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# **Smart Mobility Aid: Wireless Accelerometer-Driven Wheelchair for Differently Abled Users**

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**ABSTRACT:** This paper presents the design and development of a wireless hand gesture-controlled wheelchair system intended to aid specially-abled individuals. The system utilizes an Analog Devices 3-axis digital accelerometer sensor to detect hand tilts, which correspond to directional commands. These signals are processed by a microcontroller and transmitted wirelessly using RF modules. The receiver interprets the signals and drives the wheelchair motors accordingly. The system offers a cost-effective, efficient, and intuitive alternative to traditional wheelchair control mechanisms, promoting greater independence for users.

**KEYWORDS:** Hand Gesture, Wheelchair, ADXL345, ATmega Microcontroller, RF Module, Specially Abled, Embedded C, Arduino, Wireless Control.

## **I. INTRODUCTION**

In recent years, more and more mobile robots have moved away from industry to enter home environments. As the size and the cost have decreased significantly, the home robot is now available for use as one of the most popular consumer electronic products . More and more home robots are now working around us and they help us a lot in our daily lives. A wide variety of home robots have been proposed to do housework such as cooking, cleaning, houseplant watering and pet feeding. They are also being widely used in home security, entertainment; rehabilitation training and home care for the elderly. As the home robots get closer in our daily lives, the question arises: How to interact with them?

Complicated control interfaces designed for skilled workers and experts are not suitable for ordinary home users. They prefer simple and natural interaction with home robots through voices and gestures. This requires a user-friendly interface that allows the robot to Understand voice and gesture commands. The voice interface is suitable for a simple call-and-come service for home robots but it is not suitable for continuous remote control and usually it cannot work normally due to the interference of ambient noise. Therefore, hand gesture or hand motion-based interfaces are more suitable for control of home robots.

In this Project we used an accelerometer which is used to detect the tilting position of your hand, and a microcontroller gets different analogue values and generates command signals to control the robot. For Wireless Communication RF Module is used which is having a Frequency of 433 MHz and range is up to 125 meters.

## **II. LITERATURE SURVEY**

Several assistive technologies have been explored to improve mobility solutions.

Singh et al. (2017) implemented a joystick-controlled wheelchair with basic obstacle detection.

Kumar and Raj (2019) proposed voice recognition for wheelchair navigation, though it faced accuracy issues in noisy environments.

Patil et al. (2020) developed a gesture-based control using flex sensors, but the system required hand gloves, making it cumbersome.

Our system, in contrast, uses an ADXL345 accelerometer for hand gesture detection without any wearable constraints and offers wireless control for better convenience.

### III. METHODOLOGY

The wheelchair system is divided into two primary units: the transmitter and the receiver. The transmitter unit includes the ADXL345 sensor mounted on the user's hand, connected to an ATmega microcontroller.

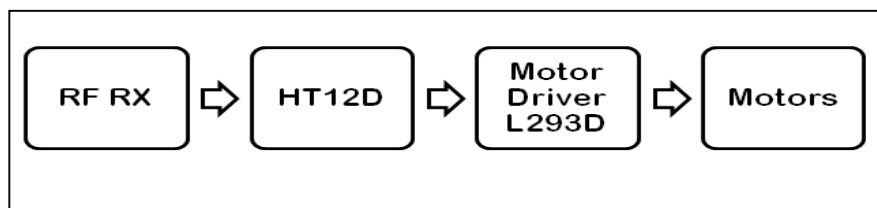
When the hand tilts in any direction, the accelerometer detects the movement and sends the data to the microcontroller. The microcontroller interprets these gestures and sends the corresponding commands wirelessly via an RF transmitter. The receiver unit receives these commands through the RF receiver module and sends signals to the motor driver circuit, which controls the geared motors for movement in the desired direction.

### IV. SYSTEM ARCHITECTURE

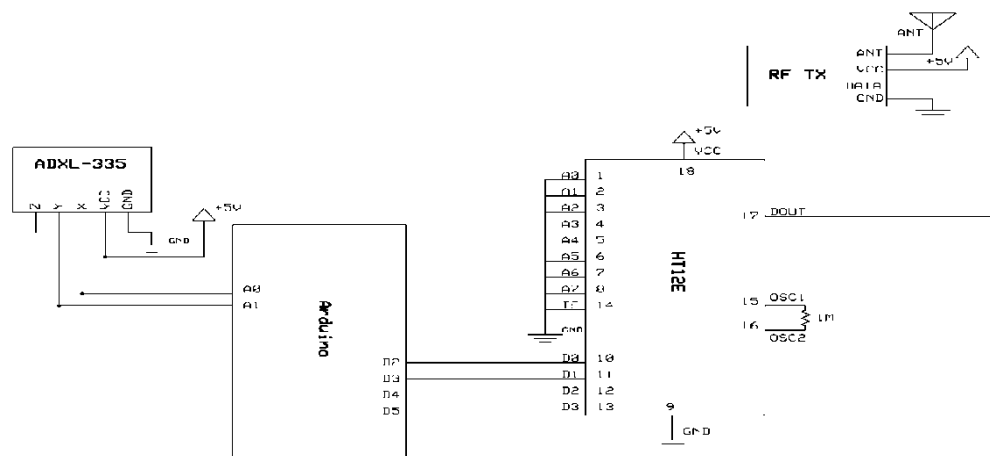
Transmitter Block Diagram :



Receiver Block Diagram :



Transmitter Circuit Diagram :





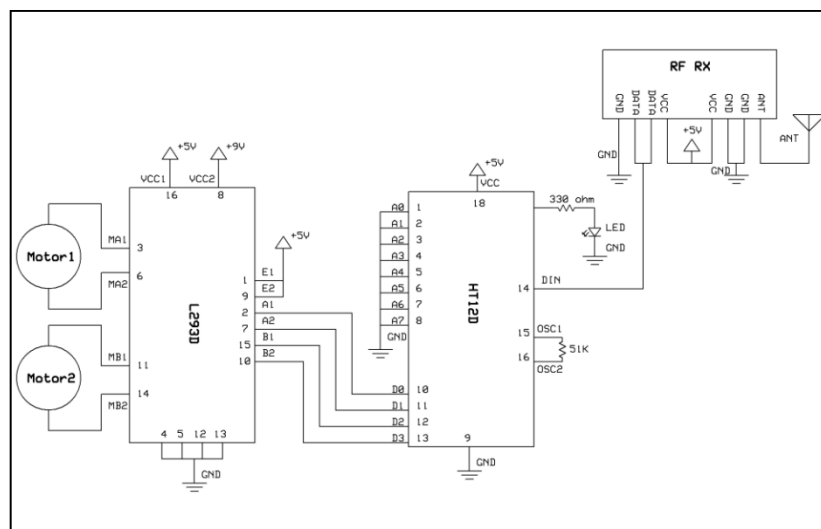
### Transmitter:

Main part of this Circuit is Accelerometer ADXL335 it is Tilt sensor which is used to measure the tilt. It has 3 output pins name as X axis, Y axis and Z axis. Each pin give the analog output voltage with respective to the 3 dimensional imaginary axis plotted with respect to gravitation.

This analog information of axis is given to Arduino microcontroller which having internal ADC who convert this analog information in digital form. In this microcontroller programming is such a way that when X and Y axis are perpendicular to the ground it generate one code and it is transmitted wirelessly to the RF receiver. When we change the position of our hand then with respective to the gravity X axis change its output voltage. Hence with respective to our hand gesture microcontroller generate the code and transmit it. Following Table shows the code transmitted From the Transmitter.

Hand Motion	Code			
	D0	D1	D2	D3
Perpendicular to gravity	Low	Low	Low	Low
Down Side	High	Low	High	Low
Up Side	Low	High	Low	High
Right Side	Low	Low	High	Low
Left Side	High	Low	Low	Low

### Receiver Circuit Diagram :



At the receiving section RF receiver, HT12D, Motor Driver IC L293D and motors are used. According to the data which is coming from the RF transmitter motor driver IC drives the motor and our robot is Move. Following table show the according to the command how robot is move.

Code				Motor State		Motion
D0	D1	D2	D3	Motor1	Motor2	
Low	Low	Low	Low	Stop	Stop	Stop
High	Low	High	Low	Anti Clockwise	Clockwise	Forward
Low	High	Low	High	Clockwise	Anti Clockwise	Reverse
Low	Low	High	Low	Anti Clockwise	Stop	Right
High	Low	Low	Low	Clockwise	Anti Clockwise	Left



Fig. Corresponding gestures to move the wheelchair

#### Hardware Specifications

- ATmega series Microcontroller
- ADXL345 Sensor
- Motor Driver
- Gear Motor
- RF Rx-Tx

#### Software Specifications

- Arduino Compiler
- MC Programming Language: Embedded C

#### V. CONCLUSION

The proposed system provides an efficient and intuitive control mechanism for specially abled individuals using simple hand gestures. It reduces the need for physical strength or vocal commands, thereby making mobility more accessible. The system is low-cost, user-friendly, and has the potential to significantly improve the quality of life of users.

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