University of Texas at Arlington

EE 2347 Summer 2013

Lab Project-4 (Group of four)

Due date: 12/02/2013

PRINT YOUR NAME in CAPITAL LETTERS.	
1) Last NAME:	**First NAME:**
2) Last NAME:	**First NAME:**
3) Last NAME:	**First NAME:**
4) Last NAME:	**First NAME:**

INSTRUCTIONS:

Print this document and attach this page as a cover of your Project Report.

	Max Points	**Points Earned**
Presentation	**20**	
Explanation	**30**	
Code + Report	**50**	
Total	**100**	

1. Title:

Texting with DTMF (Tx/Rx Design)

1. Background:

Dual-Tone Multi-Frequency (DTMF) system, which is standardized by ITU-T Recommendation Q.23, has been used in many applications including telecommunication signaling, home security, and remote control over analog telephone channel. DTMF system represents information using 16 symbols, and for analog telephony, it is implemented using a 4X4 keypad. Each symbol (or key) is represented by a dual-tone signal. The DTMF keypad and the corresponding frequencies for each key are shown below.

	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	**1**	**2**	**3**	**A**
770 Hz	**4**	**5**	**6**	**B**
852 Hz	**7**	**8**	**9**	**C**
941 Hz	*****	**0**	**#**	**D**

2. Objective:

The objective of this project is to design and implement the Transmitter/Receiver (Tx/Rx) software part of a wireless communication system using DTMF audio signal for texting application. The communication system consists of a transmitter (Tx) and a receiver (Rx). The text-based (i.e. 95 printable ASCII characters) information is encoded at the Tx and sent to the Rx via DTMF audio signal. The Rx detects the transmitted DTMF audio signal, decodes the received signal and outputs the text message. However, in practical scenario the Rx never receives the same signal transmitted at the Tx end. The communication channel introduces unknown noise and delay to the transmitted signal and hence the Rx receives the noisy and delayed version of the original transmitted signal. Hence some efficient algorithm at the Rx end has to be designed to recover the original message from the noise and delay corrupted signal. Note that there are only 16 symbols that can be used for signaling as well as for representing the 95 printable ASCII characters. Your team needs to do research on DTMF (in particular the Goertzel algorithm), printable ASCII characters, data encoding and decoding, transmission delay, additive white Gaussian noise (AWGN), connection oriented data transfer.

2.1 Project parameters and minimum requirements

The minimum number of characters for the text message is **128**. A sampling rate of **8000 samples/sec** shall be used in your program.Develop and implement algorithms in MATLAB for the Tx/Rx part of the communication system (one at the transmitter and another one at the receiver). The Tx software includes

a) P**rompt the user for a text message** (which is terminated with a "return"),

b) encode the message into Hex format and later transfer into frequencies.

c) Add arbitrary noise and delay **(the delay can be anything between 10 ms – 2 s and the signal to noise ratio (SNR) can be anything from 10 dB – 40 dB)**

d) Store it as an audio signal to be received by Rx.

The Rx part includes

e) Techniques to suppress the noise and delay and thereby recovering the original transmitted signal,

f) Decode the signal to get back the text input.

g) Print the decoded message on the receiver screen.

[If the encoded message is played in the Tx and recorded in the Rx part, then it is not compulsory to add the noise and delay]

3. Mathematical and Computational tools

Mathematical background: Correlation, Filtering.

MATLAB functions: matrix array operations (zero padding, shifting etc.). You are encouraged to study the fft(), bin2dec() , dec2bin(), zeros(), randn(), goertzel(), int8(), char(), input(), disp().

4. Tasks

a) Develop a high level algorithm (sketch the flowchart) for this project; identify major functions for the entire program.

b) Develop and validate a computer method and codes to perform information encoding/decoding.

c) Analyze and present the results using test inputs.

d) Submit a project report (in MS Word) with at least the following sections (i.e. follow the IEEE format):

- Abstract of this study

- Theory section which includes, brief description of the concept of DTMF.
- Brief description of your methods to compute the encoding and decoding.
- Validation and result analysis section which include test results using the sample user input and show/plot the results.
- Summary/Conclusions of this project
- Develop a high level algorithm (sketch the flowchart) for this project; identify major functions for the entire program.

e) Submit the project report (printed copy) in class. Email the GTA the electronic file for the report along with the complete MATLAB program (*.m extension). [Any one member of the group can email the files and include their partners name/ID in the body of the email].

f) YOUR EMAIL MUST CONTAIN THE SUBJECT: "**EE 2347: Project #4 Fall-2013**". e-mail it to the GTA: tanmoy.bhowmik@mavs.uta.edu, mohammad.hasan@mavs.uta.edu

g) Provide an 10-minute presentation and demonstration of your project during the lab/class sessions. You may include the following topics in your presentation.

- Introduction, Theory, Key points about the idea.
- Application of the Project/ Concept in real world,
- **Challenges/Problems you've faced, How you overcame the issues,**
- Additions/ Future plans/ Suggestions about the project,
- What you've learnt from it.

NOTE:
This is such a project that deals with challenges regarding practical implementation of the concept. Start working on the project as early as possible. If you have any question (or difficulty) please contact the GTAs.