

# Design of Hand Gesture Control Wheel Chair

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**Abstract:-** This study designated a wheelchair which can be meticulous using the user hand gesture. The purpose of this research was to come up with a hand gesture powered wheelchair system intended to provide assistance with the use of hand directions, which would allow users to travel efficiently and with greater ease. The system is made up of various electronics components such as the microcontroller, accelerometer, Bluetooth model, ultrasonic sensor, motor driver, among others. The microcontroller is programmed. The transmitter circuit board is made up of accelerometer sensor like ADSL335 which is able to sense three parameters. The microcontroller forms the main part or the brain of the system, and performs most of the functions. The microcontroller sends the readings sensed by the hand to the Bluetooth transmitter. The ultrasonic sensor detected obstacles, also sent the distance measured to the microcontroller. The microcontroller processed the information to the motor driver. The motor driver then powered the motors to either move forward or backward. It was observed that when the system was activated, the movement of the Wheelchair immediately start to follow the orientation of the user's hand. The wheelchair was able to be perform five (5) different gestures. The gesture follows the range that had been set. However, this range depends on the position of the accelerometer.

**Keywords:-** Hand Gesture, Wheelchair, Ultrasonic, Motor, Accelerometer, and Microcontroller.

## I. INTRODUCTION

### ➤ Background of Study

Wheel chair is a chair with wheels, and it is one of the finest supportive or assistive devices used by the aged and disabled people with difficulty in walking. Wheelchairs come in a varied variation of setups to meet the specific needs of their user. The powered wheelchair, have a very unique features like the batteries and electric motors, which physically help to propelled wheelchair without any assistances from any person. The old methods of using the wheelchair by physically pushing it is a very cumbersome for users required strength to push, therefore those without strength may need to depend on someone to push their chair. The manual wheelchair cannot be used for longer distance since it requires more energy from the disability person. The wheelchair was first invented by Harry Jennings and for his disabled friend Herbert Everest. There were both mechanical engineers, together they invented the first portable wheelchair using lightweight, steel, folding, in 1933. Other inventions took place, like the Chinese who

used wheelbarrows to move people and others substances. Currently about one percent of the world's population are using wheelchair to aid their movements. This means an increased population of elderly and people with lower arms disabilities are desiring to improve their mobility. A disable or an individual who has deformity of the lower part of the body can find it convenient to move around and maneuver using the help of a chair constructed on wheels which can either be pushed or propelled by physical force or electronically this is known as a wheelchair. Conventional wheelchairs do have a lot of limitation in many areas of design such as flexibility, bulkiness, with limited functions. This research incorporated hand gestures to synchronize with the movement of the wheelchair, so users can have comfort and ease fatigue. Even though some existing wheelchairs are fitted with Personal Computer for gesture recognition; making a wheelchair with Personal Computer makes it bulkier and increases complexity. Wheelchairs have given a lot of people independence. Wheelchairs are not only engineered products but rather it enables people with disabilities to become mobile, remain healthy and participate fully in the society. A wheelchair service as a catalyst to increased independence and social integration but not the end in itself. In addition to increased mobility, and provides these user needs. Adequate training about the use of wheelchair is needed so as to mitigate common problems such as pressure sores, the progression of deformities or other secondary conditions. A wheelchair that is functional, comfortable and can be propelled efficiently to increase the activities a disable person can performed in a day if he or she is without a wheelchair, also it makes him or her very independent in his or her daily living and reduces dependence on others. The wheelchair immensely gives them access to opportunities for education, employment and participation within the family and the society as a whole [1]. Determined the differences existed between those who used power wheelchairs and those who used manual wheelchairs. The data was collected using questionnaires for self-esteem, function and participation. There were significant differences observed between manual and power wheelchair users, however, there were several confounding factors which the authors acknowledged as limitations but did not account for varying motor function [2]. There was a three-phase observation which was used to understand the conditions and barriers that users of powered wheelchairs find difficult to drive in or over in the outdoor environment. The outcome shows that people who use power or electronic wheelchairs encounter some with the location of joystick. [3]. The research paper was an advanced approach of charging the physical gesture of hand into the electrical signal and process that signal into digital signal of appropriate magnitude and to be transmitted through the

transmitters. This paper provides some answers to people who involves accident and develop problem with their lower limbs [6]. This wheelchair lacked ultrasonic sensors that will detect obstacle in front of them [4]. Propose a system which provides solution for the physically handicapped people those who can't move by themselves, using speech commands by interfacing the Speech Recognition with microcontroller and wheelchair, and the voice commands are given to the Bluetooth module HC 05 kit with the help of mic and wheel chair moves according to the given directions which has an operating range of 10-100 meters [5]. In the late 1970s at Rehabilitation Medicine at New York the first voice used wheelchair was constructed these enables the user to be able to operate multiple items including the telephone, radio, fans, curtains, intercom, page-turner and more. Norwegain (1984) a law-student also used a voice wheelchair [7]. He was using it to attend his classes without the help of an at anybody. The wheelchair was customized for him using Katalavov speech-recognition system. Studies have shown that both age, adults and children benefit considerably from access to means of independent mobility, this includes scooters, walkers, physical wheelchair, power wheelchair and of course robotic wheelchair.

➤ *The Two main Types of Wheelchairs are as follows*

- *The Manual Wheelchair:*  
Manual wheelchairs are those that require human power to move them.
- *The Powered Wheelchair*  
The electric-powered wheelchairs are those that are propelled by an electrically based powered.

➤ *Problem Statement*

The controlling of the traditional wheelchair/manually propelled wheelchair is a harder task for users who does not have required strength to push, therefore the user becomes a burden on the family/society/community. Using the physical wheelchair for longer distance causes inevitable pain in the shoulders and arms and also Fatigue. Therefore, the need to designed a wheelchair controlled by a hand movement/hand gesture for easy movement and to incorporate into wheelchair with an ultrasonic sensor which will be used to detect an obstacle in front of the chair. This will Improve mobility and reducing dependency on caregiver and family members. It is be easy therefore a lot of people who cannot control the joystick can afford it. Users don't require any advanced training. It is easy to operate and user friendly.

**II. MATERIALS AND METHODS**

Table 1 Showing the Material and Specification

COMPONENT NAME	SPECIFICATION	QUANTITY	PURPOSE
Motor driver unit	L293D	1	For amplifying current supplied to the motor
DC motor	5v	2	It powers the motor driver
Microcontroller	ATmega2560, Arduino Mega	1	For instructions execution
Switch	SPDT	1	Use for turning the Device ON or OFF
Resistor	1k, 1k, 2.2k, 2.2k	4	Limit the flow of current
Light Emitting Diode		4	Used for indication Purposes
Ultrasonic Sensor	HC-SR04	1	To avoid obstacles, descending stairs in other to avoid accident
Bluetooth Module	HC-05	2	It establishes a communication link between the hand gesture controller wheelchair
DC battery	9volts	2	It powers the motor driver
Accelerometer	ADXL335	1	It is used to measure static and dynamic measuring devices

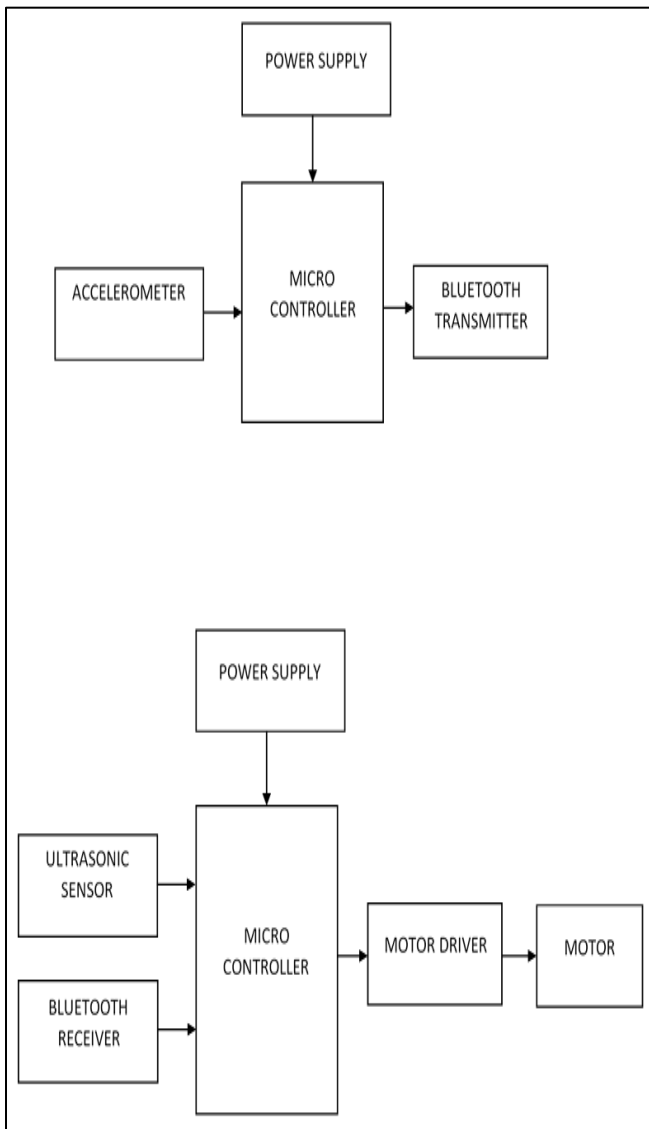


Fig 1 Hand Gesture Block Diagram and Wheelchair Block Diagram

➤ Hand Gesture and Wheelchair Block Diagram

The transmitter side which is the hand gesture and the receiver side is the wheelchair. For the hand gesture, there are four main parts: the power supply, accelerometer, microcontroller, and the Bluetooth module. The 9-volt power supply is connected to the microcontroller. The accelerometer sensor is connected to the microcontroller, which senses the position of the hand. The microcontroller sends the readings sensed by the hand to the Bluetooth transmitter. The receiver section, which is the wheelchair, is made up of an ultrasonic sensor, microcontroller, Bluetooth receiver, motor driver, and motor. The ultrasonic sensor detects obstacles and also sends the distance measured to the microcontroller. The microcontroller processes the information and sends it to the motor driver. The motor driver then powers the motors to either move forward or backwards.

➤ Methodology Flowchart

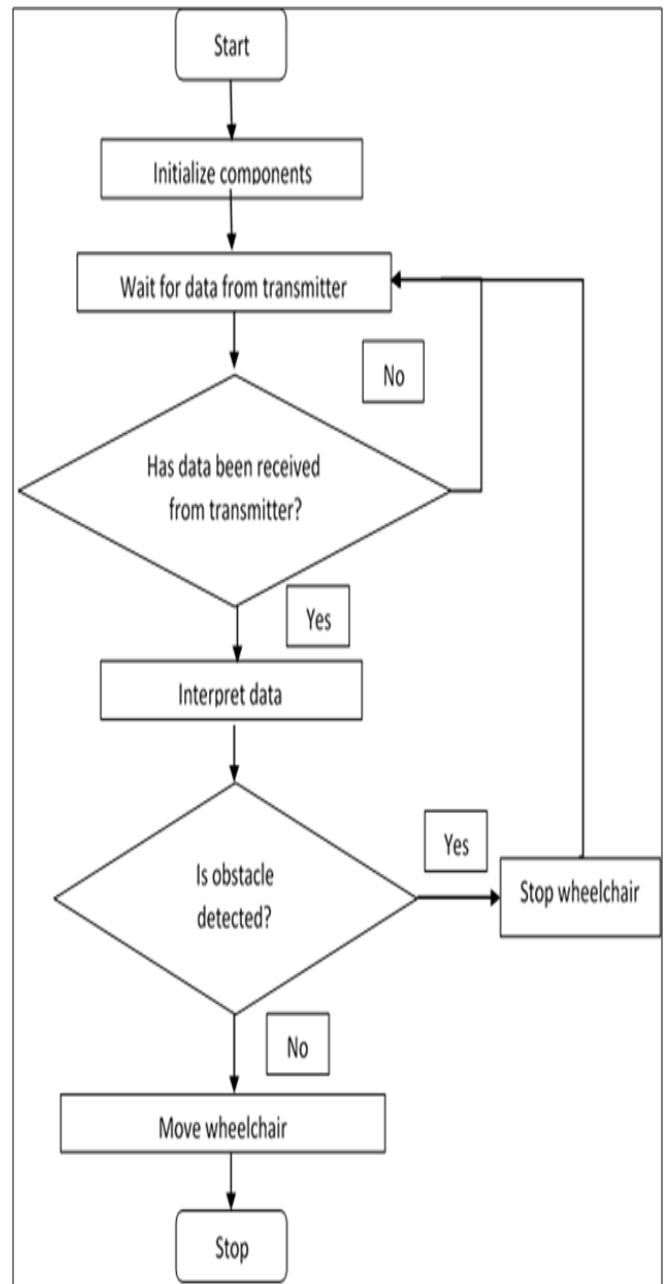


Fig 2 Flowchart

Once the system is started, all components are initialized with power supply. The receiver waits for data from the transmitter. The program constantly checks if it has received any transmitter or information. If there is no information, it moves to the wait for the data to be communicated. If the data is acknowledged from the transmitter, it then interprets the data. If there is an obstacle detected, the wheelchair stops. If there is no obstacle, the wheelchair continues to move.

➤ *Methodology Circuit Diagram Circuit Diagram of the Wheelchair (Receiver)*

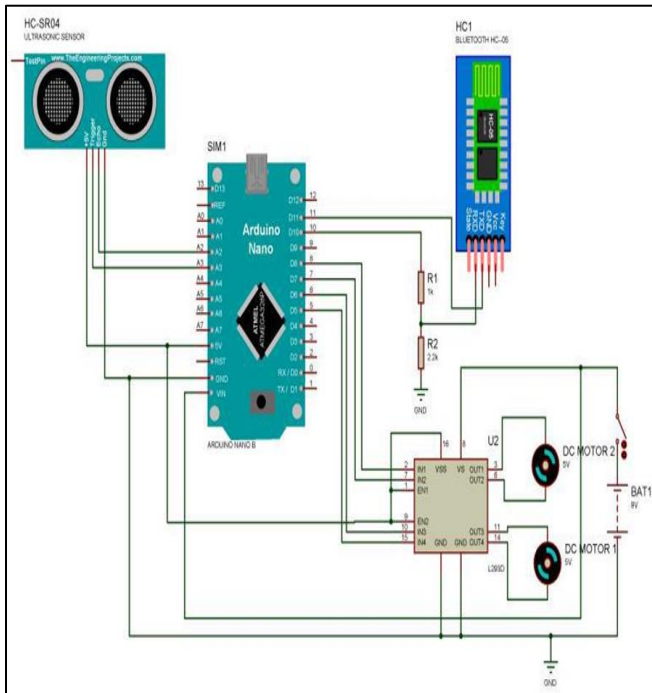


Fig 3 Showing Circuit Diagram of Wheelchair (Receiver)

➤ *Circuit Diagram of the Hand Gesture Controller (Transmitter)*

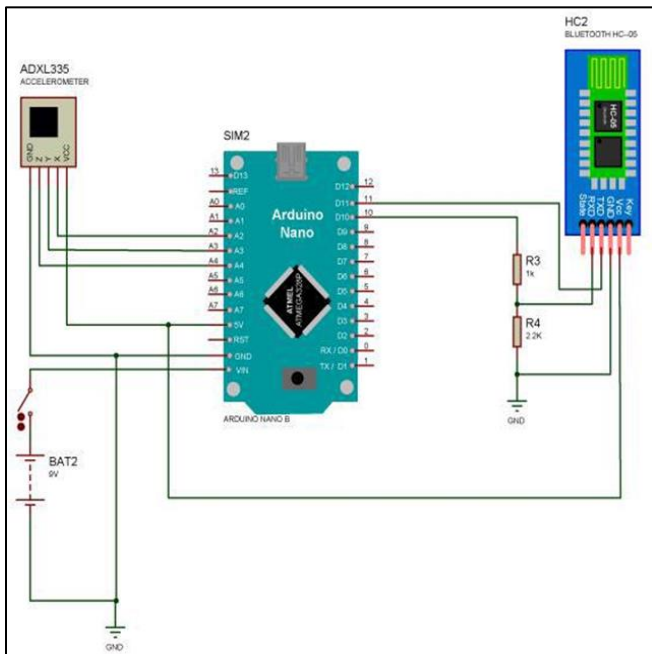


Fig 4 Showing the Circuit Diagram of Hand Gesture Controller (Transmitter)

➤ *Description Circuit Diagram*

The hand gesture wheelchair is powered with 9-volt DC batteries. One battery is connected to the receiver circuit board and the other battery is connected to the hand gesture controller which is the transmitter board. Wholly further electronic mechanisms on the circuit board are supplied with

5-volt DC battery from the Arduino AtMega board. A voltage regulator is used to regulate to 9 volts power supply into 5-volts. The transmitter circuit board is made up of accelerometer sensor ADXL335 which can sense three parameters x,y, and z axis. The microcontroller which is the main part of the brain of the system and performs most of the functions. The Bluetooth model AC06 operate on a logic level of 3-volts. For the microcontroller to send signal to the Bluetooth model without destroying it, it is sent through a voltage divider which breaks down the voltage 5volts into 3-volts. The switch is used to turn the system ON and OFF. The receiver board consist of a microcontroller, ultrasonic sensor, DC motor, Bluetooth model. The microcontroller is powered by 5volts. The Arduino board has a voltage regulator for regulation of the voltage that is needed by the microcontroller and the Bluetooth module. The ultrasonic has two power supply pin which trigger and echo pins which was used to portion the distance of obstacles in front of the wheelchair. The microcontroller determines which direction to move the motor. The commands are sent to the motor driver, which permits the motor to be driven with a higher voltage and the rest of the circuit will be driven by the remaining voltage so that it does not interfere with one another.

➤ *Working Principle*

This grants a method for monitoring wheelchair movement using hand gestures recognition. This technique was established based on the movement of the hand. It is modest and has some features to recognize and offers toughness recognizing gestures of one hand. The hand gesture is the transmitter while the wheelchair is the receiver. The hand gesture has four main parts, which is the power supply, accelerometer, microcontroller and the Bluetooth mode. The power supply which uses 9volts is connected to the microcontroller and it as well provides power to the system. The accelerometer sensor is connected to the microcontroller which sense the position of the wheelchair. This microcontroller sends the readings sensed by hand to the Bluetooth transmitter. The receiver section which is the wheelchair is made up of ultrasonic sensor, microcontroller, Bluetooth receiver, motor driver, and motor. The ultrasonic sensor detects obstacles like, accident, an object in front of the wheelchair and also sends the distance measured to the microcontroller. The motor driver which powers the motor to either move forward or backwards is an information processed by the microcontroller. In this method is able to recognize five different hand gestures in the same background for five status movements of the wheelchair like as, forward, reverse, left, right and stop.

**III. RESULT**

It was detected that when the system was triggered, the movement of the Wheelchair would instantly begin to follow the direction of the user’s hand. The wheelchair was able to be controlled in five (5) different gestures. The gesture follows the range that had been set. However, this range depending on the position of the accelerometer. The hand movement is transferred and received via Bluetooth

through which it is sent to the microcontroller. These selected hand movement includes Flat, Upward, Downward, Left, and Right. The microcontroller which has been programmed respond to the selected hand movement only. The slanting of the user's hands towards left or right resulted in a similar motion of the Wheelchair however, when the wheelchair progress near an obstacle within 20cm it stopped as it determined that it was heading for a crash. At the end of the testing 85 percent of response was achieved using the upward gesture of the hand, 80 percent of the result was achieved using the downward gesture of the hand. 85 percent of the response was achieved using the right gesture of the hand, 85 percent of the response was achieved using the left gesture of the hand and 75 percent of the response was achieved using the flat gesture of the hand.

#### IV. DISCUSSION

Some 80 percent of people with disabilities live in low-income countries According to The International Labour Organization (ILO), with a hand gesture-controlled wheelchair the majority of them will have an opportunity to improve the quality of their lives socially and economically. Therefore, having a hand gesture wheelchair will enhance movements of the disable people. By this their economic activities will improve, and making them independent.

#### V. CONCLUSION

The sign control wheelchair system was divided into two important parts, the transmitter section and the receiver section. The hand gesture signal was able to perform the task by moving forward backward and sideways as commanded. This will go a long way to help the hand impaired and the aged in the community.

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