Advance in Electronic and Electric Engineering.
ISSN 2231-1297, Volume 3, Number 2 (2013), pp. 227-232

http://www.ripublication.com/aeee.htm

Automation of Wheel Chair Using Mems Accelerometer (Adxl330)

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Abstract

This paper introduces an automated system is to be developed to control the motor rotation of wheel chair based on head and hand movement of physically challenged person. In order to facilitate these people for their independent movement, an accelerometer device (ADXL330) based transmitter is fitted either on persons head or hand. Based on the head or hand movements the transmitter will generate command signals which will be received by receiver fitted on the back of the chair. This receiver after receiving signal will drive the motor fitted to the wheel chair. The ADXL330 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs, all on a single monolithic IC. The wheel chair can be driven in any of the four directions i.e. left, right, forward, back. The automated wheelchair is based on simple electronic control system and the mechanical arrangement that is controlled by an Atmel 80s52 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. It also contains obstacle detection system to detect various kind of obstacle comes in the path of chair.*(Abstract)*

Keywords: Accelerometer, Transmitter, Receiver.

1. Introduction

Wheel Chair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of 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 runs with electric power and operation of chair depend upon the instruction given by the patient hand or head movement or any other mechanism (Arun Manohar Gurrama, 2012).

2. Objective

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 wheel chair based on head or hand movement of physically challenged person. In order to facilitate these people for their independent movement, anaccelerometer device based transmitter is fitted either on persons head or hand. Based on the head or hand movements the transmitter will generate command signals which will be received by 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 is based on simple electronic control system and the mechanical arrangement that is controlled by an 89S52 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. It also contains obstacle detection techniques with the help of IR sensor(Preethika Britto, 2010).

3. Proposed Methodology and Description

This project is based on the wireless technique with 3 D motion. In this project we use two circuits. One is transmitter and second is receiver circuit. In the transmitter circuit we use 3 Axis accelerometer base circuits and at the receiver end we use a small wheel chair with RF receiver circuit.

3.1 Transmitter:

In the transmitter circuit, as shown in fig.1, we measure the value of 3Axis accelerometer based on the hand movement and converted into digital with the help of ADC 0809. ADC converts the data from sensor and proceeds to the microcontroller for further conversion. Microcontroller gets the hex 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. At the same time microcontroller gets the data and compare inside with pre-defined variables. As we change the position of hand, values are change automatically and change values are also shown on the LCD.

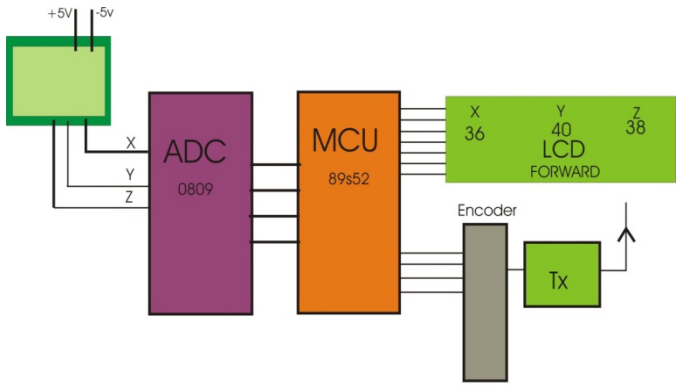

Figure 1: Block diagram of Transmitter.

We use the readings of accelerometer for wheel chair movements. We use one encoder circuit and one transmitter circuit with the microcontroller circuit for wireless transmission. We specify four variables for the wheel chair motion. As the position of hand change, data from the controller is also changes automatically. We get a four output from the controller. We use HT12 E encoder for serial communication. Data from the microcontroller is connected to the input pins of encoder and transmits via output pin of the encoder. Output from encoder is connected to the RF transmitter module. RF transmitter module gets the signal from the encoder and transmits via RF frequency 433 MHz

3.2 Receiver:

In the receiver circuit, as shown in fig.2, there is a RF receiver, decoder circuit and motor driving circuit. Receiver receives RF frequency transmitted from the transmitter and sends this signal to the HT12 D decoder circuit. Output from the decoder circuit send commands to motor driver circuits. H- Bridge is used to drive the motors of the wheel chair. Direction of the chair movement is depended upon the received signal. Depending upon the movement of the hand or head wheel chair moves in four directions like- forward, backward, left and right.

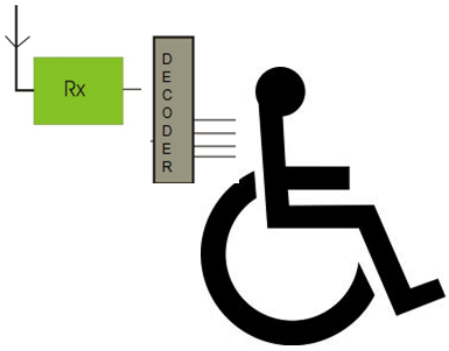

Figure 2: Block diagram of Receiver.

In this we have used Microcontroller AT89s52 as CPU to control the overall functionality of the project, DC gear motor to control the motion of the chair, LCD for displaying X, Y, Z coordinates value, Encoder and Decoder chips to encode and decode the signal messages, RF transmitter and receiver, IR sensor for obstacle detection and most important component is 3 axis accelerometer which is heart of this work (Manuel Mazo, 1995).

This is based on the wireless technique with 3 D motion. For wireless communication we use two circuits. One is transmitter and second is receiver circuit. In the transmitter circuit we use 3 Axis accelerometer base circuit and at the receiver end we use a small wheel chair with RF receiver circuit. In the transmitter circuit (as shown in Figure 3.) we measure the value of 3 Axis accelerometer and converted into digital with the help of ADC 0809. ADC converts the data from sensor and proceeds to the microcontroller for further conversion. Microcontroller gets the hex 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. At the same time microcontroller gets the data and compare inside with pre-defined variables. As we change the position of hand, values are change automatically and change values are also shown on the LCD. We use the readings of accelerometer for wheel chair movements. We use one encoder circuit and one transmitter circuit with the microcontroller circuit for wireless transmission. We specify four variables for the wheel chair motion. As the position of hand change, data from the controller is also changes automatically. We get a four output from the controller. Pin no 5,6,7,8 is the output pins for encoder. We use HT12 E encoder for serial communication. Data from the microcontroller is connected to these pins of encoder and transmits via pin no 17 of the encoder. Output from the pin no 17 is connected to the RF transmitter module. RF transmitter modules get the signal from the encoder and transmit via RF frequency 433 MHz

We use 2 by 16 LCD with port 0. Pin no 40 of microcontroller is connected to the positive supply and pin no 20 is connected to the negative voltage. Pin no 18, 19 is connected to the external crystal oscillator for external clock pulse. Output from the 3 axis accelerometer is connected to the pin no 26, 27, 28 of the ADC 0809. Pin no 23, 24, 25 is the address line of the ADC. With the help of these address line we select the desired input for data conversion. ADC converts the Accelerometer data into digital signal one by one.

3.3 Accelerometer (3 Axis):

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

because, 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 analyse the way the device is moving(S. Tameemsultana, 2011).

With the help of the accelerometer, as shown in fig.3, 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. An accelerometer thus measures weight per unit of (test) mass, a quantity also known as specific force, or g-force (Khairul anuar abd Wahid, 2008).

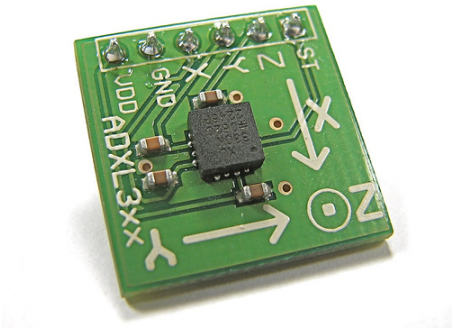

Figure 3: ADXL 3xx Accelerometer.

4. Applications and Future Work

4.1. Applications:

This automated wheelchair is valuable research for the people who could not move independently. Some of example of different categories of physically challenged people is listed below:

1. Amputees - Missing Legs and/or Arms *but with active upper bodies.*
2. People with Weak or Poorly Controlled Upper Bodies *using standard joystick.*
3. People with Little or No Upper Body Movement, *using special quad controls.*
4. Paralyzed Small People - Children and "very small" Adults ...*in special seats.*
5. Paraplegics - Healthy, Fit & Active are typically the safest users of manual, power-assisted, and fully powered wheelchairs.

4.2. Future Work:

Much future work is to be completed before commercialization of this project. This includes further development of hardware and software. It also includes the full testing of the system. The system can be redesigned and rebuild as per the patients

requirement. We have planned wide range of activities that will be useful to evaluate system.

Further to better optimization and battery level indication some other modification in this project are required. Like Anti falling system and Ramp detection for forward movement.

In Anti falling system there will be a sensor system that will find the edges and corners and will raise the command for stop movement. For this modification we can use accelerometer as well as Infrared sensors.

In Ramp detection system there will be a sensor system that will find the Ramp edges and corners and will raise the command for stop movement. For this modification we can use accelerometer, accelerometer again measure the tilt angle and will stop the backward movement of the wheelchair but forward movement will be continued.

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