# Accelerometer based Gesture Controlled Wheelchair

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## ABSTRACT
Handicap Wheelchairs are used by the people those who cannot walk due to physiological or physical illness, injury or any disability. Recently development has wide scope in developing smart wheelchairs. This proposed system a hand gesture controlled wheel chair is special kind of wheel chair which works with your hand gesture there are possibility to control the movement of wheel chair at desired direction just with your hand gesture .This system is divided into two main units. Memes Sensor transmitter and wheelchair control receiver. The Memes sensor, The ADXL335 is small thin, low power consumption, complete 3-axis accelerometer with signal conditioned voltage outputs. Which is connected to hand, is a 3-axis accelerometer with digital output (I2C) that provides hand gesture detection, you just need to wear a small transmitting device in your hand which include an acceleration meter this will transmit an appropriate command of 6- bit digital values and gives it to the PIC controller using ZigBee RF Module is a Transreceiver module which provides easy to use RF communication at 2.4 GHz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source. So that wheel chair it can move into the desired direction they want. The wheelchair control unit is a wireless unit that is developed using other controller.

## Keywords
Accelerometer, ZigBee, Smart wheelchair

## 1. INTRODUCTION
Now a day's 1% of the world's population needs a wheelchair. An increased percentage of aging and handicap people who want to build their personal body function for them wheelchair is the best assistive device. A handicap or an invalid individual (usually the disability of the lower part of the body can find it convenient to move around and drive using the help of a chair constructed on wheels which can either be pushed by another individual or propelled either by physical force or electronically. Such a chair is called as a Wheelchair. The gesture controlled wheel chair is special kind of wheel chair which works with your hand gesture It is possible to control the movement of wheel chair is desired direction just with your hand gesture .You just need to wear a small transmitting device in your hand which include an acceleration meter. This will transmit an appropriate command to the wheel chair so that it can move into the desired direction they want. Traditional wheelchairs have some limitations in context to flexibility, bulkiness and limited functions. Our system allows the users to use hand gestures for movement and synchronize them with the movement of the Wheelchair so that they can use it with comfort and ease on all kinds of terrains without the hurdle or cardio vascular problems or fatigue. Some existing wheelchairs are fitted with pc for the gesture recognition. But making use of the pc along with the chair makes it large and increases complexity. This complexity is reduced by making use of the accelerometer which is very small, thin, low power, complete 3-axis accelerometer and it can be placed on the hand of the patients. Similar existing systems, which make use of the various kind of sensors increases the complexity if the system is wired. They also limit the long range communication. This complexity is removed by using the ZigBee RF module. Signals through RF travel larger distances. Irrespective of line of sight communication, signals through RF travel even. The system is divided into two main units. Memes Sensor and wheelchair control.

### 1.1 MEMS Sensor
Most accelerometers are Micro Electro Mechanical Sensors (MEMS). The basic principle of operation behind the MEMS accelerometer is the displacement of a small proof mass etched into the silicon surface of the integrated circuit and suspended by small beams, the following block diagram consist of two sections which are developed for model transmitter and receiver having range of 100 meters. At the transmitter section 3D motion is sensed by the accelerometer and send the corresponding movement to x, y, z pins of microcontroller (AT89C2051).NRF24L01 RF Module is transreceiver module which provide easy to use RF communication at the receiver section.

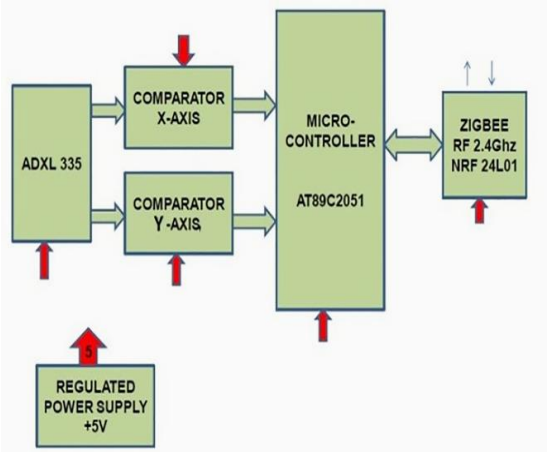


**Figure1: Block Diagram of MEMS Sensor**

## 1.1 Wheelchair Controller

At receiver section ZigBee is used as RF which transmits data at 250 kbps and provide it to microcontroller (AT89S51) and display same on LCD. Keil µVision3 is used and programming is done in embedded C language. Hex file generated by Keil µVision3 is dumped to controller with Micro flash for chip burning Power supply to microcontroller is provided by power supply unit. LCD is required to display corresponding changed values to check the system working. Number of utilities can be controlled by using control section with Microcontroller IC (AT89C51).

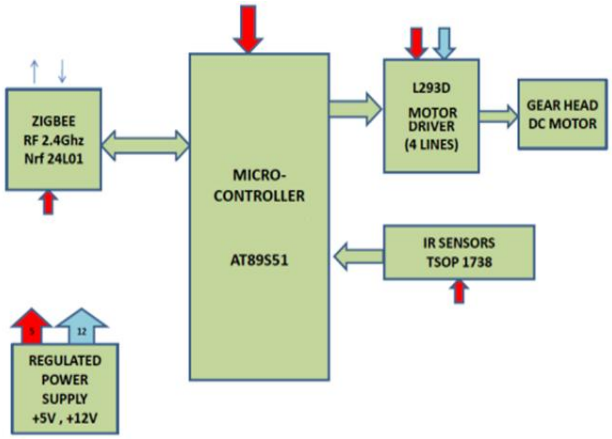


**Figure 2: Block Diagram of wheelchair controller**

# 2. LITERATURE REVIEW

## 2.1 Accelerometer Based Hand Gesture Controlled Wheelchair

[1]This project wheelchair is operated using hand gesture and to sense the hand gesture mems accelerometer is being used. Integration of mechanical elements, actuators, sensors and electronics on common silicon substrate through micro fabrication technology is Micro Electro Mechanical Systems (MEMS) .An accelerometer is an electromechanical device that measures hand motion. MEMS accelerometer is a single chip with small size and low cost. Because of their small size and weight, accelerometers are attached to back of the hand. In this model they are using MMA7660FC accelerometer, which is 3-axis accelerometer and gives digital output in I2C.The sensor can be modified as a movable beam that moves between two mechanically fixed beams. Two gaps are formed the second between the movable beam and the second stationary beam and one being between the movable beam and the first stationary beam. The ASIC uses switched capacitor techniques to measure the g-cell capacitors. Extract the acceleration data from the difference between the two capacitors. The mems sensor has inbuilt I2C protocol using which the processing speed of the system is increased. Advantage of I2C is, by using its two lines it can connect up to 128 devices to the controller.

## 2.2 Accelerometer Based Hand Gesture Controlled Wheelchair

[2]Study is performed in the province of Tungurahua, Ecuador. A wheelchair user centered design an anthropometric. The study group consists of 22 people who are wheelchairs users, are capable to perform possible activities with their upper body, have acquired the disability after reaching their physical maturity and are in working-age. In order to determinate the wheelchair dimensions, a chart with 13 chosen body measurements were developed. Author Represented hardware implementation of controlling a robotic vehicle wirelessly with the help of hand gestures. Accelerometer based hand gesture control system depends on the hand movement of the user. For different types of hand motion the Robot works in different directions. A robot which can be controlled wirelessly with the help of hand motion is much easier than other controlling methods. The gesture control system gives a new dimension in the world of controller. The focus of the project was to sense the hand motion wirelessly. Different types of movement can give the different value to the microcontroller, so by observing various data of sensor for hand motion they tried to implement it on a gesture sensing wireless robot.

A Universal remote control (URC) unit is used to control many different consumer electronics devices based on IR control system. For this the URC unit has to have many preprogrammed control source codes so a dynamic control scheme is designed based on ZigBee protocol. This system uses ZigBee based wireless network technique, WPAN, and a ZigBee to IR conversion module which converts a control commands transferred through ZigBee network into IR control signal. This scheme minimizes power consumption based on ZigBee ON/OFF control technique using multiple level timers.

## 2.3 Adaptive Hand Gesture Controlled Wireless Wheelchair Using Zigbee Protocol

[3]This technique is intended as a solution to the conventional handicap wheelchairs which involve strenuous hand motion. The user controls the direction of a wheel chair by hand motion movements by using technology. The hand gesture movement drives the sensors in the designed circuit to control the movement of the wheelchair. The control unit uses a Motor Driver IC to drive the DC Motors. The wireless transmission is employed using ZigBee Technology, popular for low data rate applications and a secured communication technique. The accelerometer sensor senses the hand motion and the output are fed to the microcontroller which processes this data and provides a digital o/p to the ZigBee RF module at the transmitter section. The ZigBee RF module at the receiver section receives the transmitted signal which is then processed using microcontroller & employed to control the Motors using Motor Driver circuit. ZigBee is a technology of data transfer in wireless communication networks. It is designed for wireless control and connectivity between small packet switch devices.

## 2.4 Hand Gesture Based Wheelchair Movement Control for Disabled Person using MEMS.

[4]When an unfortunate event affects the motor capacity of a person, it is necessary to use devices like wheelchairs that offer a means of movement for patients with motors problems of the lower limb. Tremendous leaps have been made in the field of wheelchair technology. However, even these significant advances have not been able to help quadriplegics navigate wheelchair unassisted. Some patients that cannot manipulate the wheelchair with their arms due to a lack of force or psychomotor problems in the superior members, frequently manipulated with joysticks, request electric wheelchairs; however the joystick manipulation is even not practical and frequently it must be handle with the body parts. The present article presents the partial results in the development of a wheelchair controlled by an intuitive interface, where the instructions are given by hand movement. The advancement are presented in the realization of the control software using a Webcam and some distances and presence sensors controlled by a PIC microcontroller that establishes the communication with a program developed in Lab . This paper was research from an IEEE. A Wearable Head- Mounted Sensor-Based Apparatus for Eye Tracking Applications that was presented in the IEEE International Conference in Istanbul, Turkey, dated 14 to 16 July 2008. The above paper approach was dealing with wheelchair control using eye ball movement sensor with slight modification to it. Our paper deals with the control of wheelchair motion by hand gesture.

# 3. HARDWARE DEVELOPMENT

## 3.1 Transmitter Section

### *3.1.1 Accelerometer*

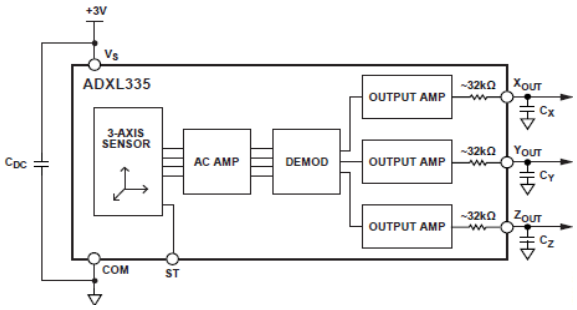


**Figure 3: Block Diagram of Accelerometer**

The ADXL335 is small, thin, low power consumption, complete 3-axis accelerometer. The sensor measures acceleration with a minimum range of ±3 g. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or vibration. The user selects the bandwidth of the accelerometer using the three axis capacitors at the three o/p pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hertz to 1600 Hertz for the X and Y axes, and a range of 0.5 Hertz to 550 Hertz for the Z axis.

### *3.1.2 Microcontroller*

The AT89C2051 is low power consumption, high-performance CMOS 8-bit microcomputer with 16K bits of Flash programmable and erasable read-only memory (PEROM). The device is manufactured by Atmel's high-density nonvolatile memory technology. Industry-standard MCS-51 instruction set is compatible with AT89C2051. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C2051 is a power-full microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89C2051 provides the following standard features: 16K bits bytes of Flash, 1024 bits of RAM, 15 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, a precision analog comparator, on-chip oscillator and clock circuitry.

### *3.1.3 ZigBee Module*

NRF24L01 RF Module is a transreceiver module which provides easy to use RF communication at 2.4 GHz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source. It works in half duplex mode.

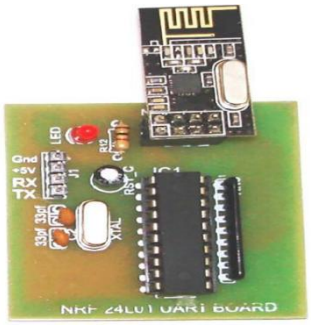


**Figure 4: ZigBee module**

### *3.1.4 Power Supply Unit*

This unit is basically designed to power up the transmitter and receiver. This provides 5 V, 500mA output to drive the nodes.

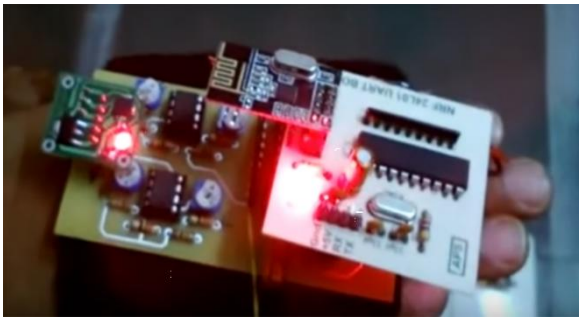

**Figure 5: Hardware for Transmitter Section**

## 3.2 Receiver Section

### *3.2.1 ZigBee Module*

NRF24L01 RF Module is a transreceiver module which provides easy to use RF communication at 2.4 GHz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source. It works in half duplex mode. The following figure same as figure [4].

### *3.2.2 Microcontroller*

The AT89S51 is low-power consumption, high-performance CMOS 8-bit microcontroller with 32K bits of In-System Programmable Flash memory. The device is manufactured by Atmel's high-density nonvolatile memory technology. Industry-standard 80C51 instruction set and pin out are compatible with it. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer.

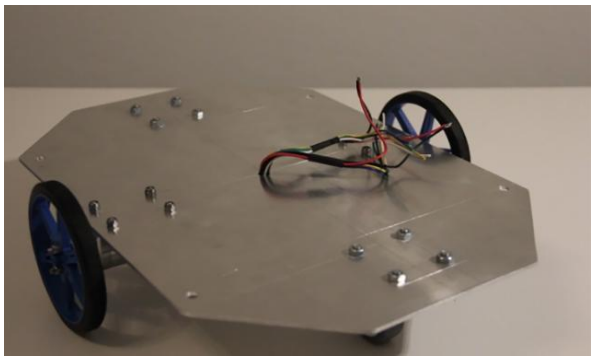

**Figure 6: Developed Hardware for Transmitter Section**

## 4. CONCLUSIONS

In this proposed system they an improved gesture technology based system based on portable and low cost components in a wearable form. They utilize the acceleration data to recognize the hand motion and then transfer the information which indicates certain motion commands into the wheelchair's smooth motions. It's a try to realize the natural interaction for the older and handicapped and handicap peoples with the wheelchair through the hand gestures. This gives the user independence and a psychological advantage of being independent. To avoid physical hardship to the user come the accelerometer to the rescue as with the slight twist of the hand the user gets the ability and freedom to turn the wheelchair into the desired direction. Of course some training is necessary to use the accelerometer as its quite sensitive but in the end there could not be a better use of technology for an individual who is deprived of the same physical strength. Improvements can be made by using various body motion such as eye gaze, leg movement or head movement, voice sensors accordingly. In the future work, they will focus on improving drawbacks and do more experiments to improve and verify the method in future.

## 5. FUTURE SCOPE

As such, many improvements can be made upon this initial design

a) The paralyzed person can operated wheelchair using eyes sensor they can move the wheel chair left or right by just looking to the required direction, they can also start and stop the wheel chair, with other gestures or else another sensor such as voice recognition system, this project can be implanted.

b) Security system can be implementing for patient such as alarm for nearby person if when required.

## 6. REFERENCES

[1] Accelerometer Based Hand Gesture Controlled Wheelchair Diksha Goyal And Dr.S.P.S.Saini.

[2] Accelerometer Based Hand Gesture Controlled Wheelchair Abirami B, Anupriya S, Divyarani R, Nagaraju V.

[3] Adaptive Hand Gesturecontrolled Wireless Wheelchair Using Zigbee Protocol.Sushree Swayamsiddha, Arunava Banerjee, Joy Chowdhury.

[4] Hand Gesture Based Wheelchair Movement Control For Disabled Person Using Mems. Prof. Vishal V. Pande, Darshana P, Masurkar, Nikita R.

[5] Mems Accelerometers Matej Andrejasic.

[6] Hand Movements Based Control Of An Intelligent Wheelchair Using Accelerometer, Obstacle Detection Using Ir Sensors D.Anjaneyulu And Mr. B.V.N.R. Siva Kumar.

[7] Microcontroller Based Gesture Controlled Wheelchair Using Accelerometer Manisha Chahal, B. Anil Kumar.