bluetooth and GPS functionalities enhance connectivity and tracking. The wheelchair is cost-effective, user-friendly, and designed to simplify operation for diverse users, including the elderly. This innovation empowers users with greater independence, mobility, and improved quality of life.

Keywords: **Wheelchair, DC Motor, Arduino Uno, ADXL Accelerometer, Gesture.**

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I. Introduction:

The wheel chair is wireless and has a range of 200 yards. It means a person can control his wheelchair from 200 yards away. He can call his chair while sitting from one place irrespective of weather conditions**.** The disabled people always find difficulties in moving from one room to another and even to do that the handicapped person was dependent on someone else who will push the wheelchair manually and take the handicapped person from one place to another. It provides an instrumental solution to the people who have difficulty in moving or their body part has paralyzed, or they have lost their limb in an accident. Bringing the technology and economy parallel to each other is paramount aim of this paper.. Today in this modern era around world's 10 percents, around 650 million people are suffering from physical disability. In order to make their life bit easier we decided to make a hand gesture controlled wheelchair which will be working on the gesture of their hand. Now with the Hand Gesture Controlled Wheelchair the handicapped person is independent and he need not to ask for help from any other person to move his wheelchair. Just with the movement of his hand the handicapped person is able to move from one place to another without needing anyone's assistance which also makes him self-dependent.

II. Literature survey:

Pushpendra Jha and P. Khurana, et.al [1] Hand Gesture Controlled Wheelchair for the physically disabled people who face difficulty in moving from one place to another in day today life. These days joystick controlled wheel chair is available in the market whose cost range between Rs 80,000 to Rs 150,000. An accelerometer is used as a sensor which gives an analog signal on its movement in any of the 6 axis directions, that is positive X axis, negative X axis, positive Y axis, negative Y axis,

positive Z axis, negative Z axis. In this project we have considered X and Y axis for the directions.

S.Padmapriya,et.al [2] Intended users control the system by wearing an instrumented glove fitted with flex or bend sensors for controlling the movement and direction of the wheelchair. Uni-directional wireless communication exists between the instrumented gloves and the controller which is sandwiched between the user's seat and the wheels. contributes to the development of intelligent, hands-free mobility solutions, significantly enhancing the independence of individuals with mobility impairments.

Veeraiyan Sridevi, P. Iswarya, Surya Chandra, et.al[3] Design and implementation of a low-cost hand gesture controlled automated wheelchair-using Arduino based microcontroller and Node MCU is presented in this paper. The main focus of this study is to control the wheelchair with the movement of the hand-wrist movement. Besides hand gestures, the wheelchair can also be controlled via Bluetooth technology.

Mufrath Mahmood, Md Fahim Rizwan, Masuma Sultana,et.al[4] Hand gesture-controlled wheelchair is a special kind of movable device which can control the motion of wheelchair at right direction through the hand movements of any person. This type of wheelchair is a blessing for those people who are not capable to move their lower limbs and are fully dependent on the caretaker for their activities.

Hemlata Sharma and Nidhi Mathur,et.al [5] A three-axis accelerometer 'Micro-Electro-Mechanical Systems (MEMS)' is used here as a sensor which is connected to the hand and sends the position of the hand to the microcontroller Arduino Lilypad. On the basis of data gathered from the accelerometer, microcontroller drives the signal to move the wheelchair in the desirable direction.

Shreedeep Gangopadhyay, Somsubhra Mukherjee, et.al[6] This paper presents an intelligent gesture-controlled wireless wheelchair system designed to improve accessibility and independence for physically handicapped individuals. The proposed system employs gesture recognition technology, utilizing accelerometer-based motion sensing to interpret hand movements and translate them into wheelchair navigation commands.

R.K. Megalingam, S. Sreekanth, G. A., et.al[7] Wheelchair mobility is essential for individuals with physical disabilities, and advancements in assistive technology have led to innovative control mechanisms. This paper presents a wireless gesture-controlled wheelchair that enables users to navigate effortlessly using hand gestures. The system employs an accelerometer-based sensor to capture gesture inputs, which are processed and transmitted wirelessly to control the wheelchair's movement

R.A. Kalantri and D.K. Chitre,et.al [8] This paper presents the development of a smart wheelchair system designed to assist users with minimal physical movement capabilities. The system integrates intelligent sensors, voice recognition, and gesture-based controls to enable seamless navigation. Advanced obstacle detection and path-planning algorithms enhance user safety, while wireless communication ensures real-time responsiveness.

Table 2.1 Summarization of Hand gesture Wheelchair.

Technology	Author	Advantages	Limitation
Joystick controlled wheelchair	Pushpendra Jha and P. Khurana et. al	• Ease of use • Precision and Control	• Maintanance • Limited movement
Hands-free Wheelchair control system	S.Padmapriya, et.al	• Hands-Free Operation • Increased Independence	• Learning Curve • Cost and Accessibility
Low-Cost hand gesture controlled automated Wheelchair	Veeraiyan Sridevi,P. Iswarya,Surya Chandra, et. al	• Cost Effective • Wireless Control	• Limited control range • Hardware limitations
Hand gesture-	Mufrath Mahmood, Md	• Improved mobility	• Limited range

controlled wheelchair	Fahim Rizwan, et. al	• Flexibility	• Sensor reliability
Gesture controlled wheelchair	Hemlata Sharma and Nidhi Mathur et. al	• Customizable • Adaptable	• Complexity in setup • Limited precision
Intelligent gesture-controlled wireless wheelchair	Shreedeep, et. al	• Wireless communication • safety feature	• Cost • Battery life
Wireless gesture-controlled wheelchair	R.K.Megalingam, S. Sreekanth,et.al	• User comfort • Experimental validation	• Precision of control • Limited hand mobility

III. System Architecture:

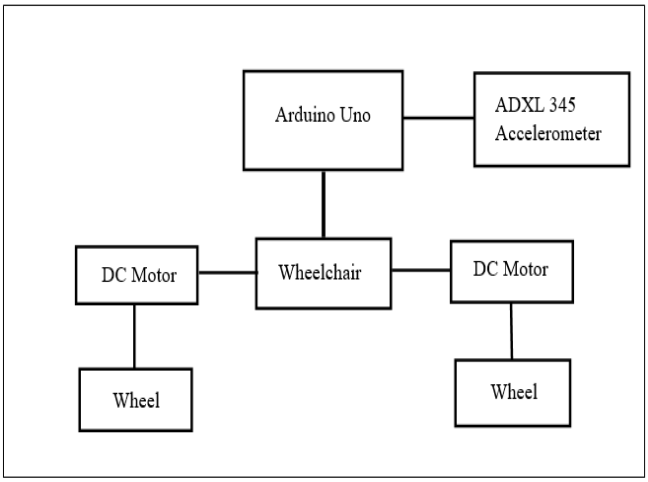

Fig 3.1. System Architecture

A hand gesture-controlled wheelchair works by using sensors that detect and interpret the user's hand movements, converting those gestures into commands to control the wheelchair's movement. The system typically employs accelerometers and gyroscopes to detect motion and orientation changes in three dimensions. The accelerometer detects changes in acceleration, indicating whether the user's hand is moving forward, backward, or sideways. These sensors provide continuous feedback to a microcontroller, which processes the data to identify specific hand gestures, such as moving the hand up to go forward or turning the wrist to steer. In some systems, infrared sensors or cameras might be used to track the position of the hand in space, enabling more complex gestures or even controlling the wheelchair's functions through visual recognition.

IV. Conclusion:

The development of a hand gesture-controlled wheelchair using Arduino Uno represents an innovative and cost-effective approach to assist individuals with mobility impairments. By leveraging Arduino's flexibility and affordability, along with sensors such as accelerometers or gyroscopes to detect hand gestures, this system allows users to control the wheelchair through simple hand movements. This can significantly enhance the independence and autonomy of users who may have limited control over traditional wheelchair mechanisms.

While the use of Arduino Uno makes this project more accessible for prototyping and experimentation, the system's success depends on the precision of the gesture recognition, reliability of the sensors, and the ease of use for the individual. Challenges such as ensuring real-time response, minimizing interference, and optimizing battery life are key areas for improvement. Furthermore, ensuring the system's robustness and safety is critical for practical real-world applications.

V. Future scope:

The future scope for hand gesture-controlled wheelchairs for disabled individuals holds significant promise for expanding functionality, enhancing personalization, and improving accessibility. Below are several exciting areas for future development:

1. Advanced Gesture Recognition: Expanding the range of hand gestures to include complex combinations, enabling more intuitive and efficient control of the wheelchair.

2. Multimodal Integration: Combining hand gesture control with other technologies like eye gaze tracking, head movement, or voice commands to provide a more comprehensive control experience.

3. Enhanced Intelligence and Safety: Incorporating advanced sensors for obstacle detection, alongside real-time path planning, to improve navigation safety.

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