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Design of an Advanced Cell Phone Operated Wheel Chair using DTMF Technology

Arunava Banerjee[1], Deep Mukherjee[2], Joy Chowdhury[3] and Abhirup Mukherjee[4]

[1,4]Student School of Electronics Engineering KIIT University
[2]School of Electronics Engineering KIIT University
[3]School of Electronics Engineering KIIT University
E-mail: [1]arunava27banerjee@gmail.com, [1]koolabhi8@gmail.com
[2]deepmukherjee@rediffmail.com, [3]joychowdhury87@yahoo.in

Abstract—*The proposed technique is intended as a solution to the conventional wheel chairs used by orthopedically handicapped person. Patients using normal wheelchairs face certain difficulties which could be overcame by the use of mobile phones in wheelchair control. It provides the advantages of robust control, free working range, system reset and status display in LED. This project aids the user to control the movement of the wheel chair by a cell phone using DTMF technology. The control involves three distinct phases: perception, processing and action. The preceptor is a cell phone mounted on the arm of the wheel chair, processing is done by the on-board microcontroller or processor, and the task (action) is performed using motors or with some other actuators.*

1. INTRODUCTION

Wheelchairs make mobility possible for people who are unable to walk or even move due to body impairments, injury or illness. Normal wheelchairs used by hand strain movement are common among patients having lower body impairments, but there are certain patients who aren't capable enough to use hand strain movement. This paper presents the design of a wheelchair which can be controlled by a mobile phone which could be more suitable for the user since it requires only finger movements.

This paper presents the movement of the wheelchair via DTMF technology. The technology used to design the robotic wheelchair includes no dependence on sensors. The wheelchair involves two DC motors mounted on the wheels. The basic locomotion like forward, backward, left and right is carried out by pressing the respective buttons on the mobile phone. The tone generated when the user press a key on the mobile phone is called Dual Tone Multi-Frequency (DTMF). A DTMF decoder circuit is used to decode the DTMF tone and detect the key which is being pressed by the user. The output of the DTMF decoder is fed to the microcontroller which will control the locomotion of the wheelchair according to the key which is pressed and the program which is installed within it

2. GENERATION OF DTMF SIGNAL

DTMF signal is the algebraic summation of two distinct frequencies in audible range

$$f(t) = A_0 \sin(2 * \pi * f_a * t) + B_0 \sin(2 * \pi * f_b * t) + \ldots.$$

where fa and fb represent two distinct audio frequencies belonging to the low and high frequency groups respectively while A and B are their peak amplitudes. f(t) is the resultant of a DTMF signal. If DTMF signals are generated from square-waves minimum hardware is required. Every recurrent waveform having a duration of T can be represented by a Fourier series consisting of the infinite sum of individual sine and cosine waveforms**.** The frequencies are chosen in a way such that none of them are harmonics of each other.

A complete communication consists of the tone generator and the tone decoder. In this article, we are using IC MT8870DE as the main component to decode the input dial tone to a 4 digital output. The decoder circuit decodes the tone to digital code. For example, the tone of 941Hz +1336Hz will be decoded as binary '1010' as the output. This digital output will be read by a microcontroller.

3. ATMEGA 16

AVR was developed in the year 1996 by Atmel Corporation. It stands for Alf-EgilBogen VegardWollan RISC microcontroller. AVR Microcontroller is used in this project because it executes most of the instructions in single execution cycle and it is about 4 times faster than PICs; it consumes less power and can be operated in different power saving modes. In this paper we will be working on Atmega16 microcontroller which is a 40-pin IC and belongs to the AVR family.

4. PROCESS

The cell phone on the wheel chair is connected to a DTMF decoder whose output is fed to the microcontroller. The microcontroller controls the dc motors mounted on the wheels through a motor driver. The block diagram of the project is shown below.

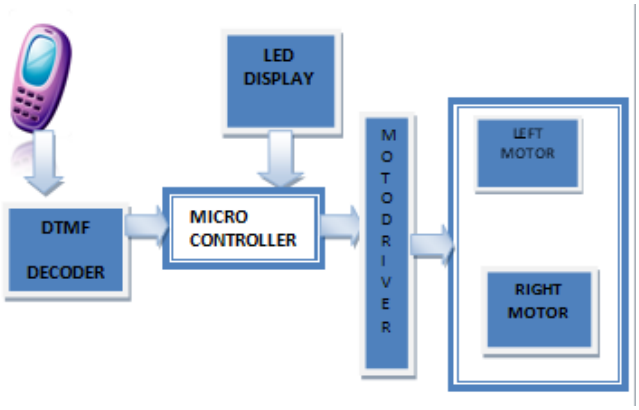

Fig. 1: System block diagram

As the user on the wheelchair dials a key on the mobile phone, a DTMF signal is generated. When a key is being pressed on the matrix keypad, it generates a unique tone consisting of two audible tone frequencies. For example, if the key '1' is being pressed on the phone, the tone we hear is actually consisting of a 697 Hz & 1209 Hz sine signal. Pressing key '9' will generate the tone formed by 852 Hz & 1477 Hz. The frequency use in the dial tone system is of audible range suitable for transmission over the telephone line.

This DTMF signal is decoded by a DTMF decoder circuit(IC MT8870DE) attached to the wheelchair that detects which

key is being pressed. The DTMF signal is decoded into a binary output, for example, if the generated DTMF tone

consists of 697Hz and 1209Hz, the binary output at the decoder end would be 0001. The output of the decoder circuit is fetched to the microcontroller which can easily detect from the binary output of the decoder that which key the user has pressed. The microcontroller is connected to the motors through a motor driver. The motor specifications tells to drive in 12V while the microcontroller can give a maximum of 5V. The main function of the motor driver is to amplify the 5V supply of the microcontroller into 12V in order to drive the motors. In this project a H-Bridge motor driver IC L293D is used. The program in the microcontroller is written is such a way that if '2' is pressed on the keypad of the mobile phone the motors will drive in the 'forward' direction and if '8' is pressed the motors move is reverse direction. Similarly when '4' is pressed by the user the motor fixed in the right hand side of the wheelchair moves forward while that on the left moves backward thus the wheelchair ends up in moving in the 'left' direction. If '6' is pressed it moves in 'right' direction in the similar way. The circuit diagram of the system is given in Fig. below.

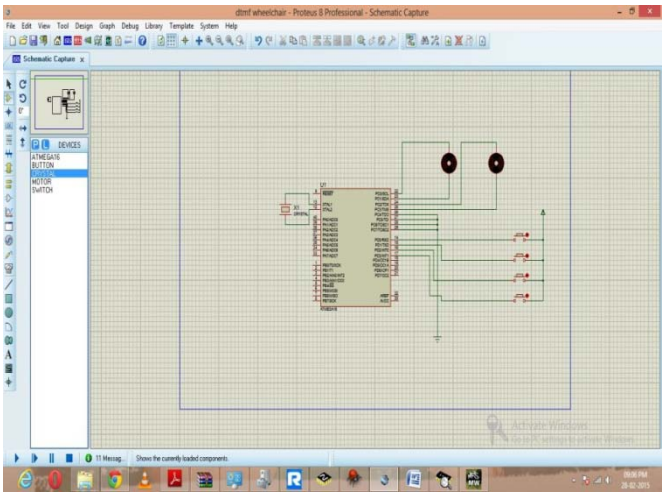

Fig. 2: Circuit diagram of the proposed system.

The full hardware implemented functional prototype of a wheel chair has been constructed and shown in Fig. below.

Fig. 3: Fully Functional Model of proposed design

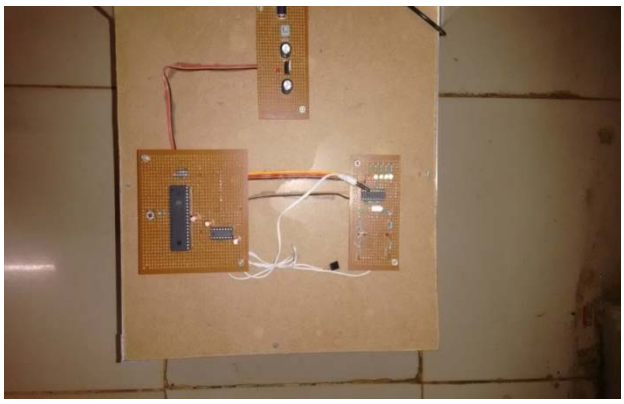

Fig. 4: PCB design of the proposed system

5. CONCLUSION

The proposed design of the wheel chair provides immense help in the mobitity of a disabled or a physically mimed person. Even the operation of the wheel chair can be controlled remotelyfrom a separate phone which has proved to be the biggest advantage of the proposed design and the most striking feature. This design can also be used in military applications, drone development and for security automation. The main advantages include remote operability, reduced hand strain for wheel chair movement, low cost. Further more complex protocols such Zigbee remains a future prospect for this application.

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