Intuitive Hand Gesture Control for Wheelchair Maneuverability

ABSTRACT

- Through the seamless integration of a Micro-Electro-Mechanical Systems (MEMS) accelerometer-based controller within an ergonomic glove, this project presents an interesting approach to wheelchair control. The intent is to develop a system that is responsive and easy to use so that people with physical limitations can operate wheelchairs with mild hand movements. With regard to forward and backward motion, as well as rotation, the MEMS technology precisely interprets movements along the x- and y-axes.
- The development process follows by user-centric design principles, which guarantee that the system satisfies a wide range of user needs. Physically disabled people participating in real-world testing is essential for iterating the system based on direct responses from users. The end result enables accurate wheelchair control and a completely new way to move around, which is a significant tech leap. The project's emphasis for accessibility, inclusivity, and ongoing cooperation seeks to make a more engaged and inclusive environment for those with restricted mobility. The ultimate goal of this project is to enhance users overall quality of life by encouraging their independence and control via cutting-edge assistive technology.

PROBLEM STATEMENT

- Addressing mobility limitations in individuals with physical disabilities, this project focuses on creating a MEMS accelerometer-based wheelchair controller integrated into a glove. The challenge involves designing a system capable of accurately interpreting subtle hand movements detected by the accelerometer. Hand movements along the x-axis control forward and backward wheelchair motion, while movements along the y-axis dictate rotation. The aim is to develop an intuitive and accessible glove-based control mechanism to enhance independence and overall quality of life for users with mobility impairments.

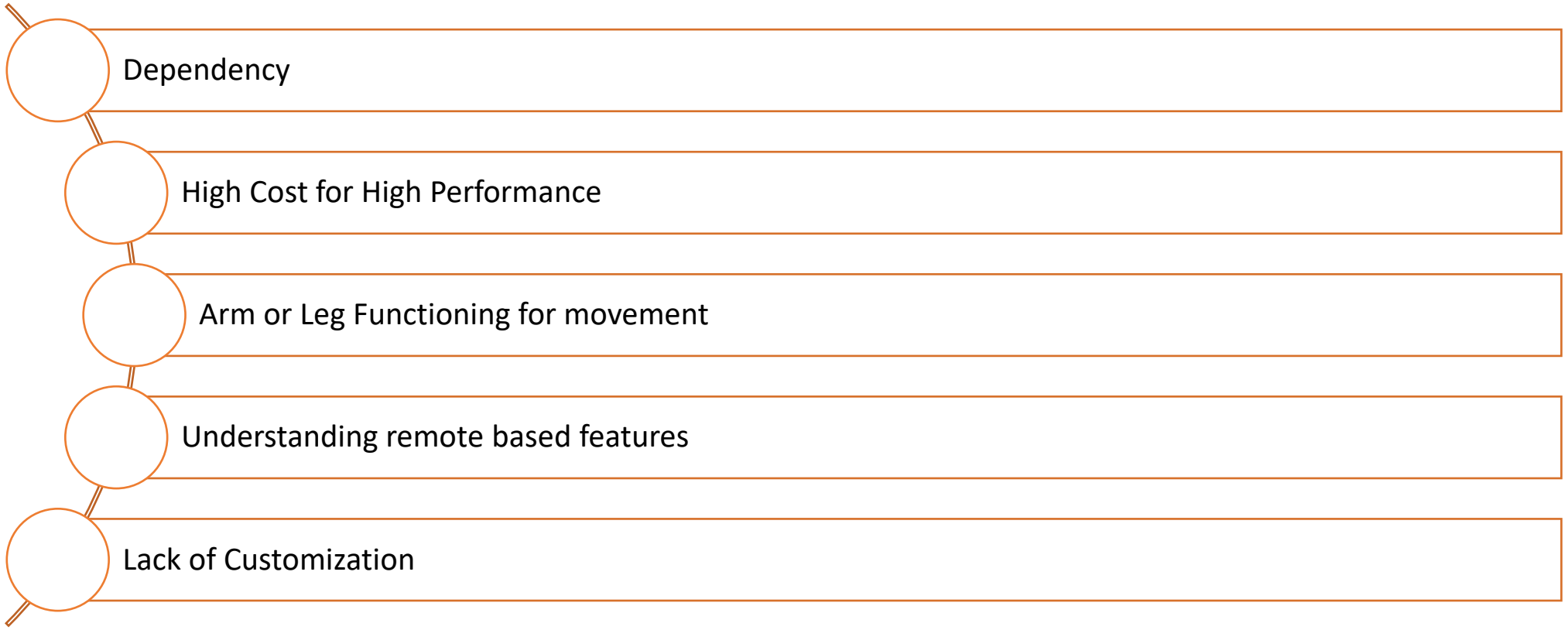
INTRODUCTION

- In an effort to empower and enhance the daily lives of people with limited mobility, the MEMS Accelerometer-Based Wheelchair Controller project pioneers an innovative integration of cutting-edge technology and human-centered design. For individuals facing physical disabilities, traditional wheelchair controls often impose limitations, prompting the exploration of advanced solutions that reimagine assistive technology. This project focuses on developing a wheelchair control system that utilizes Micro-Electro-Mechanical Systems (MEMS) technology, seamlessly built into a user-friendly glove.
- The primary view of this project is to revolutionize mobility assistance by providing an intuitive and responsive method for navigating a wheelchair. By implementing MEMS accelerometers within the glove, users can control the wheelchair with subtle hand motions. The MEMS sensors capture precise movement and orientation data, translating these gestures into seamless and accurate commands for forward and backward motion, as well as rotation. This approach not only aims to enhance quality of life for people with disabilities, but also advocates for a more inclusive world, where technological innovations lead to increased independence and control over mobility. As we embark on this endeavor, the MEMS Accelerometer-Based Wheelchair Controller project represents a commitment to innovation, human-centric design, and the transformative potential of assistive technologies.

EXISTING SYSTEM

- The following describes about the current system of wheel chair accessability:
- **Traditional Wheelchair Controls:** Many conventional wheelchairs use traditional controls such as joystick-based systems or switch controls. Joysticks allow users to control the direction and speed of the wheelchair, while switch controls often involve simple push-button commands.
- **Head-Controlled Wheelchairs:** Wheelchairs that can be controlled using head movements or sip-and-puff technology are available for individuals with limited hand or arm mobility.
- **Remote-Controlled Wheelchairs:** Some wheelchairs come with remote control capabilities, allowing caregivers or family members to assist in navigation.

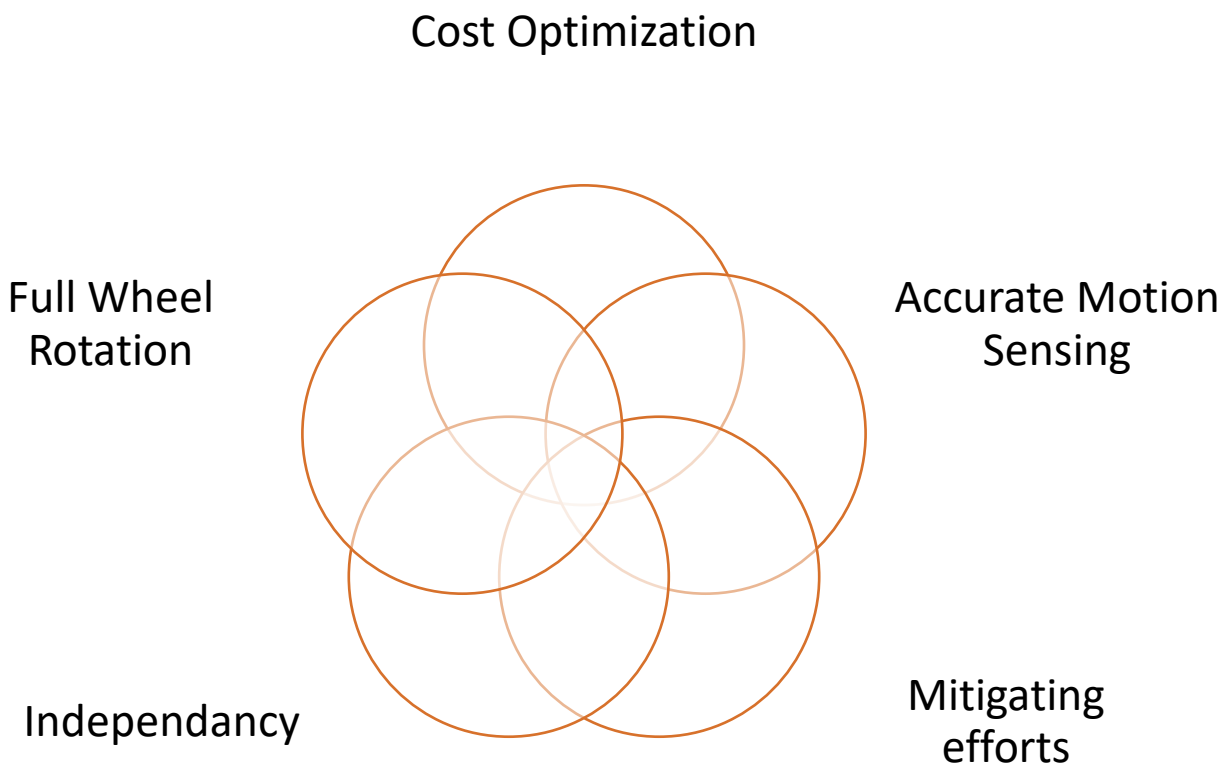
PROBLEMS OF EXISTING SYSTEM



PROPOSED SYSTEM

- The proposed MEMS Accelerometer Controller Wheelchair system introduces a groundbreaking approach to wheelchair navigation by seamlessly integrating Micro-Electro-Mechanical Systems (MEMS) accelerometer technology into a specialized glove. This innovative system allows users to control the mobility of their wheelchairs in real-time through intuitive hand gestures. The MEMS accelerometers embedded within the glove precisely capture movements along the x-axis for forward and backward motion and the y-axis for rotation, facilitating dynamic control over the wheelchair's motors.
- This axis identification by the accelerometers translates gestures into responsive commands, empowering users to navigate their wheelchairs with unprecedented precision. The incorporation of adaptive speed control enables users to modulate the wheelchair's speed based on the intensity of their gestures, ensuring a comfortable and tailored experience. This holistic integration of MEMS technology not only redefines the natural and responsive means of mobility but also places precise control over the wheelchair's motors directly into the hands of the user.

BENEFITS OF PROPOSED SYSTEM



REQUIRED COMPONENTS

Hardware Components:

- MEM sensor ADXL335
- Regulated Power Supply
- Microcontroller MC PIC176F72
- DC Motor (8V) with drivers
- LED indicators
- Crystal oscillator

Software Requirements:

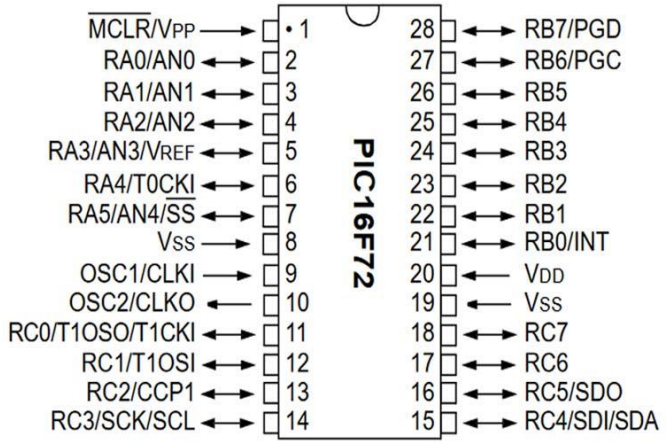
- C compiler
- OS – Windows/Mac

Additional Requirements:

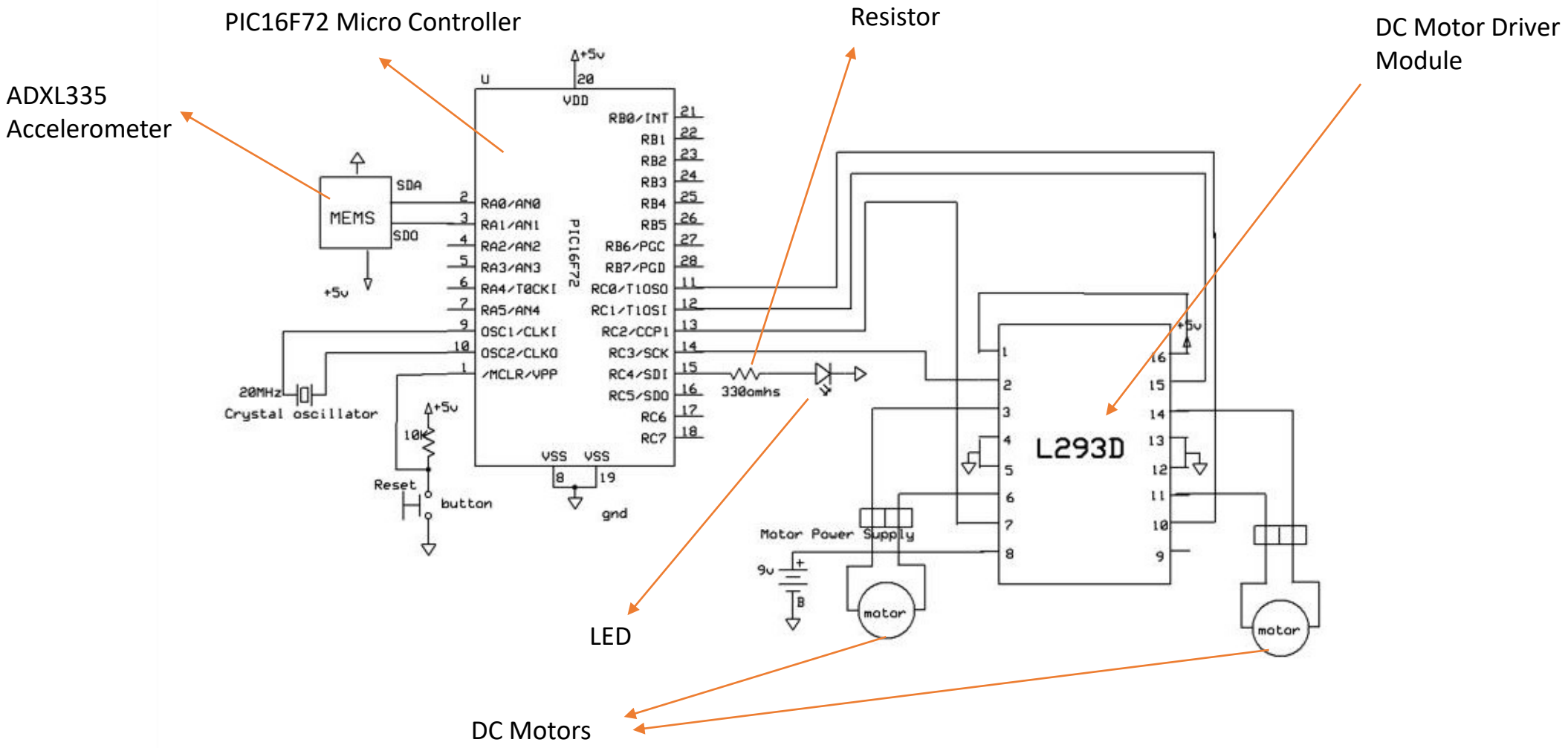
- External Moveable Objects (Wheels)
- Glue Material for Circuit Joining
- Laptop or Desktop for Programming

PIN DIAGRAM

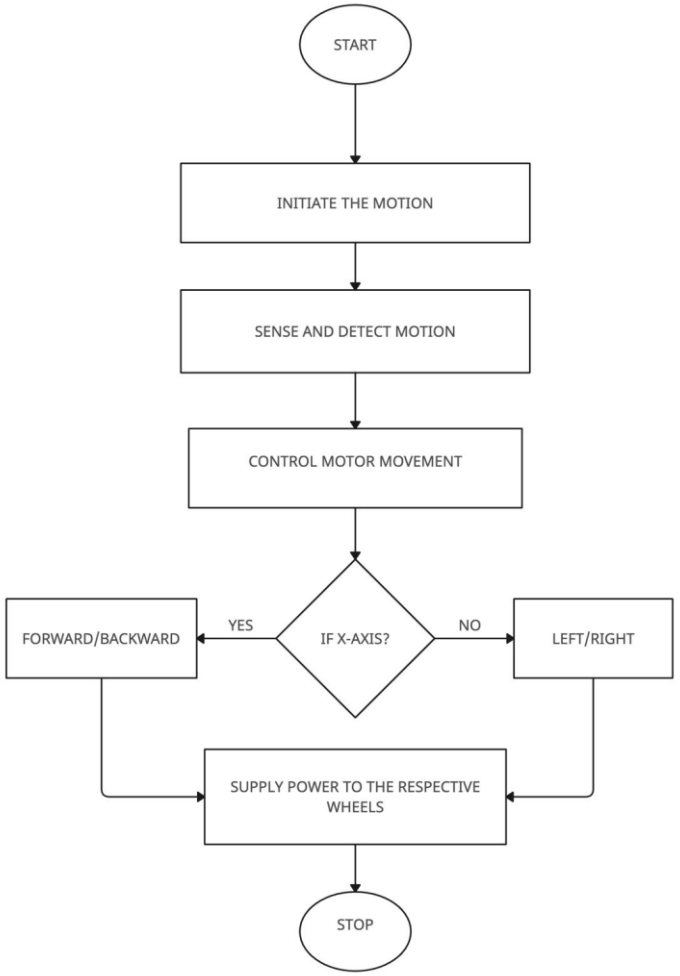
- PIC16F72 is a low-cost, low-power, high-speed CMOS Flash technology capable, 8-bit, fully-static Microcontroller unit that has 28 pins out of which 22 pins can be used as I/O pins. It has Power-on-Reset (POR) as well as the Power-up Timer (PWRT) and Oscillator Start-up Timer (OST) circuitry.



CIRCUIT DIAGRAM

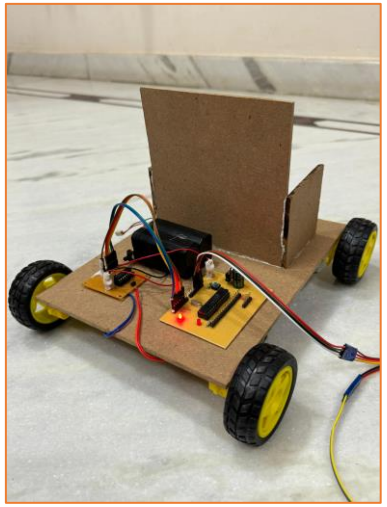


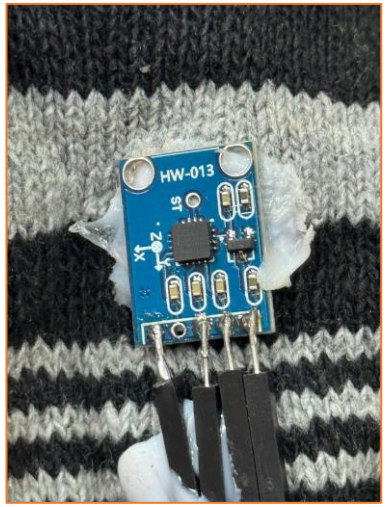
WORKING MECHANISM

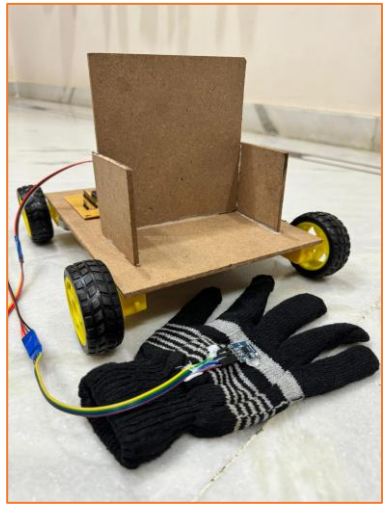


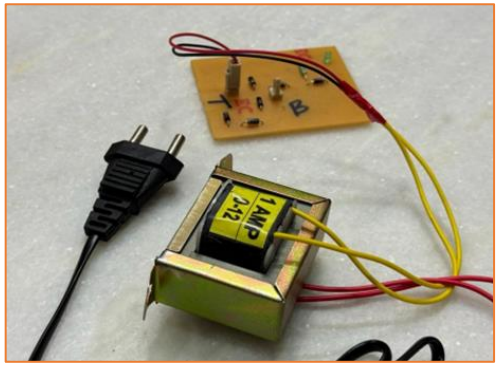
1. The sensor device is fastened to the user's glove.
2. The motion is detected by the sensor device, which notifies the device of the detected movement.
3. Examine the movement's axis.
4. The appropriate action is triggered based on the decision made by the axis (x and y).
5. The chair arrangement begins to move in response to the motor rotation trigger.
6. Repeat steps 2 through 5 until either the power supply is shut off or no hand motion is detected.

THE RESULTANT DEVICE









Key Notices of Pictures:

1. The images showcases a glove to which the ADXL335 Accelerometer is attached and a working prototype of the project.
2. The batteries in black are rechargeable and powers the entire wheelchair prototype.
3. The PIC16F72 Microcontroller is on the right and the static red LED indicates the status of the wheelchair i.e., ON/OFF.

CONCLUSION

- In conclusion, considerable progress in assistive technology has been made with the creation of the MEMS Accelerometer Controller Wheelchair system. Users may operate their wheelchairs with previously unheard-of precision by just simple hand movements via to the creative integration of MEMS accelerometers into a glove that is lightweight and easy to use.
- A more effortless and robust mobility experience is made possible by the system's 360-degree rotation capability, real-time adaptive speed control, and user-focused design. This project shows of the commitment to enhancing the quality of life for people with a variety of mobility demands, as it has undergone constant improvement based on responses conducted in the actual world.

THANK YOU