ELEC-A5240 Computer lab in digital signals processing basics

Project work

DTMF Coding

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Content of the project and Instructions on how to test the program

The project consists of the following files:

- 12 dtmf_TESTI_1xx.wav files provided as an example for testing developed code
- dtmf_testing.m
- decoder.m

To run the program and test developed function, dtmf_testing.m file should be run, where it executes and calls decoder.m and sets a .wav file as an input to it.

Structure of Matlab code and functionalities of functions

The developed code is very simple and consists of only 28 lines of code lines and one function called “decoder()”. The function takes a .wav format file as an input and returns a set of digits corresponding to audio file. The algorithm is very simple too as it computes two vectors and creates a 2xX matrix. Elements in the first row represent the row number in a keypad, whereas elements in the second row represent the column number in a keypad. For instance, to demonstrate number 0, the output will be 4 and 2.

Testing output

```
>> dtmf_testing

ans =

  Columns 1 through 23

    4    2    4    2    3    1    4    2    1    3    2    1    1    4    1    2    1    4    1    1    4    1    1
    2    2    2    2    2    1    2    2    1    2    3    1    3    2    1    2    2    2    1    2    2    3    2

  Column 24

    2
    2

File:         101

Time:         0.034695 s

Your number:    0505810518613015201203 25

Correct number: 0505810518613015201203 25

ans =

    4    2    2    2    1    1    4    1    1    2
    2    1    1    2    3    3    2    2    2    1

File:         102

Time:         0.0098855 s

Your number:    0445330224

Correct number: 0445330224

ans =

    4    1    4    1    1    1    1    1    1    3
```

2 2 2 1 3 3 3 3 2 2

File: 103

Time: 0.0065393 s

Your number: 0201333328

Correct number: 0201333328

ans =

4 2 4 1 1 3 1 1 4 1

2 1 2 3 2 2 3 3 2 2

File: 104

Time: 0.030034 s

Your number: 0403283302

Correct number: 0403283302

ans =

4 2 2 2 3 1 2 1 1 1

2 1 1 1 2 1 1 1 1 1

File: 105

Time: 0.013204 s

Your number: 0444814111

Correct number: 0444814111

ans =

4 2 1 3 3 1 3 1 3 1

2 1 1 1 1 2 3 1 3 2

File: 106

Time: 0.0056794 s

Your number: 0417729192

Correct number: 0417729192

ans =

4 2 4 3 1 2 1 1 1 2 2 2

2 2 2 1 2 1 1 1 3 2 2 3

File: 107

Time: 0.0085052 s

Your number: 050724113556

Correct number: 050724113556

ans =

4 1 2 2 3 1 1 2 1 1

2 1 2 2 1 1 1 1 3 2

File: 108

Time: 0.0057221 s

Your number: 0155711432

Correct number: 0155711432

ans =

2×0 empty double matrix

Output argument "pn" (and maybe others) not assigned during call to "decoder".

Error in dtmf_testing (line 38)

result = f_h(['dtmf_TESTI_' num2str(100+k) '.wav']);

Summary

Developing and writing a function that could decode different sets of numbers with background noise was very challenging and fun to do at the same time. We gained a lot of knowledge about particular topic and how Dual Tone Multi Frequency decoder operates. To be able to implement the function that can decode audio files, a lot of research has been done. There are different methods available online, however audios from 109 to 112 could not be decoded and the reason for that is background noises that interrupt decoding the key noises.

In addition to this, it is worth mentioning that working on this project has been a catalysator in developing our MATLAB skills and gaining knowledge about signal processing. Furthermore, we can say that we achieved the aim of the project work as we learned some issues of DSP, and can experiment building a working entity with MATLAB and enhance collaboration skills.