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Touch-Tone Recognition

EE301 Final Project
April 26, 2010
MHP 101

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A 1970's era AT&T "Touch-Tone" telephone

Agenda

- Introduction and History
- Applications and Future
- Project Description
- Relation to EE301
- Individual Contributions
- Technical Results and Problems Encountered
- Demonstration
- Conclusion
- Bibliography
- Questions?

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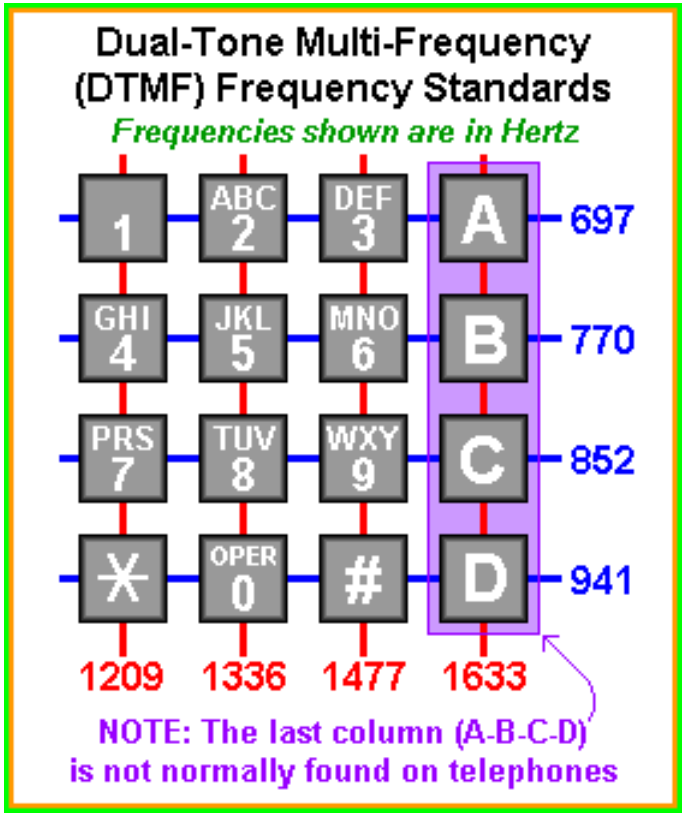
Introduction to DTMF

- 4 x 4 grid, one frequency for each row and column
- Unique two-tone signal for each digit
- Switching station decodes signal with 8 bandpass filters



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History of DTMF

- Pre-'60s: Manual switching, pulse dialing
  - Pulse dialing payphone abuse
- DTMF frequencies chosen to avoid harmonics, modulation problems

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Applications and Future of DTMF

- **Current Application:** Telephone Technology & Communication
- **Improvements:** Better filtering to deal with noise
- **Future:** Battle with digital technology
  - Requires a more widespread application and improvements in design

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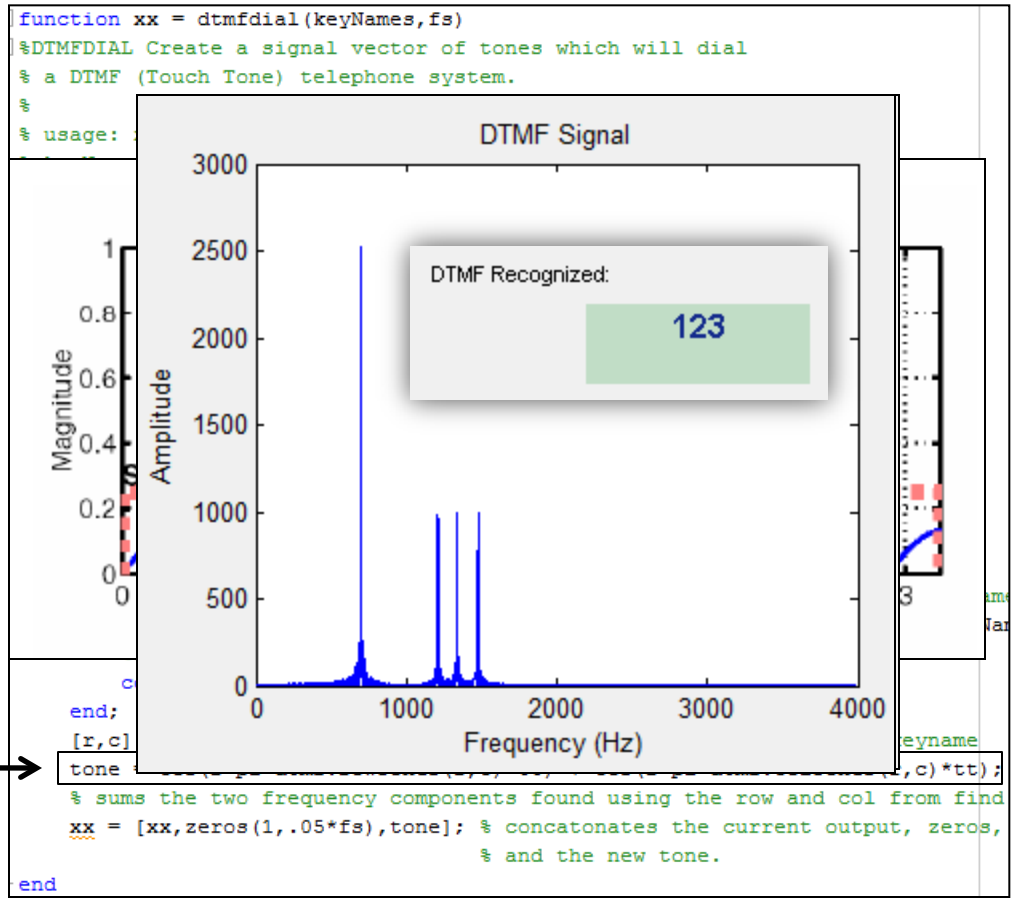
Project Description

- **5 main parts**:
  - DTMF generation
  - Parse DTMF signal
  - Filters
  - Scoring function
  - Decode/return string



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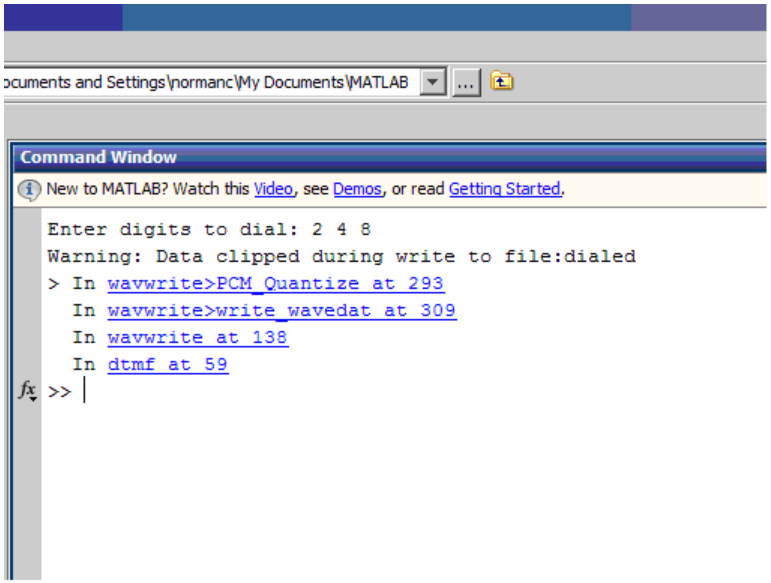
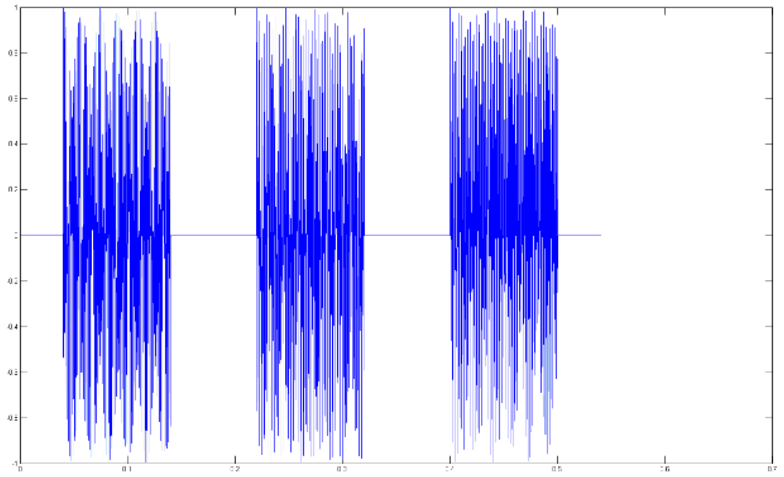
Relation to EE301

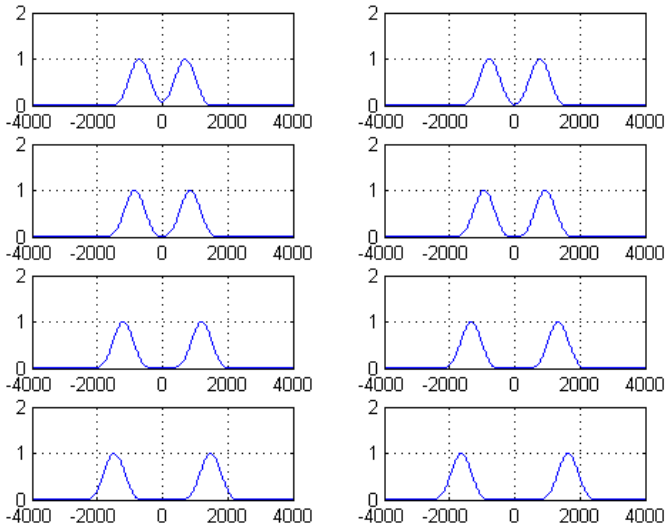
Input signal “2 4 8” represented as impulse response in time domain

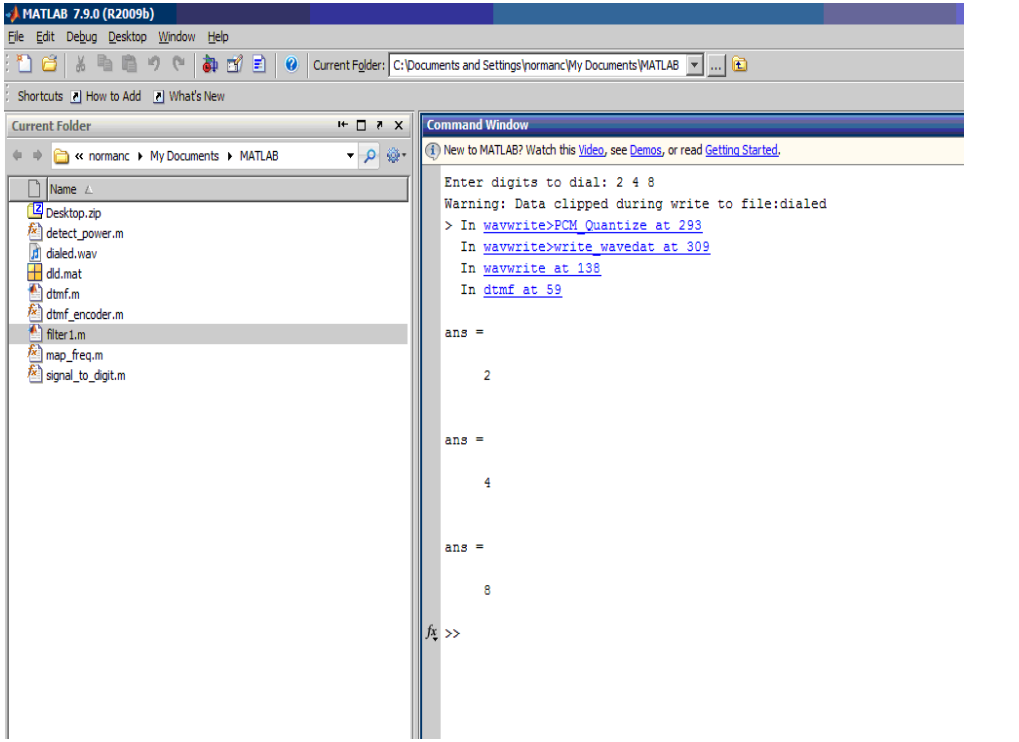




Relation to EE301

Applying filter to detect the input signal by eight bandpass filters





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Individual Contributions

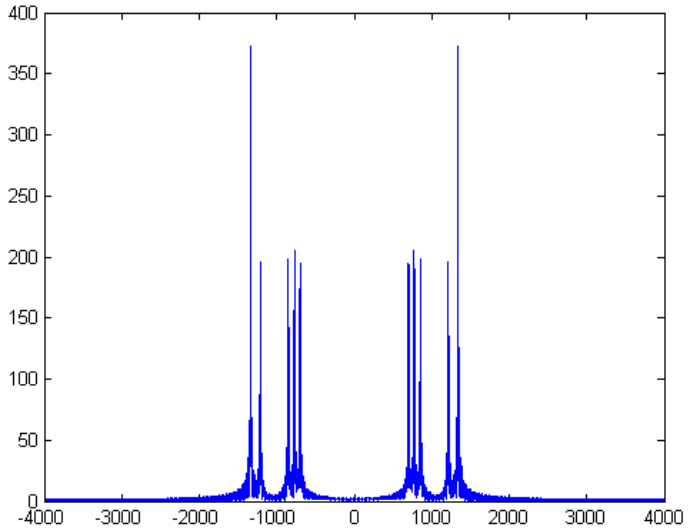
What Bryce worked on...

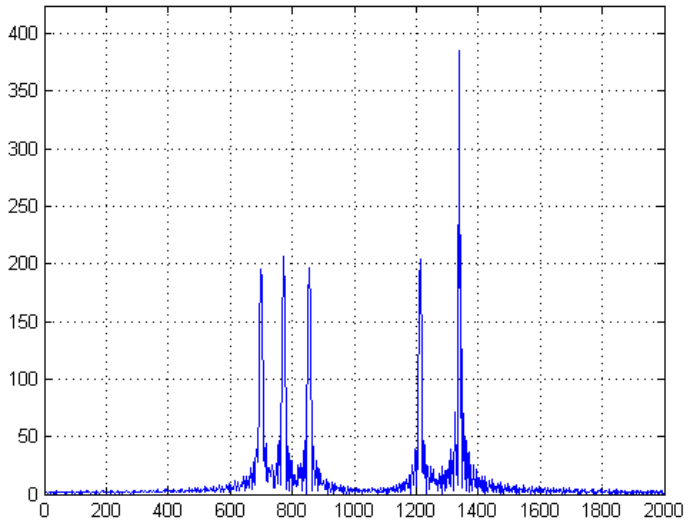
DTMF Dial Function: function that creates the tone from a combination of 2 tones corresponding to the input element

	16603Hz	16811Hz	17011Hz	17203Hz	17401Hz	17609Hz	17807Hz	18013Hz	18211Hz
8009Hz	1	2	3	A	J	S	a	j	s
8209Hz	4	5	6	B	K	T	b	k	t
8419Hz	7	8	9	C	L	U	c	l	u
8609Hz	!	0	"	D	M	V	d	m	v
8803Hz	@	&	^	E	N	W	e	n	w
9001Hz	%	$	£	F	O	X	f	o	x
9203Hz	{		}	G	P	Y	g	p	y
9403Hz	(	-	)	H	Q	Z	h	q	z
9601Hz	-	;	_	I	R	[	i	r	]

What Norman worked on…

Input signal “2 4 8” represented as frequency response in frequency domain





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What Rocky worked on…

Matlab Coding

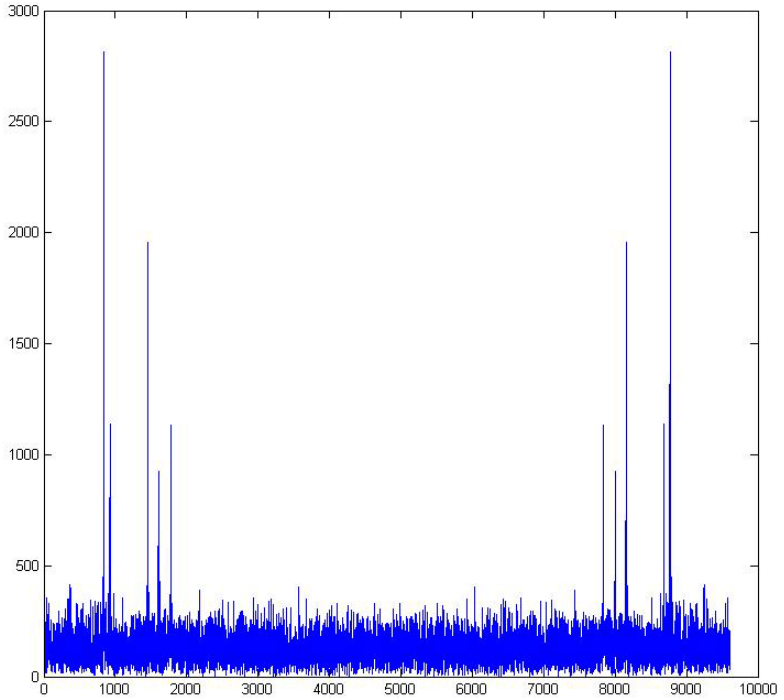
- dtmfcut.m

Adding Noise

- White Gaussian Noise
- FFT

Noise Reduction

- FDATool
- wdencmp



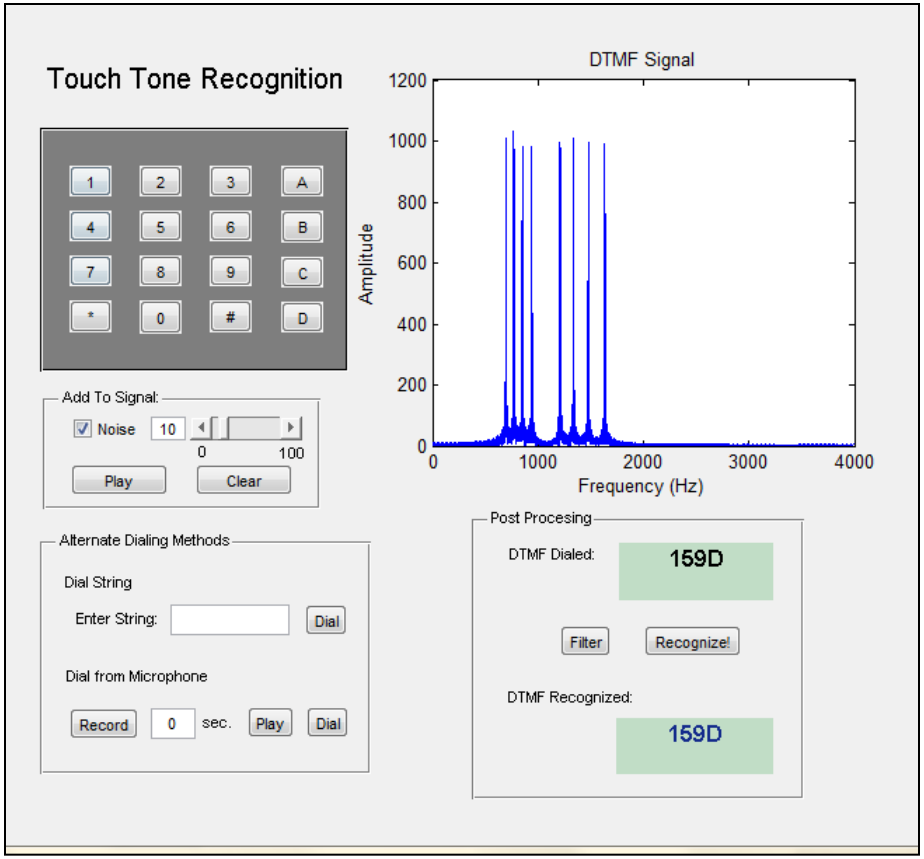
What Hieu worked on…

Creating the GUI

- Made project easy to integrate together, test/debug, and demonstrate
- Writing the code…

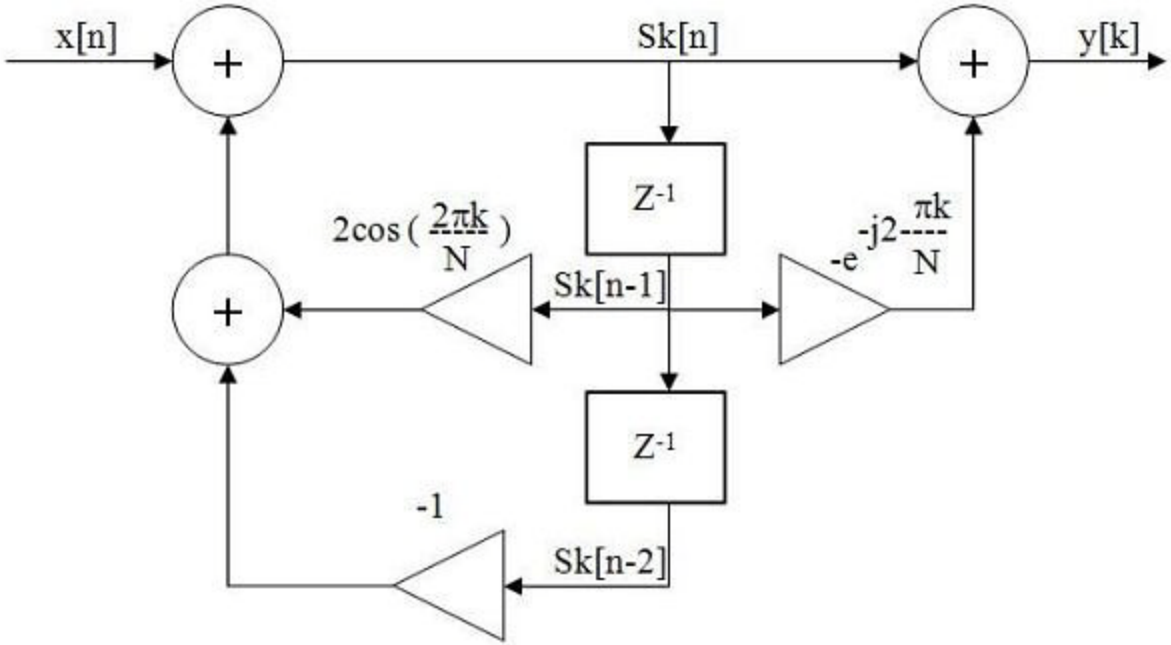
dtmfscore.m

- Making sense of the DTMF signal



What Alex worked on…

- **Fourier series Matlab function**
- **dtmfdesign.m**
- **Goertzel Algorithm**



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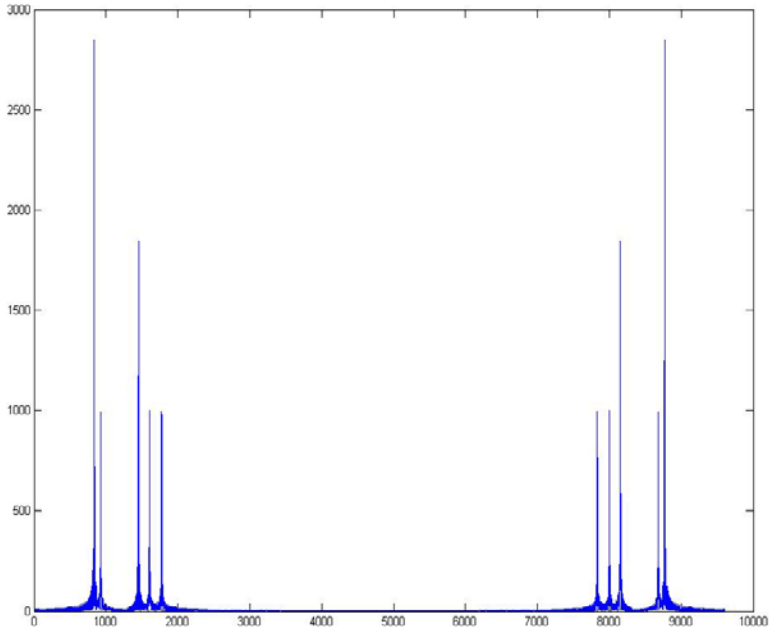
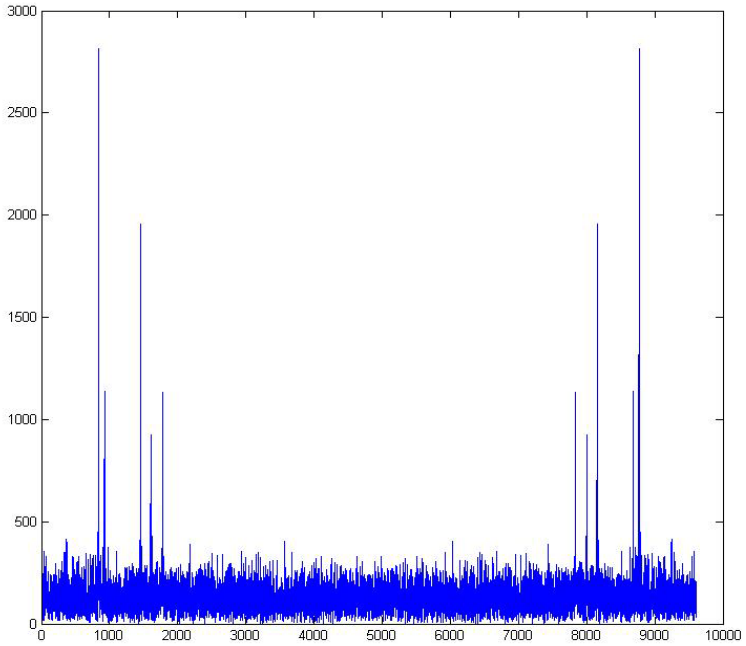
Technical Results

Without Noise



With Noise



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Problems

- Inexperience with Matlab
- Extending DTMF to entire alpha-numeric alphabet
- Analyze Raw Signal with Audio Device
- White Noise Filtering

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Project Demonstration

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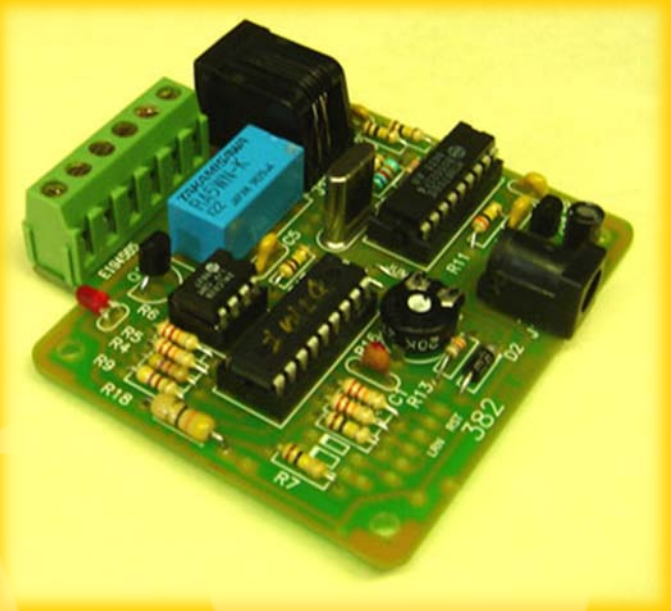
Conclusion



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- http://www.lumenvox.com/resources/whitePapers/dtmfSpeech.aspx
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