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Hand Gesture Recognition Based Wheel Chair Direction Control Using AVR Microcontroller

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Abstract: In today's world, physically handicapped person & elder peoples are depending on others peoples. But today's world becomes fast, everyone is very busy & there are few peoples to take care of these peoples properly. They find the automated wheelchairs for an easy transportation for these physical disable persons. The proposed work is to design & develop a hand gesture based wheelchair using Gesture Control System. Wheelchairs are used by which person who cannot walk due to physiological, injury or any disability. Recent development promises a wide scope in developing hand gesture based wheel chair or smart wheelchairs. The present article presents an accelerometer sensor using gesture based wheelchair which controls the direction of wheelchair using hand movements. This paper presents a model for hand Gesture controlled user interface and identifies trends in current technology, application and usability. We present very useful an integrated approach to real time detection, hand gesture based data glove technique is very used which controls the wheelchair using hand movements by using the accelerometer sensor. This paper proposed a low voltage supply, low-cost and small 3-axis wireless system to control the wheelchair using AVR microcontroller.

Keywords: microcontroller, accelerometer sensor, wheel chair control, hand gesture recognition, RF module.

I. INTRODUCTION

The purpose of this project is to design & develop a hand gesture based wheelchair or smart wheelchair which can be easily controlled by the help of gesture recognition system. This project is very helpful to movement of physically handicapped or elder people by hand movements only. Accelerometer module is used for Gesture recognition and Gesture recognition module is the one of the most important part of this project. The moment of hand is detected by the accelerometer sensor or module. The wheelchair control system is designed with the help of MEMS accelerometer sensor, AVR microcontroller, Motor driver IC and RF module is mainly used in this project, as the motor drivers we used the L293D IC and control the motors from it. The hand gesture based wheelchair reduces the extra effort of the physically handicapped person and elder peoples so they can live freely and independently in the today's fast world and it is very easy to use by the needed person.

The aim of this work is to develop a hand gesture recognition based wheelchair which is control by the physical disable person or needed person with the movement of the hand or motions of the hand only that could move forward, backward, left and right direction very easily.

The main purpose of this work is to provide supports or help to the physically challenged person who cannot move from their places without other person helps. A wheelchair consists of MEMS accelerometer sensor as sensing element, a AVR microcontroller unit a decision making device and motors to navigate the control the movement of wheelchair that motors are control by the L293D motor driver IC. By tilting accelerometer sensor using hand movement it quickly control or move the wheel-chair in four directions.

The complexity of the previous some system can be reduced by using accelerometer sensor which is very small MEMS IC placed on the fingertips of the patient very easily. Hand Gesture control wheel chairs are extensive employed in human for non-verbal communication, in which the accelerometer is used control the gesture controls using the movements of the hand and hand gesture also making the system very less complex and lighter in weight. The MEMS accelerometer sensor which is used for gesture recognition or movement control is a micro electromechanical sensor which is highly sensitive sensor and capable of detecting the tilt very fast. This sensor find the tilt and makes use of MEMS accelerometer sensor to change the direction of wheel chair which is control with the movements of hand using this sensor. With the help of this highly sensitive sensor we easily control the direction of wheel chair by the movement of the hands only. The wheel-chair movement can be controlled in left, right, forward and reverse direction with the help of MEMS accelerometer sensor. It is the one of the best motion sensor or hand gesture sensor.

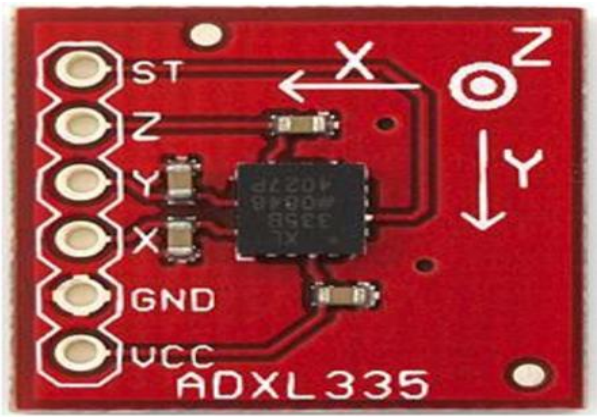

Figure 1: Accelerometer ADXL 335

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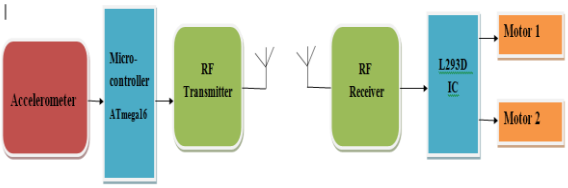

Figure 2: Basic block diagram of hand gesture based wheel chair direction control

The whole device is portable and easily driven by wireless technology, anywhere. In this system uses a microcontroller, that is avr microcontroller in this project used, which is programmed, with the help of embedded c instructions using the winavr or notepad++ software. This avr microcontroller is capable of easily communicating with transmitter and receiver modules which we have designed. The MEMS sensor detects the tilt and given the information to the avr microcontroller and it controlled the instruction of the movements i.e. left, right, forward and backward.

The controller is interfaced with two dc motors using motor driven IC which is used to driven the motor to controls the direction of wheel-chair. Also, the devices are operated wirelessly using hand movement through highly sensitive accelerometer sensor. To perform the task, microcontroller is loaded with program which is written using embedded-C language and after run this program, it is generate the .hex file of this programme, which is used to load the programme in the microcontroller.

II. TECHNOLOGY

In this work we have used the MEMS accelerometer based hand gesture technology. An accelerometer measures change in speed (acceleration) of anything that it's mounted on. Accelerometer is very important sensor in the sensor world because it can sense a wide range of motion very quickly. An accelerometer is an electromechanical device which is measure the acceleration forces in three directions with respect to the gravity.

Accelerometer is quickly measure the change of the speed hence it is very useful to our project to control the direction of the wheel chair. The Accelerometer is an IC which is used to measures motion and its proper intensity in all three axes and generates the analog signals proportional to acceleration.

An analog data while moving in X, Y, Z direction which is taken by the accelerometer hand gesture very highly sensitive motion sensor. Here an image of accelerometer sensor is shown (Figure 3).

The primary goal of the gesture control recognition research is to create a system which can be used by identify specific human gestures control and use them to convey information easily or for device control. There are different types of the gestures recognition sensors such as hand, face (emotion), body gestures etc.

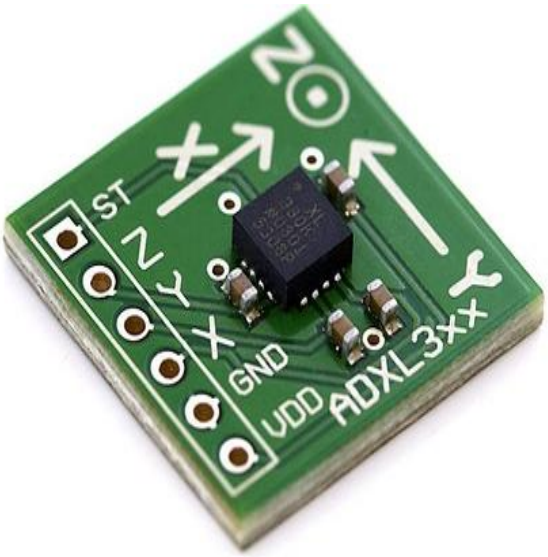

Figure 3: An Accelerometer sensor IC (ADXL3x)

Table I: How to connect the pins of Accelerometer Sensor

Pin No.	Use of pin
1- VDD	On this pin we will give the +5volt supply.
2- GND	We connect its pin no. 2 to the ground for biasing.
3- X	This pin is used receive the analog data for x direction movement.
4- Y	This pin is used to receive the analog data for y direction movement.
5- Z	This pin is used to receive the analog data for z direction movement.
6- ST	This pin is used to set the sensitivity of accelerometer 1.5g/2g/3g/4g.

In this project we used the hand gesture recognition system because we control the wheel chair with the motion or movement of the hand using the accelerometer sensor. Hand gesture recognition is one of the obvious ways to create a useful and highly adaptive interface between the machines and their users. Hand gesture technology is the one of the best way which would allow for the operations of complex machines using only hand movements.

III. DESIGN PROPOSED

The design proposed for real time embedded system is based on the hand gesture with avr atmega16 microcontroller interface. For the hand gesture control we used the MEMS accelerometer sensor which is control the direction of the wheel chair with the help of the movement of the hand. This design or project is reducing the effort or it is gives the very benefits to elders or physical challenging persons which are don't move to one to other place without the help of others. The person with are dependent on other they are independent to move to one to other place with the help of the hand gesture based wheel chair that is control by their hand movements easily. It is the portable device which is easily move or used by the

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person. For the implement of this design the mainly basic building blocks are accelerometer module, AVR microcontroller module, transmitter module, receiver module and for the driven the dc motor we used the L293D IC, so we also used the motor driver module. The Transmitter module is used to transmit the signal which is given by the hand gesture sensor accelerometer that is connected to the person figure or hand and the receiver module is used to the receive the signal that is transmitted by the transmitter and work according to the that given signal instruction through the microcontroller. The receiver module is connected to L293D module to control the direction of Wheelchair.

To going to the design of hardware module implementation we also check the programming or design with the help of the proteus software. It is the software which helps us to design our design on this software and check the after programming build in it with the help of hex file of program it is properly work or not. We design the hardware design on it similar with the help of this software to check the design it work or not after that we implement it on hardware device. The protues design of this project or implementing device is shown in figure 4.

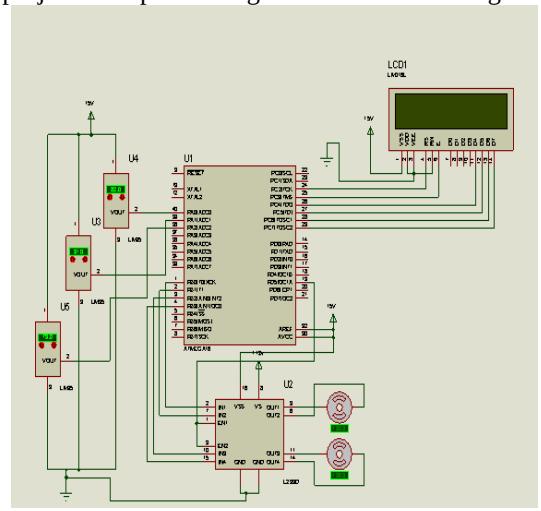

Figure 4: protues design

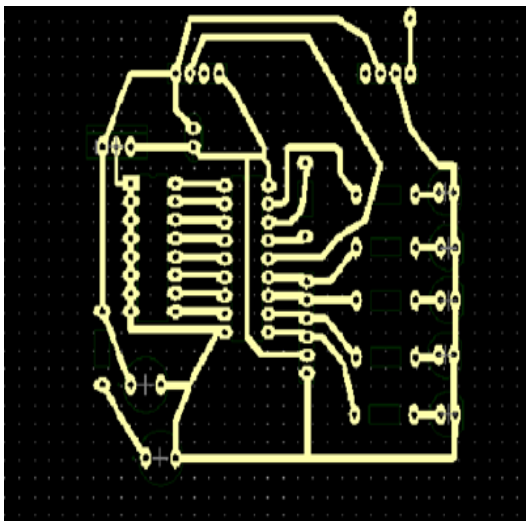

Figure 5: PCB Layout of RF Receiver

After complete the PCB we are drilling on it and mount the component on it. After mounting the component we solder or fabricate the components on it and complete the required design module properly. Before the fabricate the components on the PCB's we check these components are work properly after that we fabricate the components. Now we check the all connection and components rating of the device properly. After complete the hardware design implementation properly, now we load the programme .hex file in the microcontroller and check the performance or working of the device is properly.

Now finally our hardware implementation of the device is ready and it is work properly.

IV. PROGRAMMING

The programming of this design is written in the embedded-C language using Win AVR or notepad++ software. After properly run this programme, the .hex file of this programme is generated. This .hex file of programming is used to load in the microcontroller IC, which is AVR microcontroller in this project. After load this .hex file or programming the microcontroller is work properly with the given instruction of the programme.

```
#include <avr/io.h>
#include <util/delay.h>
#include <stdio.h>
#include<inttypes.h>
#define RS PC2
#define E  PC3
#define D4 PC4
#define D5 PC5
#define D6 PC6
#define D7 PC7
#define output_low(port,pin)  port &= ~(1<<pin)
#define output_high(port,pin) port |= (1<<pin)
#define set_input(portdir,pin) portdir &= ~(1<<pin)
#define set_output(portdir,pin) portdir |= (1<<pin)
#include<lcd.h>
int channelselect(char);
unsigned int l;
char n[5],m[5],p[5];
int temp=0;
unsigned int l;
char n[5];
int x,y,z;
int main(void)
{
 DDRC=0XFF;
  InitLCD();
  DDRA=0X00;
  DDRD=0XFF;
  PORTD=0x00;
  DDRB=0XFF;
  PORTB=0X00;
  ADCSRA=0X87;//10000111
  ADMUX=0xC0;
TCCR1A=(1<<WGM10)|(1<<COM1A1)|(1<<COM1A0);
//enable fast pwm in inverting mode, 8 bit pwm
```

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```
 TCCR1B=(1<<CS11)|(1<<WGM12);
 int x,y,z;
 WriteStringToLCD("Welcome");
 //ShiftLCDLeft(16);
 _delay_ms(100);
 ClearLCDScreen();
 GoTo(0,0);
 WriteStringToLCD("X:");
 GoTo(6,0);
 WriteStringToLCD("Y:");
 GoTo(11,0);
 WriteStringToLCD("Z:");
while(1)
{
 //ClearLCDScreen();
 x=channelselect(0);
 _delay_ms(1);
 y=channelselect(1);
 _delay_ms(1);
 z=channelselect(2);
 _delay_ms(1);
 GoTo(0,1);
 sprintf(m,"%d",x);
 WriteStringToLCD(m);
 GoTo(6,1);
 sprintf(n,"%d",y);
 WriteStringToLCD(n);
 GoTo(11,1);
 sprintf(p,"%d",z);
 WriteStringToLCD(p);
 if(x>340 && x<350 && y>330 && y<350)
 {
   PORTB=0X00;
          _delay_ms(100);
 }
 if(x>350)
 {
   PORTB=0X01;
          temp=((x-350)*255)/63;
          OCR1AL= 255-temp;
 }
 if(x<340)
 {
   PORTB=0X04;
    temp= ((255/63)*(340-x));
          OCR1AL= 255-temp;
 }
 if(y>350)
 {
   PORTB=0X05;
          //output_low(PINB,7);
          temp=((y-350)*255)/65;
          OCR1AL= 255-temp;
 }

/*if(y>370 && y<381)
                {
                 OCR1AL=0;
                 _delay_ms(10);
                }
if(y>381 && y<392)
{
 OCR1AL=64;
 _delay_ms(10);
}
if(y>392 && y<403)
{
 OCR1AL=128;
 _delay_ms(10);
}
if(y>403 && y<415)
{
OCR1AL=192;
 _delay_ms(10);
} */
 //}
 if(y<330)
 {
   PORTB=0X0A;
//output_low(PINB,7);
temp= ((255/53)*(330-y));
          OCR1AL= 255-temp;
                /*if(y>317 && y<330)
                {
                 OCR1AL=0;
                 _delay_ms(10);
                }
                if(y>304 && y<317)
                {
                 OCR1AL=64;
                 _delay_ms(10);
                }
                if(y>291 && y<304)
                {
                 OCR1AL=128;
                 _delay_ms(10);
                }
                if(y>277 && y<291)
                {
                 OCR1AL=192;
                 _delay_ms(10);
                }  */
                }
  _delay_ms(100);
}
return 0;
}
int channelselect(char a)
{
   ADMUX=0b11000000;
          ADMUX=ADMUX+a;
   ADCSRA|=(1<<ADSC);
          //ADCSRA&=(0<<ADIF);
          //ADCSRA|=(1<<ADATE);
          while((ADCSRA&(1<<ADIF))==0);
          /*PORTD=ADCH;
          PORTB=ADCL;
          l=ADCH;
          _delay_ms(100);
          sprintf(n,"%d",l);
```

```
        ClearLCDScreen();
        WriteStringToLCD(n);*/
        return(ADCL+(ADCH*256));
}
```

V. CONCLUSION

Accelerometer is the best sensor to use for the hand gesture based device implementation, it is very highly sensitive and it is very important sensor in the sensor world because it can sense such a wide range of motion very quickly. In this project we used this sensor because it is very small in size, take very low supply voltage, the cost of this sensor is also very low and it is highly sensitive sensor which is made to the easy our hand gesture based wheel chair direction control idea and work properly on it. This design is very useful to the person who depends upon the other to move anywhere.

This design is mainly implementing for the physical challenging or elder person who need to help others to moving this device is help them to moving with the help of this device they only need to operate this device with the movement of the hand only.

This device is easy to operate and taking very less power to work properly. We also control the speed of the wheel chair to moving it with the direction of the wheel chair.

This system can be made to very easily use by the physical challenging or elder persons and it also made free from challenges and it is also designed at the low cost and low supply.

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