International Journal of Applied Engineering Research
ISSN 0973-4562 Volume 10, Number 9 (2015) pp. 22265-22274

http://www.ripublication.com

Design and Fabrication of Hand Gesture Wheelchair For Disable Person Using Mems

K.naveen kumar,M.Tech.,
M.TECH-Robotics,
SRM university,
Kancheepuram (District), Tamil Nadu-603203.
n209091@yahoo.com
Mr.Naveen john punnoose, M.S.,
School of Mechanical engineering,
SRM university,
Kancheepuram (District), Tamil Nadu-603203.

Abstract

The objective of the project is to design and control the wheelchairs which are used by the people who cannot walk due to physical illness. The gesture based wheelchair which controls the wheelchair using hand movements. The system is divided into two main units MEMS Sensor and wheelchair control. The MEMS sensor, which is connected to hand, is a 3-axis accelerometer. The MEMS sensors inside the hand can sense the movement of fingers. The controller sends the signals to the receiver section which is placed under the wheelchair. The receiver gets the signals from the transmitter according to the signals the motor is runs which changes the wheel movement. In this phase, the wheelchair will be controlled by pressing the keypad and in the next phase the wheelchair is controlled by using a MEMS sensor.

Keywords: Wheelchair, Accelerometer, DC Motor Driver, Physically Handicapped.

Introduction

The Aim of this work is to design and build an automated wheel chair for physically challenged persons for their independent movement. Idea behind this work is to control the motor rotation of a wheel chair based on hand movement of a physically challenged person. In order to facilitate these people for their independent movement, an accelerometer device based transmitter is fitted on the persons hand based movements the transmitter will generate command signals which will be received by the receiver fitted on the back of the chair. This receiver after receiving signal will

drive the motor fitted to the wheel chair. The wheel chair can be driven in any of the four directions. The automated wheelchair design is based on simple electronic control system and the mechanical arrangement will be controlled using an ARM7 Microcontroller. This automatic wheel chair also helps people who have various other disabilities to sit on the chair and just hold the accelerometer and move it over to control the vehicle movements. Wheel Chair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of an attendee or by means of Self-propelling. The wheel chair is divided into two different types based on the power used for mobility.

1. Manually powered wheelchairs.
2. Electric powered wheelchairs (automated).

Manual powered wheelchairs are driven by manual power which is again classified into foldable and non-foldable with or without commode design. Electrical powered wheel chairs run with electric power and operation of the chair depend upon the instructions given by the patient's hand movement or any other mechanism.

The aim of this project is to control a wheel chair and often associated electrical devices by using MEMS ACCELEROMETER SENSOR (Micro Electro-Mechanical Systems*)* technology. MEMS ACCELEROMETER SENSOR is a Micro Electro Mechanical Sensor which is highly sensitive and capable of detecting the tilt. This sensor finds the tilt and makes use of the accelerometer to change the direction of the wheel chair depending on the tilt angle. For example, if the tilt is to the right side then the wheel chair moves in right direction or if the tilt is to the left side then the wheel chair moves in the left direction. Wheel chair movement can be controlled in Forward, Reverse, and Left and Right direction.

Automation is the most frequently used term in the field of electronics. The hunger for automation brought many revolutions in existing technologies. One among the technologies, which has greater developments, is the MEMS ACCELEROMETER SENSOR. These have a greater importance than any other technologies due its user-friendly nature. MEMS ACCELEROMETER SENSOR based devices can be easily available to the common man due to its simpler operation.

This wheel chair automatically senses the presence of obstacles in its path and deviate its direction of movement. The obstacle detection mechanism is done by an ultrasonic sensor that makes uses of ultrasonic waves to find the presence of an obstacle in its path. It makes use of the ultrasonic sensors to detect the obstacle present in its expected trajectory and dynamically changes the trajectory to be followed.

This device is portable and this system operation is entirely driven by wireless technology. User can wear it to his wrist like a watch and can operate it by tilting the MEMS ACCELEROMETER SENSOR Accelerometer sensor.

This project makes use of a micro controller, which is programmed, with the help of embedded C instructions. This microcontroller is capable of communicating with transmitter and receiver modules. The MEMS ACCELEROMETER SENSOR based sensor detects the tilt and provides three information to the microcontroller (on board computer) and the controller judges whether the instruction is for a right motion or left motion instruction and controls the direction respectively. The controller is

interfaced with two dc motors to control the direction of the wheel chair. Also, the devices are operated through MEMS accelerometer sensor.

Methodology

The approach towards the making of the robot has been split into different steps which start from designing, modeling, fabrication and controlling of the robot. Figure 1 depicts the steps of the methodology of work. First step is identifying the problem. The second step is developing the concept to overcome the problem which has been identified in the first step. Once the concept is developed for the identified problem, the different possibilities of the concept is sketched out and studied. The optimum solution for the concept is arrived after the studies. The next step is to develop the conceptual idea into a 3 dimensional model using modeling software. The various calculations are done such as kinematic parameters. Then analysis of the complex model in order to identify fundamental properties had been carried out. Next stage is to fabricate the wheelchair robot. Then an algorithm is to be developed for the locomotion of the wheelchair robot for the purpose of physical disabled person and for the obstacle avoidance. Finally, the wheelchair is developed and controlled using MEMS technology.

The wheelchair robot will be separated into three different parts of tasks, namely the mechanical part, the electronics & electrical part, and the programming part. The programming part will include the control for locomotion of the wheelchair robot by programming the DC motor, response to the sensors feedback, respond to user command, and able to move the wheelchair according to the hand movement. In this project wheelchair is operated using hand gesture and to sense the hand gesture MEMS accelerometer is being used. Micro Electro Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. An accelerometer is an electromechanical device that measures acceleration forces. MEMS accelerometer is a single chip with small size and low cost. Because of their small size and weight, accelerometers are attached to the fingertips and back of the hand.

In this proposed system, MEMS sensors are used to control the wheel chair movement from one place without much movement. For this, the control section consists of a MEMS sensor connected to a microcontroller and a RF transmitter. The device and wheel chair section consists of a RF receiver with relays. MEMS sensors produce different analog values for different orientation. These values are converted into digital values by the microcontroller and transmitted via RF transmitter to the devices. The set up will have a switch to the control the wheelchair. Commands like start, stop, left, right, forward and reverse are provided to the wheel chair when the switch is pressed and MEMS sensor is tilted. These values are received by the RF receiver in devices and wheel chair and the corresponding relay is triggered for motor movement of wheel chair. LCD is used to display the commands sent from the control section.

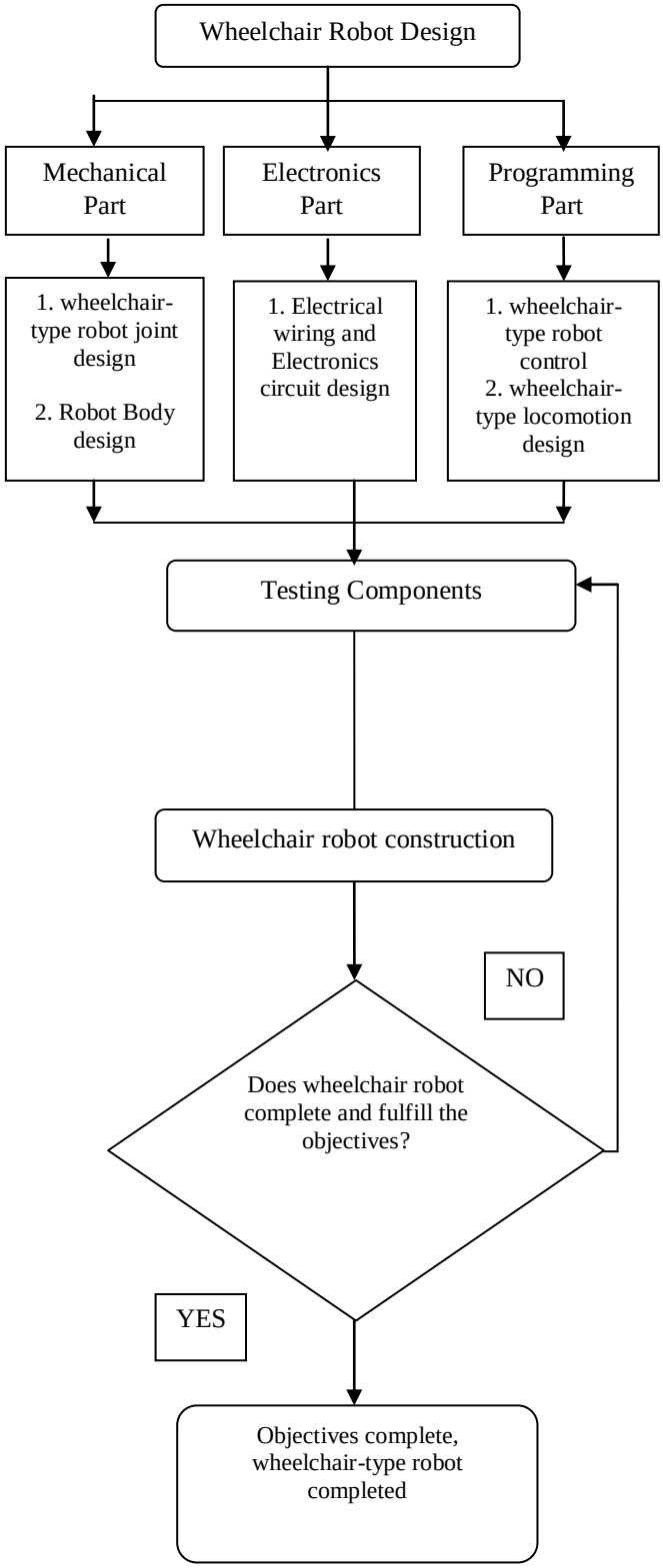

Figure 1: The Glow Graph For The Wheelchair Robot Design Project

Working

The implementation of this proposed problem mainly involves two steps. They are gesture recognition and controlling direction of wheelchair using microcontroller based on the received gesture commands. (a) Transmitter Block Diagram, (b) Receiver the hand gesture is sensed by accelerometer using the instrumented glove approach. The ADXL 330 accelerometer which convert the hand position into 3-Dimensional Output. The values obtained from the accelerometer are analog values which should be further converted into digital values so they can be used by the microcontroller. The accelerometer analog outputs are converted into digital with the help of ADC 0809. ADC converts the data from sensor and proceeds to the microcontroller (P89V51RD2) for further conversion and calibration. Microcontroller gets the data from the accelerometer and converted into ASCII code for LCD display. LCD display the X— Y—Z values and display the values on the LCD.

A. MEMS accelerometer

The MEMS sensor, which is connected to hand, is an 3-axis accelerometer. The MEMS sensors inside the hand can sense the movement of fingers. The controller sends the signals to the receiver section which is placed under the wheelchair through a wireless technology. In The receiver section get the signals from the transmitter according to the signals the motor is running which changes the wheel movement. In this phase the wheelchair controlled by pressing the keypad and next phase the wheelchair is controls by MEMS sensor.

B. Accelerometer (3 Axis)

An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic caused by moving or vibrating the accelerometer.

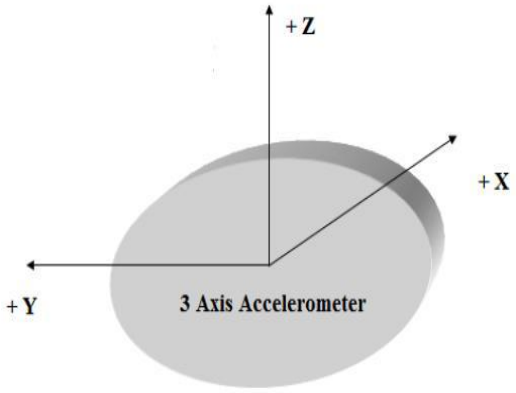

Figure 2: Shows The 3 Axis Accelerometer

The ADXL335 is a small, thin, low power, complete accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing

applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. TheADXL335 is available in a small, low profile, 4 mm × 4mm × 1.45 mm, 16-lead, plastic lead frame chip scale package.

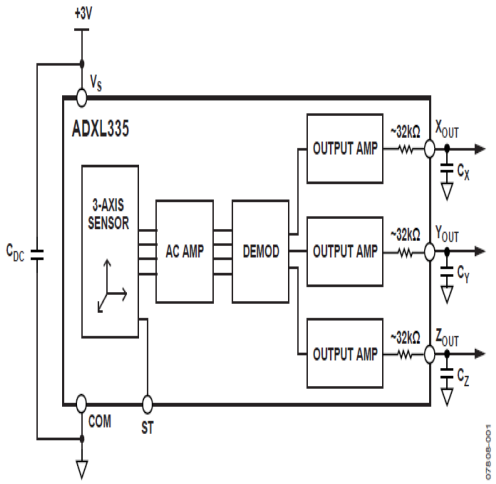

Figure 3: Block Diagram of ADXL335

An accelerometer is a device that measures the proper acceleration of the device. This is not necessarily the same as the coordinate acceleration (change of velocity of the device in space), but is rather the type of acceleration associated with the phenomenon of weight experienced by a test mass that resides in the frame of reference of the accelerometer device. For an example of where these types of acceleration differ, an accelerometer will measure a value when sitting on the ground, because masses there have weights, even though they do not change velocity. However, an accelerometer in gravitational free fall toward the centre of the Earth will measure a value of zero Automation of Wheel Chair Using MEMS Accelerometer (Adxl330) 231because, even though its speed is increasing, it is in an inertial frame of reference, in which it is weightless. By measuring the amount of static acceleration due to gravity, you can find out the angle the device is tilted at with respect to the earth. By sensing the amount of dynamic acceleration, you can analysis the way the device is moving with the help of the accelerometer; we can control the movement of any robotic arm or movement or control of any electrical appliances. If we install our accelerometer to our hand, then it is possible to control anything with the help of our hand. With the help of four different motions we control the direction of chair for forward, reverse left and right.

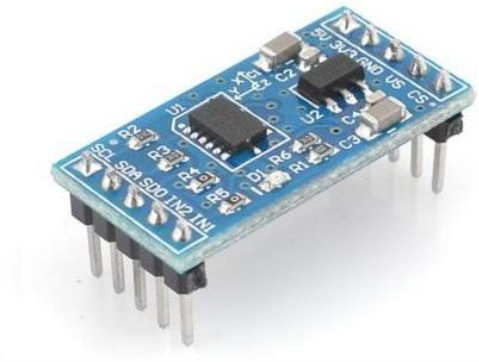

Figure 4: Accelerometer (3-Axis)

C. Microcontroller Used

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

The microcontroller used for this project is the latest controller existing in the electronics market ARM7 MICROCONTROLLER.

D. Tilt Sensing Using a 3-AxisAccelerometer

Accelerometers are sensitive to both linear acceleration the local gravitational field. The former provides on taps; while the latter provides information on the accelerometer orientation which allows wheelchair to move accordingly. This application note documents the mathematics of orientation determination using a three accelerometer. The techniques are applicable to both digital accelerometers and, after signal digitization, to accelerometers. For convenience, it is assumed accelerometer is mounted on head any product with an embedded three- axis accelerometer. Joystick' s axes interpretation: 1) full speedforward,2) full speed reverse, 3) full speed clock wises pin, 4) full speed counterclockwise spin.

E. Physical Simplified Module Using Accelerometer

It consists of a three-axis accelerometer sensorMMA7660FFC with sensitivity +/- 1.5g, with digital output. It is interfaced to the control unit by I2C (Inter Integrated

circuit) protocol. It is low cost and has high shocks survivability (10,000 g). It has low current consumption (0.4 micro Amp) and low power consumption analog voltage (2.4v-3.6v) and digital voltage (1.71v- 3.6v) > It has an auto sleep / wake feature for low power consumption. Tilt orientation detection can be done accurately. [6] scale Accelerometer consists of a M g-cell and a signal conditioning ASIC contained in a single package. The sensing element is sealed hermetically at the wafer level using a bulk micro machined cap wafer. The g-cell is a mechanical structure formed from semiconductor materials (poly silicon) using masking and etching processes. The sensor can be modeled as a movable beam that moves between two mechanically fixed beam. Two gaps are formed. One being between the movable beam and the first stationary beam and the second between the movable beam and the second stationary beam. The ASIC uses switched capacitor techniques to measure the g-cell capacitors and extract the acceleration data from the difference between the two capacitors. The ASIC also signal conditions and filters (switched capacitor) the signal, providing a digital output that is proportional to acceleration.

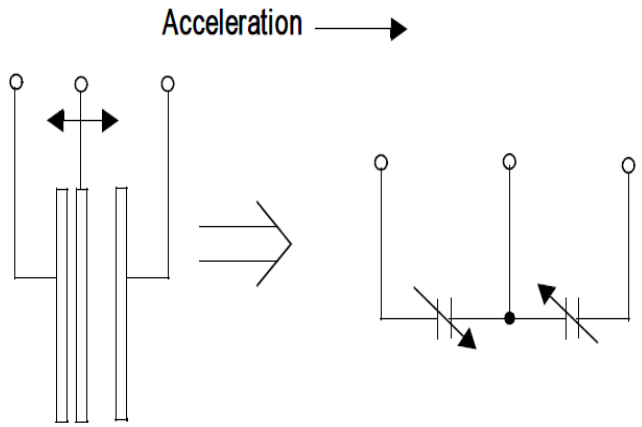

Figure 5: Physical Simplified Model of Accelerometer

F. LPC2148 ARM 7 microcontroller IC

ARM 7 IC is the heart of the smart automated wheelchair. A LPC2148 ARM 7 IC is a programmable device [7] that can be used to perform any arithmetic and logic operations. The difference between a microcontroller 8051 and a ARM 7 IC is the availability of internal memory to store the program code and it can function as a standalone controller. The need for ARM 7 IC in this concept design involves receiving data from the working of servo or DC motors. Also ARM 7 has Von Neumann architecture.

The ARM 7 IC is a 64-bit microprocessor based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ARM 7 IC achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent

registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. It is programmed in such a way to control the servo and DC motors. It is also the cheapest and most widely used controller. As we employ only simple operations this controller is sufficient. The main reason for employing this controller is its low power consumption and ease in the coding. The supply is drawn from the batteries which are used to run the motors. The output of the controller just indicates the motors that are to be activated are. The output ports are coupled to motors via the relays and based upon the controller output, the corresponding motor rotates to move the wheel chair in the desired direction

G. DC Motor:

This motor follows linear laws of operation and because of this it is easier to fully exploit its characteristics compared to synchronous or asynchronous motors. Many applications call for a high start-up torque. The D.C. motor, by its very nature, has a high torque vs. falling speed characteristic and this enables it to deal with high starting torques and to absorb sudden rises in load easily. The speed of the motor adjusts to the load. Furthermore, the D.C. motor is an ideal way of achieving the miniaturization designers are constantly seeking because the efficiency it gives is high compared with other designs. The specifications of the DC motor as per the market and technical specification surveyed by us are 12v DC, 90W,10 RPM having a weight of 200kg which will be very efficient and reliable for the weight of any patient of any age to for the starting torque.

Conclusion

As the accelerometer based automated system has been presented which would be very helpful for physically challenged persons. Recent improvements in the development of the smart wheelchair are making lives easier for everybody. Our work is to control Wheelchair by accelerometer where the wheelchair is programmed to reacts according to the motion of accelerometer (forward, reverse, stop, left and right). The movement is recognized by ADXL335 is used to control the motion of the Wheelchair. Also the accelerometer sensor is calibrated such that it produces particular analog voltage for a corresponding tilt. Ultra sonic sensor is used to avoid the obstacle in path and physically disabled patients.

Future Scope

Automatically recharging the battery using alternator during movement of the wheelchair. Various security systems for the patient can be impended which can alarm the nearby people if when required. Also by using voice recognition system, this project can be implanted

Reference

[1] Simon P. Levine, David A. Bell, Lincoln A. Jaros, Richard C.Simpson, Yoram Koren, Senior Member, IEEE, and Johann Borenstein, Member, IEEE transactions on rehabilitation engineering, vol. 7, no. 4, December 1999. "The NavChair Assistive Wheelchair Navigation System ".

[2] Benjam´ın Romero, Abraham Camacho, Jorge Varona, Carlos Delgado and Ramiro Vel´azquez Mecatr´onica y Control de Sistemas (MCS), Universidad Panamericana, Aguascalientes, Mexico. *IEEE AFRICON 2009 23 - 25 September 2009, Nairobi, Kenya* "A Low-Cost Electric Power Wheelchair with Manual and Vision-Based Control Systems"

[3] Amundson, Robertson, and James F. Ster, III, "*Electric PoweredWheelchairs*" IEEE, transactions on control systems technology, vol. 8, no. 1, january 2009.

[4] Steeper,yoshiakishirai, "*Wheelchair Based on the Integrationof Human and Environmental Observations"*IEEE, robotics,may 2008.