Generating Dual Tone for Creating Our Own Communication Channel

K.Sai Krishna Chaitanya, E.Lokesh Reddy, P.V.Praneeth Reddy

Abstract- When we dial land number or Mobile number on our phones , it gives a ring to the person we need to contact, this is possible by the concept of DUAL TONE – MULTIPLE FREQUENCY (DTMF). The DTMF is a popular signalling method between telephone and switching centres .It is also used for signalling between the telephone network and computer network. DTMF signals are the superposition of two sine waves with different frequencies. In this the key stroke we give is converted to frequency and this sine wave is decode by the decoder and switching centre connects our line to the desired destination. In recent days when we call to customer care , instead of person of person computer is able to solve our query ,this is possible by programming the sound card of computer with the frequencies generated by phone. This paper mainly deals about dtmf, their working, verification using mat lab and their application.

Index Terms— Dual Tone Multiple Frequency, Rotary Dial, Encoding, Decoding.

I. INTRODUCTION

Dual-tone multi-frequency signalling (**DTMF**) is used for telecommunication signalling over analog telephone lines in the voice-frequency band between telephone handsets and other communications devices and the switching centre. The version of DTMF that is used in push-button telephones for tone dialing is known as **Touch-Tone**. DTMF standard was developed by Bell Laboratories. Dual Tone Multifrequency System (DTMF), is a touch pad dialing tone. DTMF standard is used in touch tone telephones and voice mail systems. Allow users and devices to dial at much higher rate because of the uniformity of numbers. Each digit corresponds to a high frequency and a low frequency Both are transmitted simultaneously Works by sending two sinusoids for each symbol pressed on the telephone keypad. The tones are divided into two groups:
Low group: 697 Hz, 770 Hz, 852Hz, 941 Hz
High group: 1209 Hz, 1336 Hz, 1477 Hz,
History of phones and DTMF is discussed below.

A. Rotary Dial

Fig.1

Above gives the picture of Rotary Dial .It is invented around 1905. The functioning of this is that, When the user puts a finger in the corresponding finger hole and rotates the dial clockwise until it reaches the finger stop. The user then pulls out the finger, and a spring in the dial returns it to the resting position. For example, if the user dials "6" on a North American phone, electrical contacts wired through the cam mechanism inside the phone will open and close six times as the dial returns to home position, thus sending six pulses to the central office.

B. Push Button Type Telephones

Fig.2

This push button type model is common now a day. It's functioning is that when a button is pressed, will send a sinusoidal tone for each of the two frequencies i.e When a button is pressed two frequencies are generated. The original keypads had levers inside, so each button activated two contacts. The multiple tones are the reason for calling the system multifrequency. These tones are then decoded by the switching centre to determine which key was pressed.

C. DTMF - Keypad :-

Fig.3

This type of keypad is used in early development of push button phones, generally in military purposes. Except the letters A, B, C, D remaining buttons are familiar to us. These A,B,C,D were used before dialling the phone in order to

Manuscript Received July, 2013.

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give some calls priority, cutting in over existing calls if need be. The idea was to allow important traffic to get through every time. The levels of priority available were Flash Override (A), Flash (B), Immediate (C), and Priority (D), with Flash Override being the highest priority. Pressing one of these keys gave your call priority, overriding other conversations on the network. Pressing C, Immediate, before dialling would make the switch first look for any free lines and if all lines were in use, it would disconnect any non-priority calls, and then any priority calls. Flash Override will kick every other call off the trunks between the origin and destination.

II. WORKING OF DTMF

A. Encoding

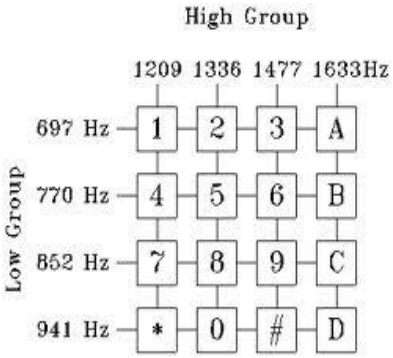

Fig.4

When you press the buttons on the keypad, a connection is made that generates two tones at the same time. A "Row" tone and a "Column" tone. These two tones identify the key you pressed to any equipment you are controlling. If the keypad is on your phone, the telephone company's "Central Office" equipment knows what numbers you are dialling by these tones, and will switch your call accordingly. If you are using a DTMF keypad to remotely control equipment, the tones can identify what unit you want to control, as well as which unique function you want it to perform. There might be interference between between tones, but the telephone is designed in such a way that spacing between each tone is 40ms which is shown graphically below.

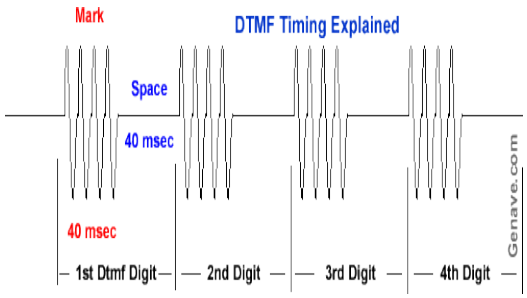

Fig.5

So by using the above process, dialled buttons are encoded .There is timeout for this encoder's i.e. if the time delay between the key strokes is greater than timeout there will be a message that number is not valid. Next step is these signals are transmitted through cables to near by telephone exchange office ,where the encoded signals are decode .The process for decoding the signal is discussed below.,

B. Decoding

In the decoder part the signal is decode by dividing the signal into segments depending on spacing .Then they determine which frequency components are present in each segment, then they are converted to number pressed. This decoding mainly consists of two parts:-

1. A set of band pass filters to isolate individual frequency components.
2. A detector to determine whether or not a tone frequency is present.

C. Using bandpass filter

A filter with a transmission that is high for a particular band of frequencies, but that falls to low values above and below this band.

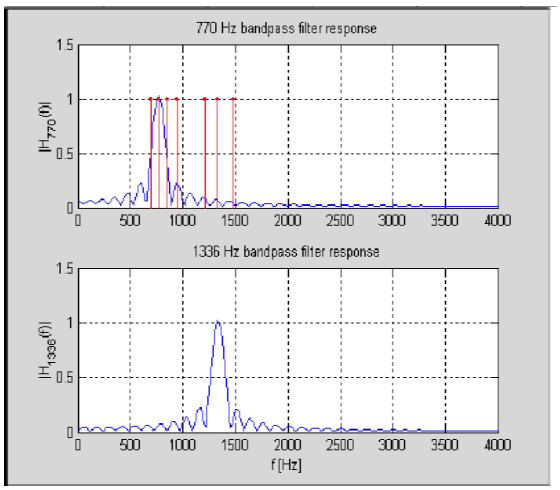

Fig.6

Using DFT

A block of samples is taken, and its Discrete Fourier Transform is found for a set of frequencies used in signalisation. The most efficient way to find DFT for small number of frequencies is the use of Goertzel's algorithm. The Goertzel algorithm is a special case of the Discrete Fourier Transform (DFT). The Goertzel algorithm is more efficient when only a small number of points need to be calculated. The Goertzel filter is an IIR filter that uses the feedback to generate a very high band pass filter where the coefficients are easily generated from the required centre frequency.

$$v_k(i) = 2\cos\left(\frac{2\pi k}{\mathbf{N}}\right) v_k(i-1) + v_k(i-2) + x(i)$$

$$y_k(i) = v_k(i) + v_k(i-1) W_N^k$$

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

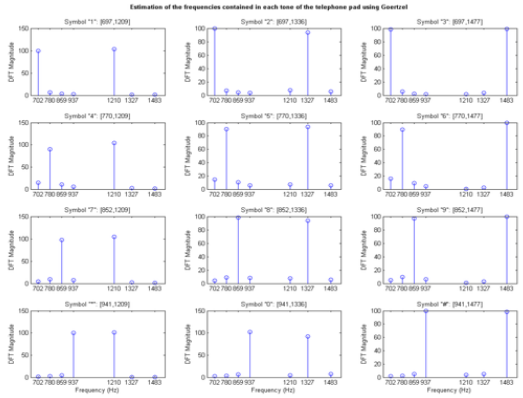

Fig.7

Above shows the plot of decoded Frequencies using Goertzel mat lab algorithm.

III. APPLICATIONS

1) DTMF can be used for operating robots remotely i.e. mobile controlled robots mainly use DTMF frequencies for their functioning.
2) Used in mobile switching centres for decoding the dialled digits.
3) For interfacing computer networks with mobile.
4) Customer care (gsm networks) which is manually done can be replaced by programming the sound card of computer with DTMF.
5) Home appliances can be operated using DTMF.

IV. CONCLUSION

- ✓ Concept of Dual tone multiple frequency has been explained
- ✓ DTMF decoding and encoding methods have been discussed
- ✓ Decoding using band pass and goertzel algorithm using mat lab algorithm has been done
- ✓ Seven different frequencies (697 Hz, 770 Hz, 852Hz, 941 Hz, 1209 Hz, 1336 Hz, 1477 Hz) in DTMF system were tested.
- ✓ All frequencies were plotted using mat lab algorithm

REFERENCES

1. Schenker, L (1960), "Pushbutton Calling with a Two-Group Voice-Frequency Code"
2. ITU's recommendations for implementing DTMF services (PDF)
3. Pushbutton Calling with a Two-Group Voice-Frequency Code - The Bell system technical journal (ISSN 0005-8580) Schemer yr:1960 vol:39 iss:1 pg:235-255
4. Frank Durda, Dual Tone Multi-Frequency (Touch-Tone®) Reference, 2006.

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