Augmented Human Interaction with Remote Devices Using Low Cost DTMF Technology

R. Singathiya, Neeraj Jangid, Prateek Gupta and Suman Deb

Abstract In present world, we must use assorted high tech devices and equipments to get our jobs done and make the life simpler. These devices can be controlled by home care taker from any place since the home care taker might not present at home. Thus we need a remote interaction system with our every day essential devices for a technology blended state of the art life of present time. Smart home is equipped with such system so that we can control our home appliances from any location. In order to examine a true remote and enough secure solution to be really favorable and practicable, mobile technology is better than any other solution. In this paper we introduce new criteria so that the unremarkable services of the mobile phones can enlarged to communicate with and operate the home appliances and make our home a really well groomed one with obvious cost effective technology.

Keywords DTMF · Appliance control system · Smart home · Augmented control

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1 Introduction

As we know today's world is connected with the modern electronic equipments, so it is necessary that every human being should get such facilities which can be easily sustained. Although the DTMF Technology was discovered earlier but we have tried to make its use in day to day life as it is cost effective and it does not require any external remote system. There are many corporations which are trying to research in this sector; it enables them to control system easily in home or outdoor. The system is provided with mobile phone normally registered in communication service and another phone which receives the call automatically. In this research we have investigated the different ways we could use the cell phones to go beyond making calls and sending SMS and device some ways to implement the remote control system. This paper proposes methods of control that use simple voice call. The method proposed uses the Dual-Tone-Multi-Frequency (DTMF) generated when a keypad button of the mobile phone is pressed by the user. In this manner user controls the system.

2 Traditional DTMF Technology

It is widely used in remote control system and is mostly available in every cellular phone. It comprises of 16 keys as mentioned in the Table 1.

2.1 DTMF Tone Generation

When we press the key of mobile phone, an authentication code (basically DTMF tone) generates, consisting of two sinusoidal waves which can be represented as follows.

$$f(t) = a\ \sin(2\pi f_a t) + \ b\ \sin(2\pi f_b t) + \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots$$

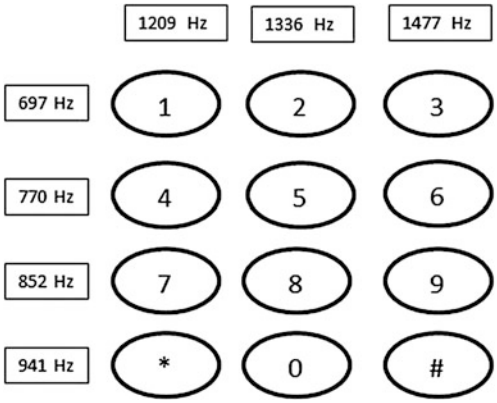
where f_a and f_b are frequencies of two sinusoidal waves with a and b as their peak amplitudes and f as the resultant DTMF signal. Here,

$$(0.7) < (a/b) < (0.9)\ \text{V}$$

The frequencies are adjusted in such manner that they are not the harmonics of each other (Fig. 1).

The frequencies associated with assorted keys on the keypad are shown in Table 2.

Table 1 The frequencies corresponding to a particular key on the mobile phone used



It can be noticed that for every key there are two frequencies, one specified for the row while the other for the column. There are also 4 special keys i.e. A, B, C and D which are used for special purposes

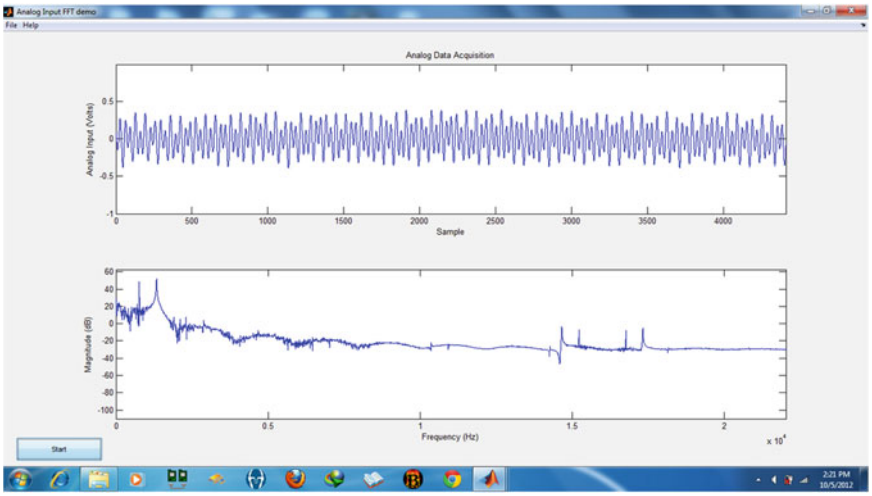


Fig. 1 Frequency spectrum analysis of DTMF tone of key '5' on mobile phone

2.2 DTMF Signal Through Cellular Network

The DTMF signals work in similar manner as the voice would have as you usually talk mobile passing through many base towers and even satellites in case of long

Table 2 Individual key press at transmitter end reflects as a BCD value A3, A2, A1 and A0 at the outputs of M-8870 DTMF decoder

Button	Low frequency (Hz)	High frequency (Hz)	A3	A2	A1	A0
1	697	1,209	0	0	0	1
2	697	1,336	0	0	1	0
3	697	1,477	0	0	1	1
4	770	1,209	0	1	0	0
5	770	1,336	0	1	0	1
6	770	1,477	0	1	1	0
7	852	1,209	0	1	1	1
8	852	1,336	1	0	0	0
9	852	1,477	1	0	0	1
0	941	1,209	1	0	1	0
*	941	1,336	1	0	1	1
#	941	1,477	1	1	0	0

distances. When a call is connected the number buttons send an authentic code which is carried as a digitized and compressed audio stream.

3 Description of Equipment

3.1 Input Device

The telephony device sends the DTMF signal to the receiver telephony device connected with the DTMF Decoder circuit through the earpiece.

3.2 Decoder Circuit

The Decoder M-8870 consists of a filter which is basically a band split filter and its work is to separate the high and low frequency of specific received tone. Also there is a digital decoder which verifies both the frequencies that we receive as the filter output before passing it to output bus. When we get the valid tone, then the early steering flag bit gets high, and for any signal loss it falls down (Fig. 2).

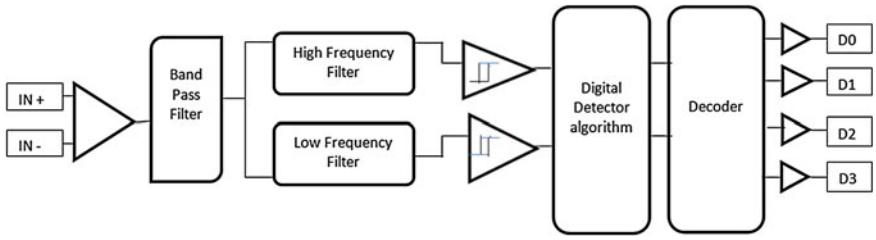


Fig. 2 This figure represents working of decoder circuit

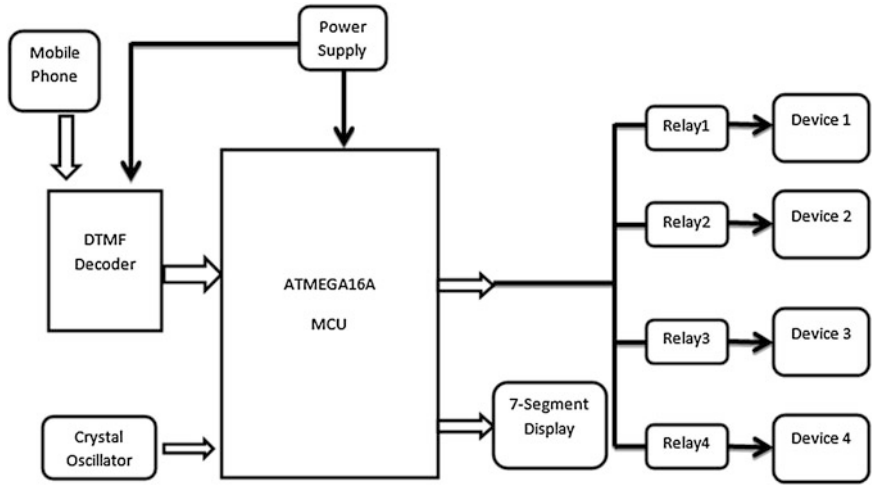


Fig. 3 Block diagram of circuit

3.3 Microcontroller ATmega16A

The role of microcontroller is to monitor the input signal to get the desired output. When the binary data comes from decoder IC it is transferred to microcontroller, and it gives the desired output as we program in the flash memory in the microcontroller.

3.4 Relay

It is used to operate the AC device from the microcontroller's output (Fig. 3).

4 Structure of Proposed Work

The signal is transmitted to the second mobile phone which is at the receiver end connected with the DTMF decoder circuit. The receiver end comprises of input device, decoder, microcontroller, seven-segment display and condenser microphone. For the decoder section, the underlying concept is DTMF signal and this signal is fed to display driver and microcontroller. The microcontroller is connected to relay circuit which performed the required action.

Once the connection is maintained between the two phones whatever phone key is pressed at the transmitting end, the corresponding DTMF tone is heard in the earpiece of the receiver phone. The earpiece is connected to a condenser microphone which picks up the DTMF tone. Its output is amplified by the DTMF decoder. The DTMF decoder will give the corresponding BCD value of the tone. Seven-segment display acts as a visual indicator when the valid signal is received by the system. This output, through a driver circuit is connected to PORTS of the microcontroller (ATmega16A). This microcontroller's output is fed to real circuit to trigger a voice feedback.

5 Working Structure

The circuit was built and tested for the given picture of tested circuit. The device controlled was a 230 V/20 W Power saving CFL (Fig. 4).

5.1 Schematic Diagram

See Fig. 5

5.2 Major Areas of Applications

Industrial Automation
Home Security system
Remote switches
Mobile Robot Control
Wireless Radio Control.

Fig. 4 Working model of remote interaction system

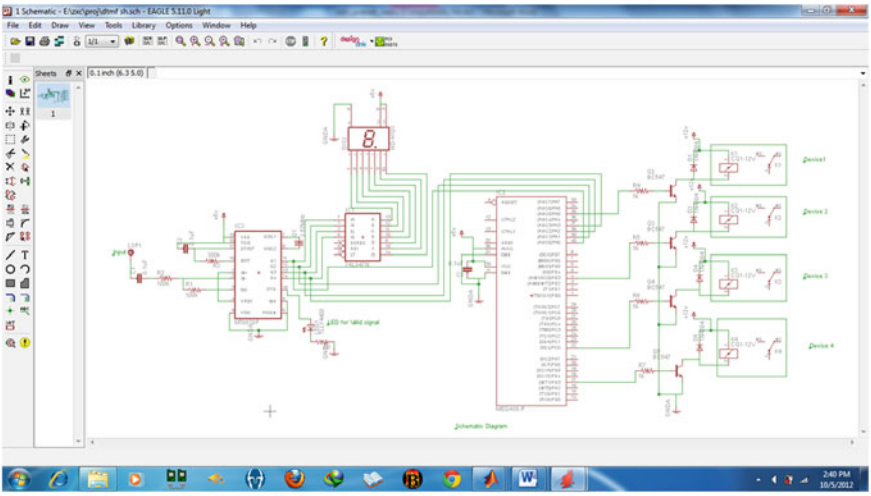


Fig. 5 This figure shows the schematic of complete structure designed in easily applicable graphical layout editor (*EAGLE*) software

6 Conclusions

It can be controlled by computer by using software which generates an artificial DTMF tone and can be further used in agriculture for sprinkling pesticides in the field using a control system which gives a message automatically to the farmer about the amount of chemical to be mixed to form pesticide according to different seasons. Moreover, DTMF technology is well applicable for irrigation of field by supplying water whenever it requires through mobile control system.

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