# INTUITIVE HAND GESTURE CONTROL FOR WHEELCHAIR MANEUVERABILITY

**Designed and developed by**



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**2023-2024**

# MALLA REDDY UNIVERSITY

(Telangana State Private Universities Act No.13 of 2020 and G.O.Ms.No.14, Higher Education (UE) Department)

## CERTIFICATE

This is to certify that this is the Application development lab record entitled **"Intuitive Hand Gesture Control for Wheelchair Maneuverability"** submitted by **PALADUGU NIKETH (2011CS010223), PEDDY SRIKANT (2011CS010208), POTHAKAMURI RAJINISH CHOWDARY (2011CS010227), NALLAVALLI AKASH (2011CS010187)** B. Tech IV year I semester, Department of CSE during the year 2023-24. The results embodied in this report have not been submitted to any other university or institute for the award of any degree or diploma.

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# DECLARATION

I declare that this project report titled **Intuitive Hand Gesture Control for Wheelchair Maneuverability** submitted in partial fulfillment of the degree of B. Tech in CSE is a record of original work carried out by me under the supervision of
**Dr. G. NANDHA KISHOR KUMAR**, and has not formed the basis for the award of any other degree or diploma, in this or any other Institution or University. In keeping with the ethical practice in reporting scientific information, due acknowledgements have been made wherever the findings of others have been cited.

Signature

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# ACKNOWLEDGEMENT

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Furthermore, we would like to express our gratitude to our team members who have worked tirelessly to ensure the successful completion of this project. Their dedication, commitment, and collaboration have been exemplary, and we are grateful for the opportunity to work alongside such talented individuals.

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# ABSTRACT

This project introduces an innovative approach to wheelchair control by integrating a Micro-Electro-Mechanical Systems (MEMS) accelerometer into the system. The MEMS accelerometer serves as a key component, allowing users to manipulate the wheelchair's movement through subtle hand gestures. The project focuses on developing a responsive and intuitive control mechanism that enhances mobility for individuals with physical disabilities.

The proposed system leverages MEMS technology to accurately capture hand movements, translating them into precise commands for wheelchair navigation. Users can control forward and backward motion by tilting their hand along the x-axis, while rotation is achieved through tilting along the y-axis. This approach aims to provide a user-friendly, adaptive, and accessible means of wheelchair control, catering to varying levels of mobility impairment.

Throughout the development process, the project emphasizes user-centric design, ensuring the glove integrated with the MEMS accelerometer aligns seamlessly with users' lifestyles and preferences. Real-world testing involving individuals with physical disabilities plays a pivotal role in refining the system based on user feedback, contributing to a more inclusive and user-friendly wheelchair control solution.

Key objectives include achieving a high level of accuracy in interpreting hand movements, prioritizing user comfort and adaptability, and addressing accessibility challenges. The MEMS accelerometer controller wheelchair project not only represents a technological advancement but also aims to significantly improve the quality of life for users by offering a transformative and empowering means of mobility.

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# CHAPTER – 1
# INTRODUCTION

## 1.1 Introduction

In an era marked by technological innovation, there exists a compelling opportunity to enhance the quality of life for individuals with physical disabilities. Mobility, a fundamental aspect of daily life, can be significantly improved through the integration of cutting-edge technologies. This project aims to revolutionize the field of assistive technology by developing a Micro-Electro-Mechanical Systems (MEMS) accelerometer-based controller for wheelchairs, seamlessly integrated into a user-friendly glove. Leveraging the precision and responsiveness of MEMS technology, this innovative system allows users to navigate their wheelchairs with intuitive hand gestures, providing a transformative and empowering means of mobility.

The selection of a MEMS accelerometer-based wheelchair controller emerged from a thoughtful consideration of the challenges faced by individuals with mobility impairments. Traditional wheelchair controls, often reliant on physical interfaces, can be limiting and cumbersome. Recognizing the potential of MEMS technology to interpret subtle hand movements with exceptional accuracy, the project aims to create a user-centric solution that redefines wheelchair navigation.

The glove, embedded with MEMS accelerometers, serves as an extension of the user's intent, allowing for precise control along the x-axis for forward and backward movement and the y-axis for rotation. By selecting this project, we endeavor to empower individuals with physical disabilities, offering them a newfound sense of independence and control over their mobility, ultimately contributing to a more inclusive and accessible world.

## 1.2 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.

## 1.3 Objective of Project

In addressing the challenges faced by individuals with physical disabilities, the primary objective of this ambitious project is to introduce an innovative and transformative solution. Recognizing the limitations that traditional wheelchair controls may pose, the focus is on developing a state-of-the-art MEMS accelerometer-based wheelchair controller seamlessly integrated into a user-friendly glove. This integration not only marks a significant technological advancement but, more importantly, aims to redefine the landscape of mobility assistance.

1. Introduce an innovative MEMS accelerometer-based wheelchair controller.
2. Seamlessly integrate the controller into a user-friendly glove.
3. Redefine the landscape of mobility assistance for individuals with physical disabilities.
4. Adopt a comprehensive, user-centric design philosophy.
5. Consider diverse needs and capabilities in addition to technical innovation.
6. Deliver a transformative experience aligned with users' lifestyles and preferences.
7. Empower individuals with physical disabilities with a newfound sense of independence.
8. Foster collaboration and feedback from end-users, healthcare professionals, and accessibility experts.
9. Incorporate diverse perspectives to address nuanced needs and preferences.
10. Ensure the final solution is technically advanced, practical, adaptable, and well-received by the community.

By building a dialogue with the community that will benefit from this technology, the aim is to address nuanced needs and preferences, ensuring that the final solution is not only technically advanced but also practical, adaptable, and well-received.

## 1.4 Goal of Project

To achieve the overarching objective, the project sets specific and measurable performance goals for the wheelchair controller. The system's success hinges on the precise interpretation of subtle hand movements along the x-axis, facilitating seamless forward and backward wheelchair motion. Simultaneously, movements along the y-axis will dictate rotation, enhancing the control and versatility of the wheelchair.

1. Set specific and measurable performance goals for the wheelchair controller.
2. Emphasize precise interpretation of hand movements along the x-axis for forward and backward motion.
3. Use movements along the y-axis to dictate rotation, enhancing wheelchair control and versatility.
4. Design the system to meet and exceed predefined benchmarks for accuracy and responsiveness.
5. Prioritize accessibility with a goal to make the solution universally user-friendly for various mobility impairments.
6. Address challenges related to usability, comfort, and adaptability.
7. Commit to iterative prototyping and testing for continuous refinement based on real-world feedback.
8. Implement an adaptive development approach to ensure alignment with users' daily lives and preferences.
9. Aim for a transformative user experience, offering reliable, cutting-edge technology- driven solutions.
10. Focus on creating a tool that enhances the overall quality of life for individuals with limited mobility.

# CHAPTER – 2

# PROBLEM IDENTIFICATION

## 2.1 Existing System

Joystick-controlled wheelchairs often rely on the user's arm strength and dexterity. This can be a significant drawback for individuals with limited upper body strength or those with conditions affecting their fine motor skills. Many traditional wheelchairs can be bulky and challenging to maneuver, especially in tight spaces or crowded environments. This lack of agility can be a hindrance to users when navigating through doorways or around obstacles. Conventional wheelchairs may carry a social stigma, and individuals using them may face challenges in terms of societal perception, inclusivity, and accessibility. This can impact the user's confidence and social interactions.

Transporting traditional wheelchairs can be cumbersome, particularly in vehicles with limited space. This limitation can affect users who need to travel frequently or use public transportation.
Some wheelchairs may not provide adequate support for users who require specific postures or seating arrangements. This can lead to discomfort, pain, or even health issues over time. Traditional wheelchairs may have braking systems that are not as efficient, leading to potential safety concerns, especially when navigating downhill or on slopes. Conventional wheelchairs often lack smart features that could enhance the user experience, such as obstacle detection, route planning, or integration with assistive technologies.

## 2.2 Proposed System

**Proposed System:**

The proposed system represents a groundbreaking advancement in mobility assistance technology, aimed at empowering individuals with physical disabilities through an intuitive and efficient means of controlling their wheelchairs. This innovative solution integrates a MEMS accelerometer-based wheelchair controller seamlessly into a glove, providing users with unprecedented control over their mobility.

The proposed system goes beyond addressing technical challenges; it strives to significantly improve the quality of life for users. The intuitive control mechanism not only enhances user independence but also provides a transformative experience in wheelchair navigation. By offering a reliable and cutting-edge solution, the proposed system contributes to a more inclusive and accessible world for individuals with limited mobility, fostering a positive impact on their daily lives. At the heart of the system lie three essential components:

a) a MEMS accelerometer,

b) a Microcontroller Unit (MCU),

c) and a Communication Interface.

The MEMS accelerometer, with its high sensitivity and precision, captures nuanced hand movements along the x-axis for controlling forward and backward wheelchair motion and along the y-axis for rotational movements. The MCU processes the accelerometer data in real-time, translating these movements into precise control commands. The communication interface facilitates seamless interaction between the glove and the wheelchair, ensuring a responsive and cohesive user experience.

**Functionality and Benefits:**

The functionality of the proposed system revolves around the accurate interpretation of hand gestures to enable responsive and seamless wheelchair navigation. Users can effortlessly control the wheelchair's forward and backward movements by subtly tilting their hand along the x-axis. Similarly, rotational movements are achieved by tilting the hand along the y-axis. The system prioritizes real-time responsiveness, providing users with an immediate and natural control experience that enhances their overall mobility.

**User-Centric Design:**

An integral aspect of the proposed system is its user-centric design. The glove is meticulously crafted for comfort, adaptability, and inclusivity, accommodating various hand sizes and preferences. The design process places a strong emphasis on user feedback, ensuring that the interface aligns with the diverse needs of individuals with varying levels of mobility impairment. The result is a glove that seamlessly integrates into the user's daily life, providing not only functional control but also a comfortable and intuitive experience.

**Accessibility Features:**

The proposed system sets a new standard for inclusivity. Beyond its technical capabilities, the design incorporates features specifically aimed at enhancing accessibility. The controls are intentionally user-friendly, the ergonomic design of the glove prioritizes comfort, and adaptability ensures that the system caters to a spectrum of mobility impairments. By embracing a universal design philosophy, the proposed system seeks to create an accessible and inclusive user experience for all individuals, regardless of their mobility challenges.

**Integration and Testing:**

The successful implementation of the proposed system relies on rigorous integration and testing. The hardware components will be seamlessly integrated, and the software algorithms will be fine-tuned to achieve optimal performance. Real-world testing, involving individuals with physical disabilities, will be a pivotal phase in the development process. This iterative testing approach allows for continuous refinement based on valuable user feedback, ensuring that the final product meets and exceeds expectations. The integration and testing phase will involve not only technical assessments but also a focus on user experience. Human-centric testing, involving individuals with varying degrees of mobility impairment, will be conducted to validate the system's effectiveness in real-world scenarios. This iterative approach to testing ensures that the proposed system not only meets technical specifications but also aligns seamlessly with the daily lives and preferences of its users.

**Scalability and Adaptability:**

The proposed system is designed with scalability and adaptability in mind. As technology advances, future iterations can incorporate additional features and improvements, ensuring the system remains at the forefront of assistive technology. The modular design allows for easy updates and enhancements, providing a pathway for continuous innovation and customization based on evolving user needs and technological advancements.

# CHAPTER – 3
# REQUIREMENTS

## 3.1 Software Requirements

- PIC-C compiler for Embedded C programming.
- PIC kit 2 programmer for dumping code into Micro controller.
- Express SCH for Circuit design.
- OS – Windows/Mac

## 3.2 Hardware Requirements

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

# Hardware Components:

## ADXL335 Accelerometer Module:

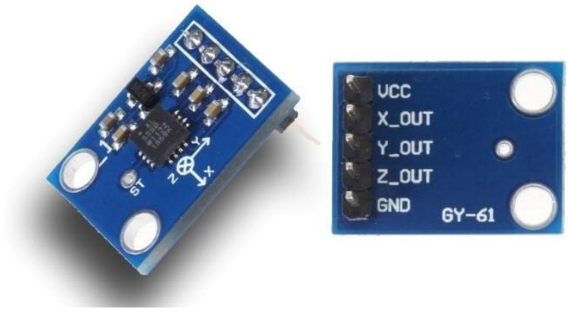



Fig 3.1 ADXL335 Accelerometer Module

Accelerometer can be used for tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

- The ADXL335 gives complete 3-axis acceleration measurement.
- This module measures acceleration within range ±3 g in the x, y and z axis.
- The output signals of this module are analog voltages that are proportional to the acceleration.

As we can see from the above figure, basic structure of accelerometer consists fixed plates and moving plates (mass).

- Acceleration deflects the moving mass and unbalances the differential capacitor which results in a sensor output voltage amplitude which is proportional to the acceleration.
- Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration.

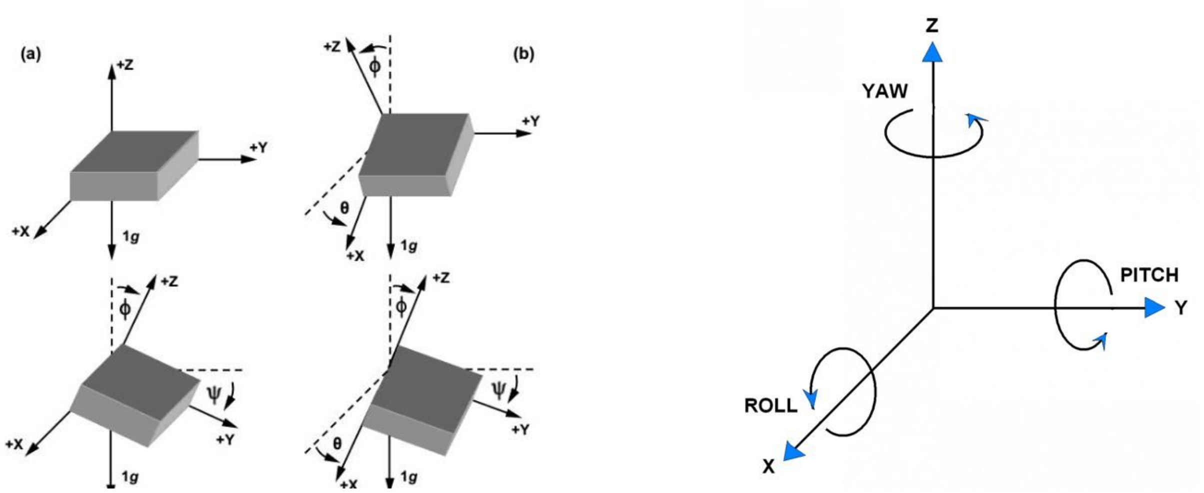



Fig 3.2 Angle of rotation of Accelerometer Module

Now let's find a complete angle of rotation (0° to 360°) around X, Y, Z axis, which we can also call as,

- Roll - Angle of rotation along the X axis
- Pitch - Angle of rotation along the Y axis
- Yaw - Angle of rotation along the Z axis

**D.C. Motor:**

Fig 3.3 DC Motor

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is speed.

**PIC16F72 Micro controller:**

A Microcontroller is a programmable digital processor with necessary peripherals. Both microcontrollers and microprocessors are complex sequential digital circuits meant to carry out job according to the program / instructions. Sometimes analog input/output interface makes a part of microcontroller circuit of mixed mode (both analog and digital nature).

1. A smaller computer
2. On-chip RAM, ROM, I/O ports...


Fig 3.4 PIC16F72 MC

- PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1640 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller".
- A PIC's instructions vary from about 35 instructions for the low-end PICs to over 80 instructions for the high-end PICs. The instruction set includes instructions to perform a variety of operations on registers directly, the accumulator and a literal constant or the accumulator and a register, as well as for conditional execution, and program branching.
- 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.
- It has a SLEEP mode, which can be configured in Power saving applications. PIC16F72 also comes with the code protection, watchdog timer mode that serve the power and reliability feature. Also, system cost can be greatly reduced by using this microcontroller unit.
- It has a wide operating voltage ranging from 2V to 5.5V. Thus, it can be used in 3.3V or 5.0V logic level operations.

**High-Performance RISC CPU**

1. Only 35 single word instructions to learn.
2. All instructions are executed in 1μs.
3. Operating speed is 20MHz clock input.

**Peripheral Features**

1. Two 8-bit timer/counter (TMR0, TMR2) with 8-bit programmable
2. One 16-bit timer/counter
3. Capture/Compare PWM (CCP) Module

**Special Microcontroller Features**

1. Power-On Reset
2. Power-up Timer (PWRT) and Oscillator Start-Up Timer (OST)
3. Power saving Sleep mode

**CMOS Technology:**

1. Fully static design
2. Low power, high speed CMOS FLASH technology
3. Wide operating voltage range: 2.0V to 5.5V

The below image is showing the detailed pin diagram of the PIC16F72.

**Pin Diagram:**

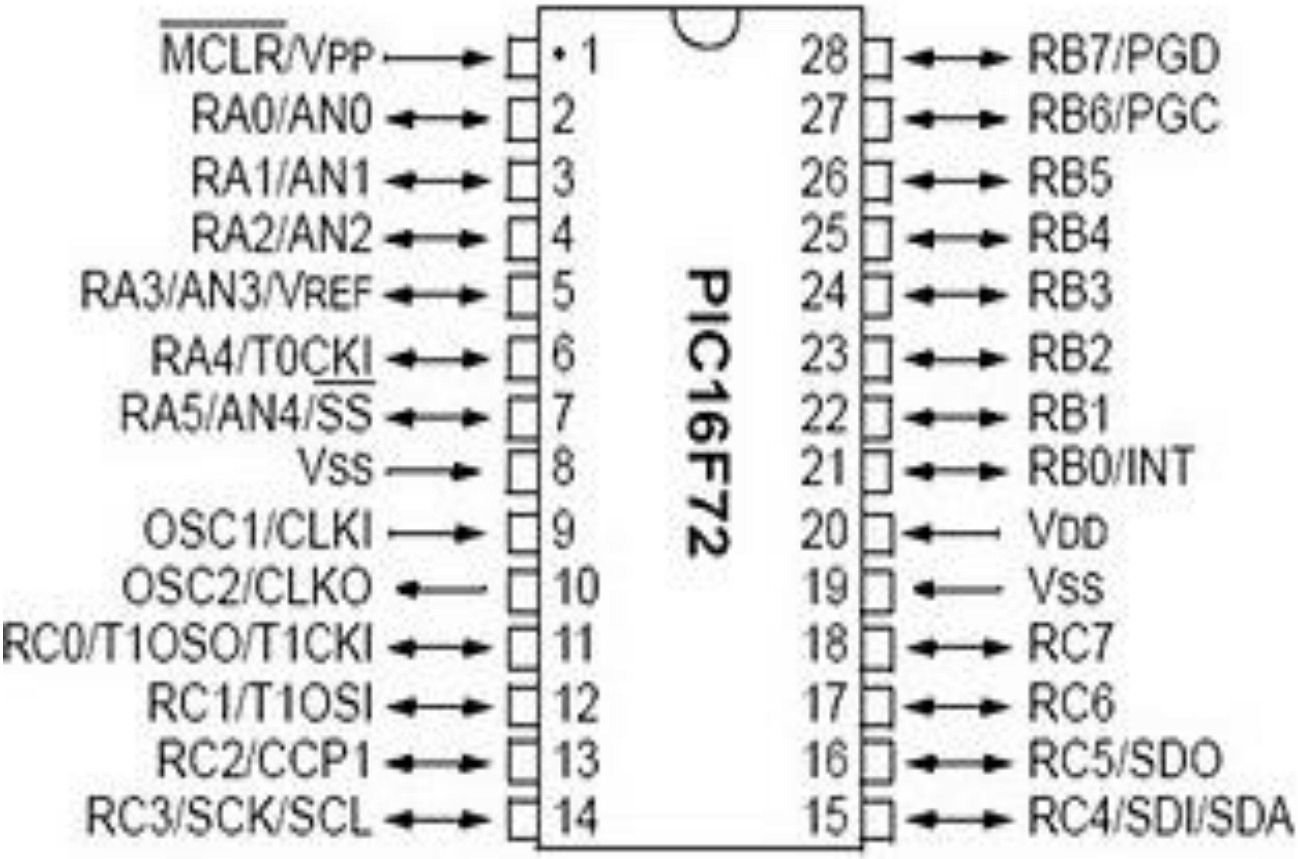
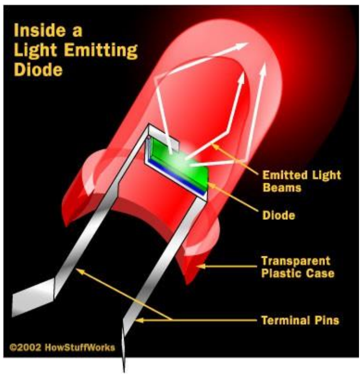



Fig 3.5 Pin diagram of the PIC16F72

**LED:**

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.



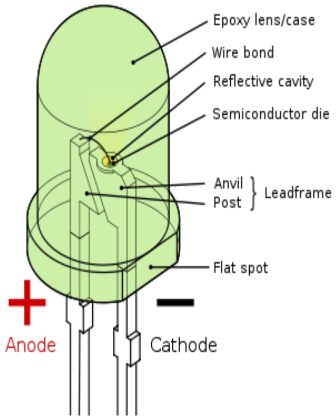




Fig 3.6 Components of LED

When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability.

**DB107:**

Now -a -days Bridge rectifier is available in IC with a number of DB107. In our project we are using an IC in place of bridge rectifier.

Fig 3.7 DB107

**Battery power supply:**

A battery is a type of linear power supply that offers benefits that traditional line-operated power supplies lack mobility, portability and reliability. A battery consists of multiple electrochemical cells connected to provide the voltage desired.

Fig 3.8 Battery

## Block Diagram:

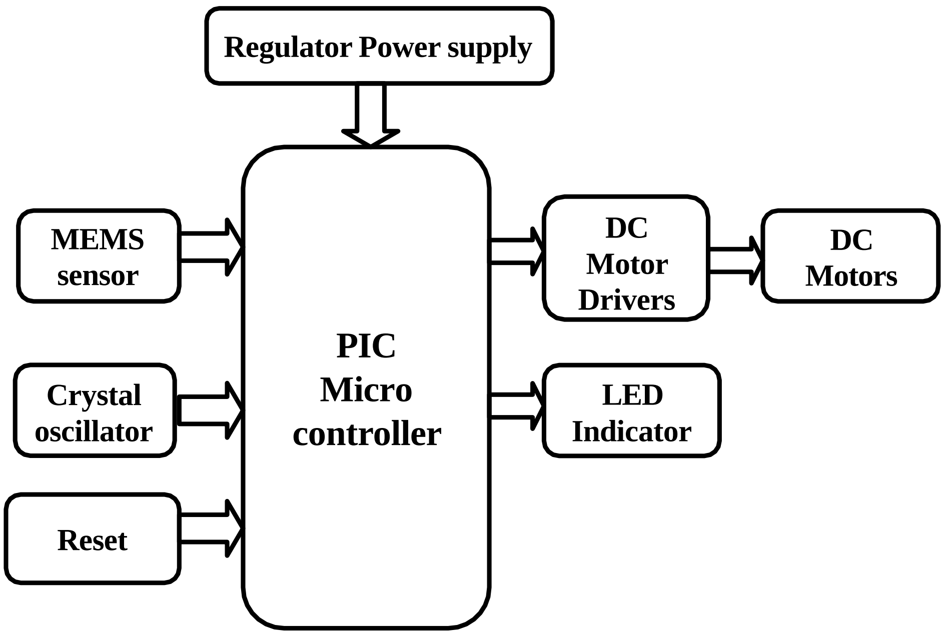



Fig 3.9 Block Diagram

# CHAPTER – 4

# DESIGN AND IMPLEMENTATION

## 4.1 Design

Designing plays a major part in the development of any application. To make a product future proof and know its limitations designing plays a major role in the success of a product. Therefore, designing a product with client use case and scalability in mind is very necessary. The following diagrams show the designing phase of the project with different design diagrams

**DFD/UML diagram**

The Unified Modeling Language allows the software engineer to express an analysis model using the modeling notation that is governed by a set of syntactic, semantic and pragmatic rules.

**Use Case Diagram:**

Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. So, when a system is analyzed to gather its functionalities use cases are prepared and actors are identified.

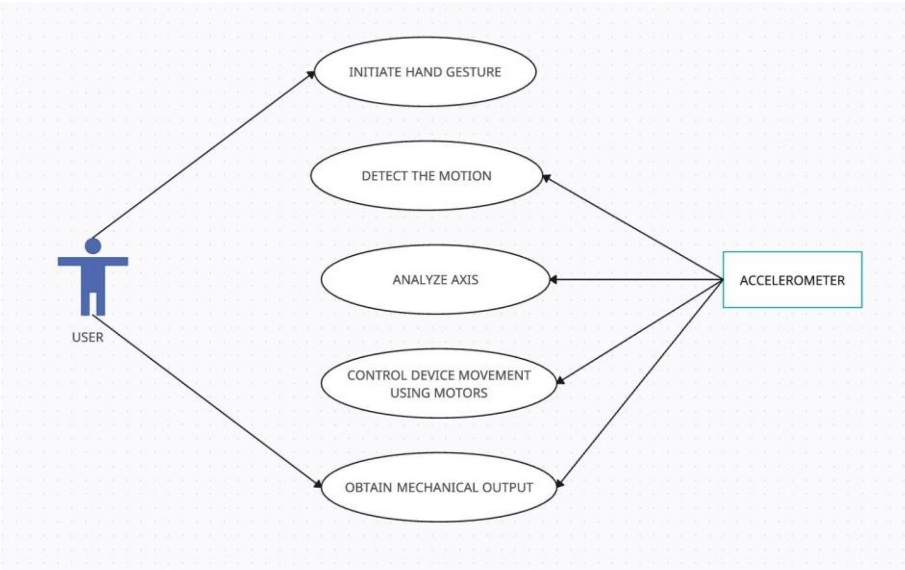



Fig 4.1 Use Case Diagram

**Sequence Diagram:**

Sequence Diagrams describe interactions among classes in terms of an exchange of messages over time. They're also called event diagrams. A sequence diagram is a good way to visualize and validate various runtime scenarios. These can help to predict how a system will behave and to discover responsibilities a class may need to have in the process of modelling a new system.

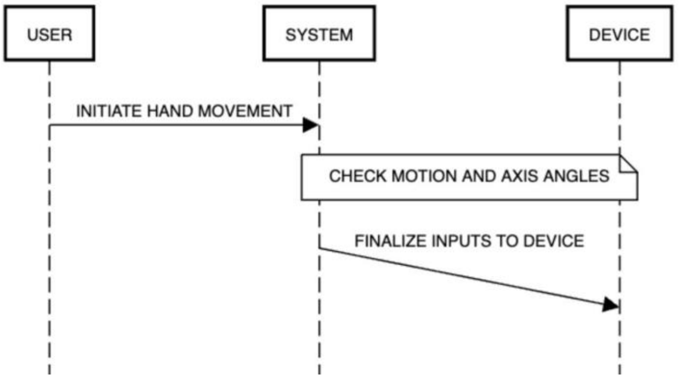



Fig 4.2 Sequence Diagram

**Class Diagram:**

Class diagrams are the main building blocks of every object-oriented method. The class diagram can be used to show the classes, relationships, interface, association, and collaboration. UML is standardized in class diagrams. Since classes are the building block of an application thatis based on OOPs, so as the class diagram has appropriate structure to represent the classes, inheritance, relationships, and everything that OOPs have in its context. It describes various kinds of objects and the static relationship in between them.

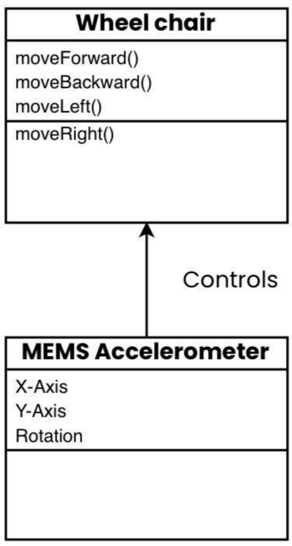



Fig 4.3 Class Diagram

**Activity Diagram:**

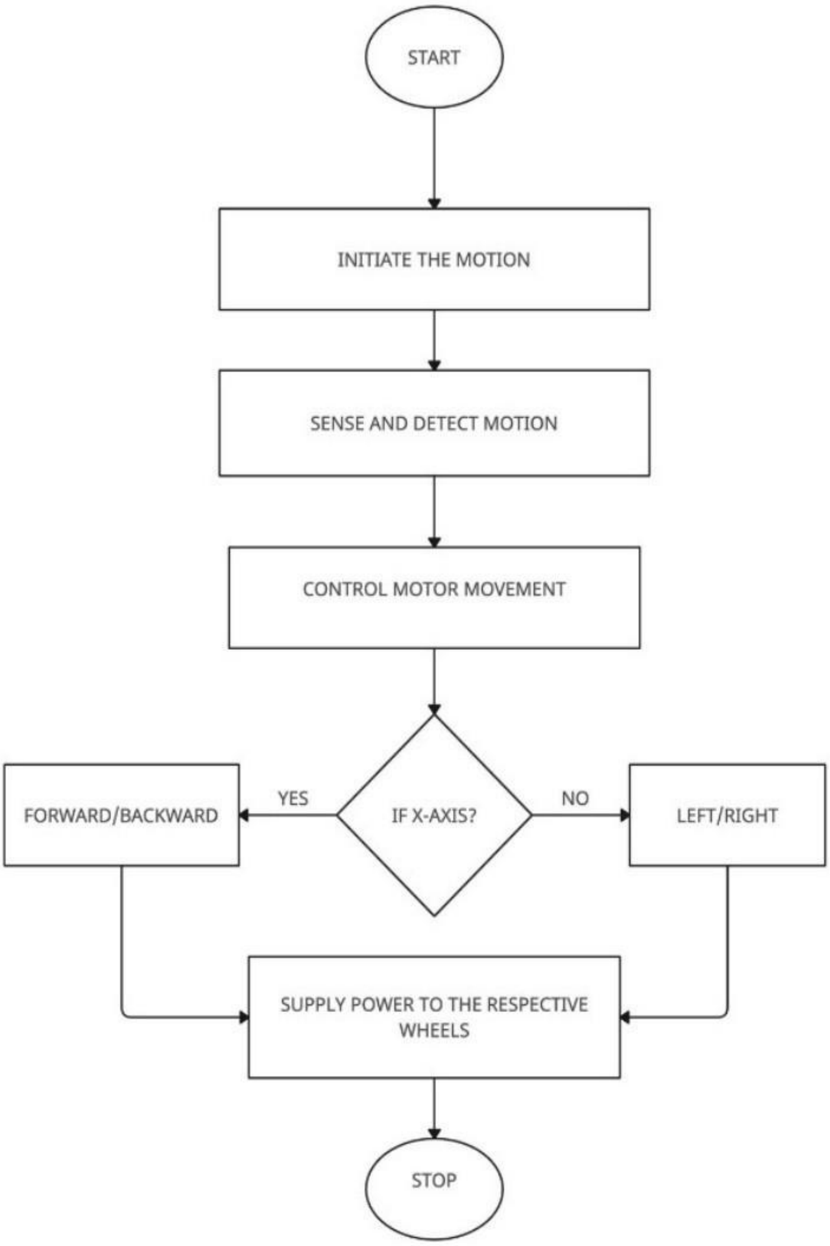



Fig 4.4 Activity Diagram

**Steps:**

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.

## 4.2 Implementation

**Circuit Diagram:**

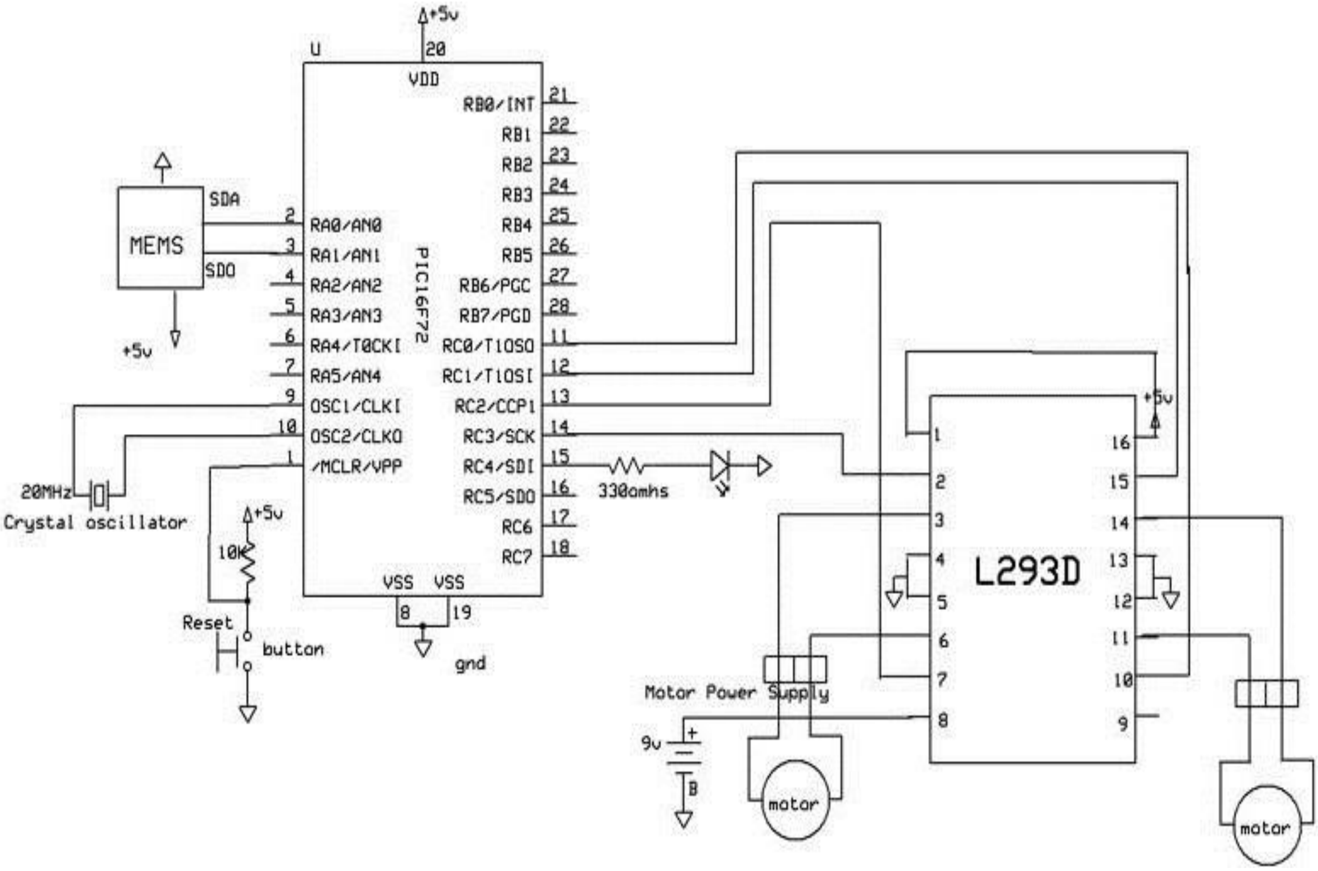



Fig 4.5 Circuit Diagram

**Implementation Steps:**

1. The user wears a glove with a sensor device attached to it.
2. The sensor device detects the motion and inform the device as movement detected.
3. Analyze the axis of movement.
4. According to decision of axis (x and y) respective action gets triggered.
5. The chair setup starts moving according to the motor rotation triggered.
6. The steps 2 to 5 is iterated until there is no hand motion detected or the power supply is cutoff.

# CHAPTER – 5

# CODE

## 5.1 Source Code

```
#include <16F73.h>
#fuses HS, NOWDT, BROWNOUT, PROTECT, PUT
#use delay(oscillator=20M)
unsigned long duty = 0;
void Motor_M1(int direction)
{
    delay_ms(10);
    if(direction == 1) //Forward
    {
      output_low(PIN_C0);
      output_high(PIN_C1);
    }
    if(direction == 0) //Reverse
    {
      output_low(PIN_C1);
      output_high(PIN_C0);
    }
    delay_ms(100);
}

void Motor_M2(int direction)
{
    if(direction == 1) //Forward
    {
      output_low(PIN_C3);
      output_high(PIN_D0);
    }
    if(direction == 0) //Reverse
    {
      output_low(PIN_C0);
      output_high(PIN_C3);
    }
    delay_ms(100);
}

void main()
{
  unsigned long int x=0;
  unsigned long int y=0;

  //Microcontroller Health Check
  output_high(PIN_C2);
  output_high(PIN_C3);
  output_high(PIN_C4);
  output_high(PIN_C5);
```

```
delay_ms(1000);
output_low(PIN_C2);
output_low(PIN_C3);
output_low(PIN_C4);
output_low(PIN_C5);
delay_ms(1000);
output_high(PIN_C2);
output_high(PIN_C3);
output_high(PIN_C4);
output_high(PIN_C5);
delay_ms(1000);
output_low(PIN_C2);
output_low(PIN_C3);
output_low(PIN_C4);
output_low(PIN_C5);

setup_adc(ADC_CLOCK_INTERNAL);   //enables the a/d module
setup_adc_ports(ALL_ANALOG);   //sets all the adc pins to analog

//PWM Settings
 duty = 620;
 setup_timer_2(T2_DIV_BY_16, 127, 1);
 setup_ccp1(CCP_PWM);
 set_pwm1_duty(duty);
 setup_ccp2(CCP_PWM);     //pwm setting for motor 2
 set_pwm2_duty(duty);

while(1)
{
   set_adc_channel(1);
   delay_ms(1);
   y = read_adc();
   delay_ms(1);
   set_adc_channel(0);
   delay_ms(1);
   x = read_adc();
   delay_ms(1);
   duty = 600;
   set_pwm1_duty(duty);
   set_pwm2_duty(duty);
   if(y < 80)
   {
       output_high(PIN_C2); //LED on
       Motor_M1(0);
       Motor_M2(0);
   }
   else if(y > 100)
   {
       output_high(PIN_C3);
       Motor_M1(1);
       Motor_M2(1);
   }
```

```
      else if(x < 80)
        {
          output_high(PIN_C4);
          Motor_M1(1);
          Motor_M2(0);
        }
      else if(x > 100)
        {
          output_high(PIN_C5);
          Motor_M1(0);
          Motor_M2(1);
        }

     set_pwm1_duty(0);
     set_pwm2_duty(0);

     output_low(PIN_C2);
     output_low(PIN_C3);
     output_low(PIN_C4);
     output_low(PIN_C5);
    }
  }
```

## 5.2 Images of the Device

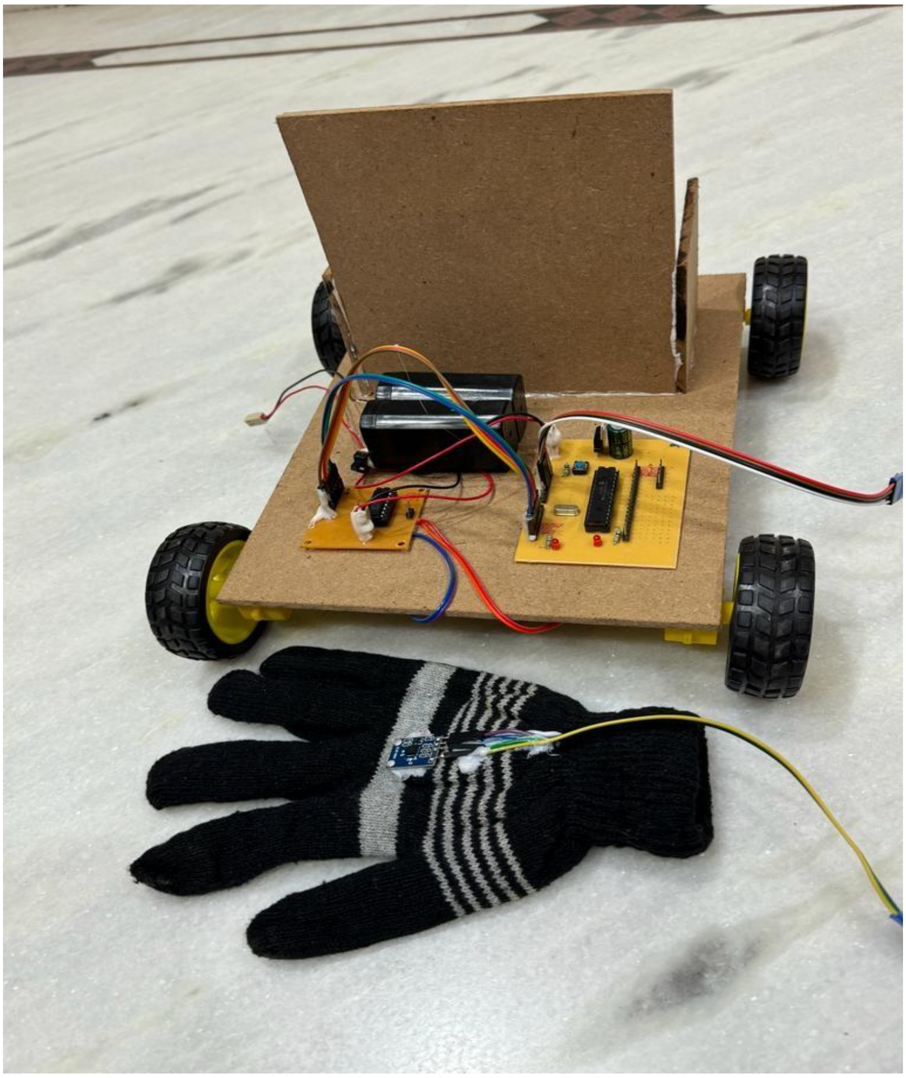


Fig 5.1 Front view of the model

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

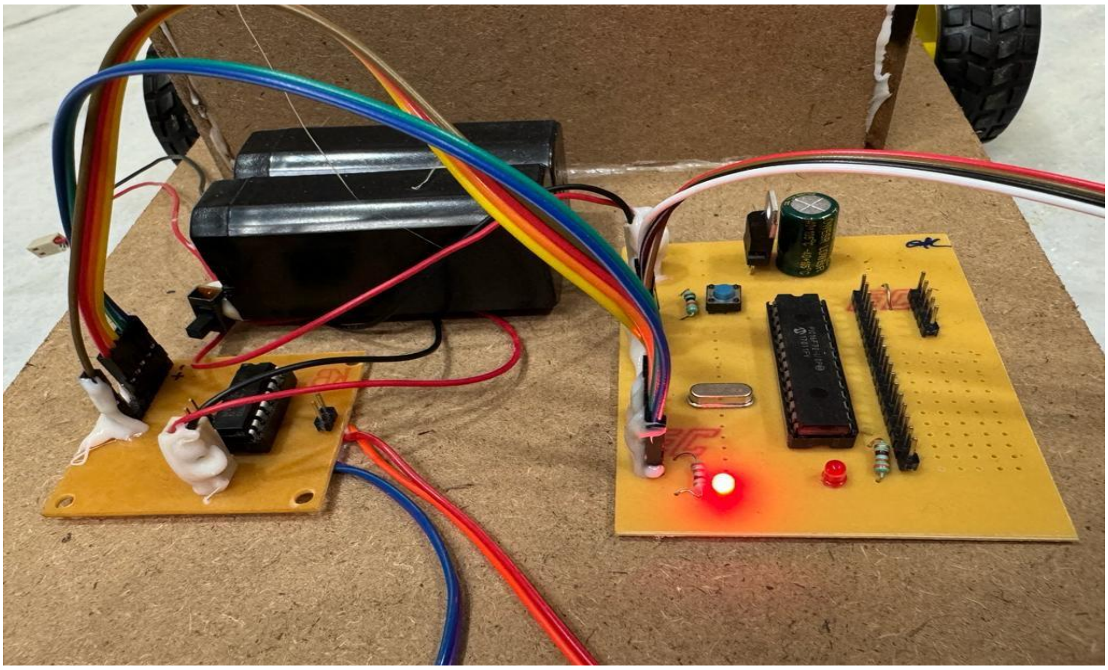


Fig 5.2 A closer look at the components

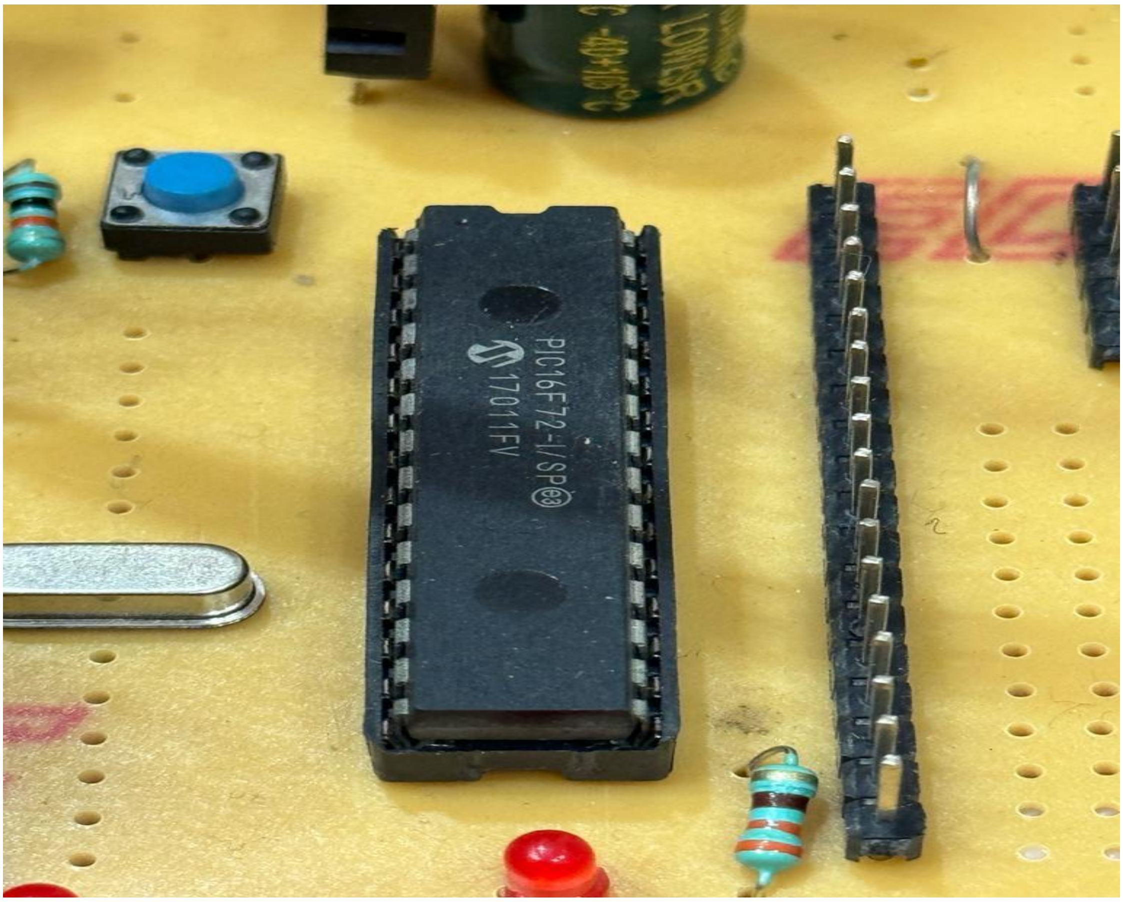



Fig 5.3 A closer look at the MC PIC16F72

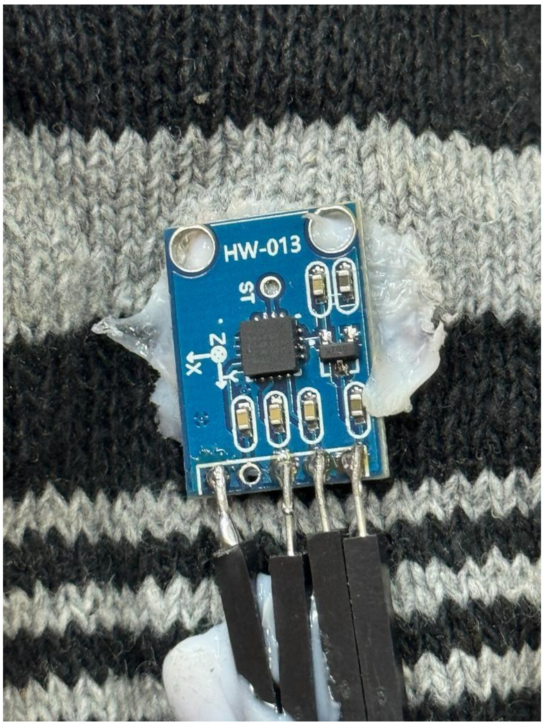



Fig 5.4 A closer look at the MEMS Accelerometer

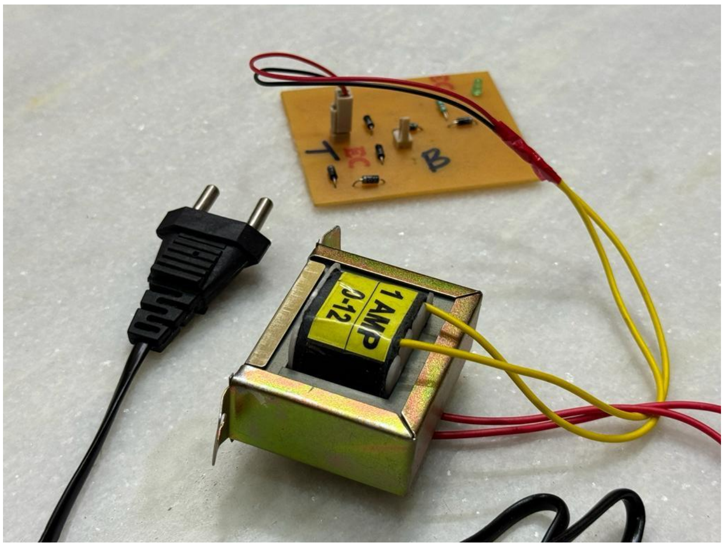



Fig 5.5 A closer look at the Battery Charging setup

The batteries (in black) shown in **Fig 5.2** are rechargeable and can be charged using the above setup. The charger auto shuts down once the battery is fully charged to prevent over-heating and other adverse effects.

# CHAPTER – 6
# RESULTS AND CONCLUSION

## 6.1 Results

This project MEMS controller device is successfully working. The tilt can be detected using Micro Electro Mechanical Sensor which is a highly sensitive sensor and capable of finding the tilt and makes use of the accelerometer to change the direction of the vehicle depending on tilt.

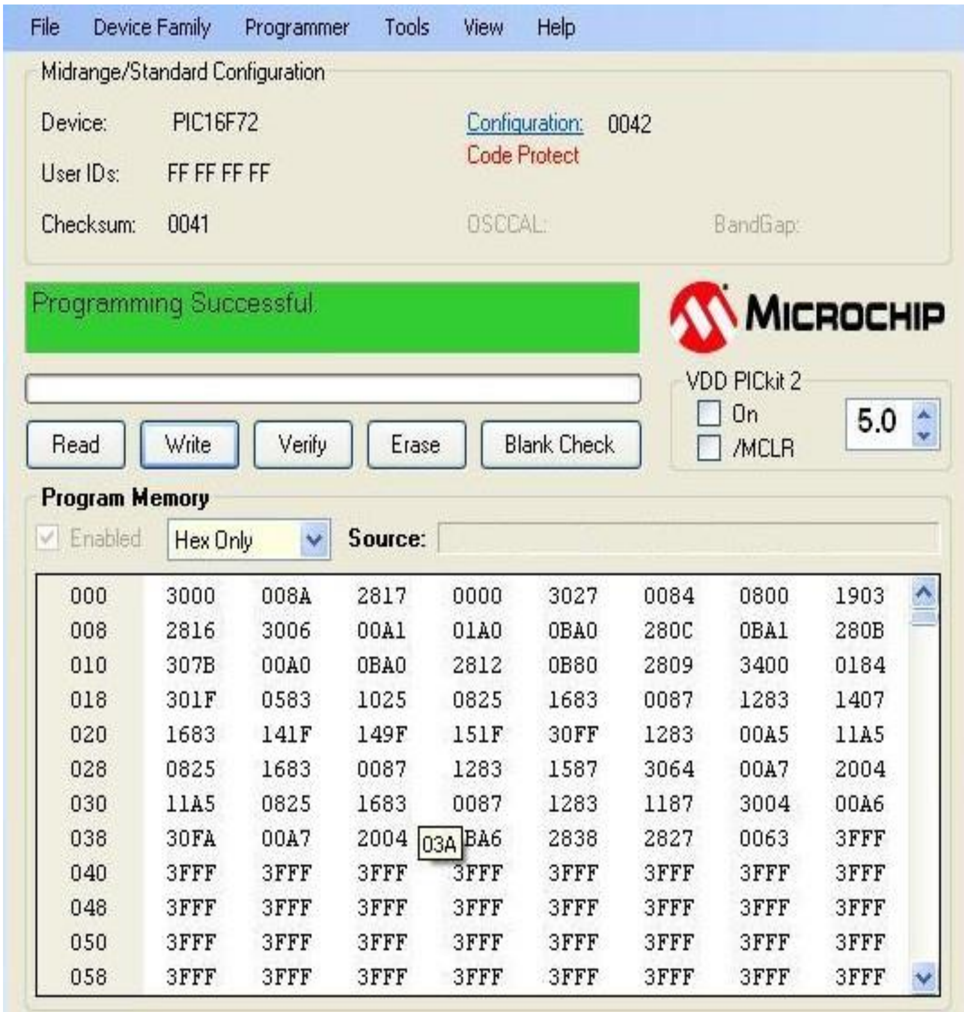



Fig 6.1 Picture after program dumped into the microcontroller

**Future Work**

This project can be extended by using a heart beat sensors to this system. Heart beat sensor continuously monitors the heart rate, which can be designed such that alarm horns if the heart level goes beyond set level. Also, this MEMS accelerometer can be used to control different devices basing on the tilt angle. We can also include a voice based control system to operate the wheelchair and include a buzzer as well for the person to be assisted in case of emergency.

## 6.2 Conclusion

In conclusion, the MEMS accelerometer-based wheelchair controller project represents a pioneering effort to bridge the gap in mobility assistance technology. By harnessing the capabilities of MEMS technology and integrating it into a user-friendly glove, we have endeavored to redefine the way individuals with physical disabilities navigate their wheelchairs. This innovative solution goes beyond the conventional constraints of traditional controls, offering users an intuitive and responsive means of mobility through subtle hand gestures.

Through the course of this project, we have not only explored the technical intricacies of MEMS technology but have also placed a strong emphasis on user-centric design. Real-world testing and continuous refinement based on user feedback have been integral components of our development process, ensuring that the resulting solution aligns seamlessly with the diverse needs and preferences of its users.

As we envisage a future where individuals with mobility impairments experience heightened independence and control over their daily lives, this project marks a significant step forward. The MEMS accelerometer-based wheelchair controller, embedded within a glove, not only symbolizes technological advancement but, more importantly, embodies a commitment to enhancing the quality of life for those who rely on assistive technologies. In fostering a more inclusive and accessible environment, this project contributes to the ongoing narrative of using technology to empower and uplift the lives of individuals with diverse abilities.

# REFERENCES

[1] A. Ko and H. Y. K. Lau, “Robot Assisted Emergency Search and Rescue System With a Wireless Sensor Network,” International Journal of Advanced Science and Technology, vol. 3,pp. 69-78, 2009.

[2] D. J. Sturman and D. Zeltzer, "A survey of glove-based input," in IEEE Computer Graphics and Applications, vol. 14, no. 1, pp. 30-39, Jan. 1994.

[3] T. Takahashi, F. Kishino, “A hand gesture recognition method and its application,” Systems and Computers in Japan vol. 23, no. 3, pp, 38–48, 1992.

[4] Yi Zhang, Jiao Zhang, Yuan Luo (2011), A Novel Intelligent Wheelchair Control System Based On Hand Gesture Recognition, Proceedings of the 2011 IEEE/ICME International Conference on Complex Medical Engineering, May 22-25,Harbin,China,pp:334- 339,201.

[5] https://www.st.com/en/mems-and-sensors/accelerometers.html

[6] https://www.utmel.com/components/db107-rectifiers-features-pinout-and-datasheet?id=658

[7] https://components101.com/microcontrollers/pic16f72-8-bit-pic-microcontroller

[8] https://veerobot.com/wiki/L293D_Motor_Controller

[9] https://aticleworld.com/interfacing-dc-motor-pic-microcontroller-l293d/

[10] https://microcontrollerslab.com/adxl-335-accelerometer-interfacing/

[11] https://www.utmel.com/components/l293d-vs-l2978n-what-s-the-difference?id=1493

[12] https://www.utmel.com/components/db107-rectifiers-features-pinout-and-datasheet?id=658

[13] Raj Kamal –Microcontrollers Architecture, Programming, Interfacing and System Design

[14] PCB Design Tutorial – David.L.Jones

[15] PIC Microcontroller Manual – Microchip