BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

Department Of Electronics And Telecommunication

PROJECT BASED LEARNING:

"ANALYSIS AND PRODUCTION OF AUDIO SIGNALS USING DIGITAL SIGNAL PROCESSING"

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CONTENT

INTRODUCTION

- Music is an integral part of everyone's lives. Music helps in relaxation, therapy, and entertainment. The audio industry is booming with online platforms for music streaming. This program helps identify the musical notes in a piece of audio and gives valuable information about its pitch, frequency, and type. The music piece fed to the system can be decoded to identify which note the signal corresponds to.

- In conclusion, using this format of MATLAB code, we should be able to create any song if the notes are available. Change the notes line of code as well as the frequency line of code to match the notes being used. Once all necessary notes are added, the melody can be changed to match the song and the song should be able to play in MATLAB. Also, if the length of the notes is not the way we want, we can edit the note line in the code to match the length we desire. It may not sound perfect, as MATLAB just plays the frequency that the note is, however it will play the correct note if we have defined it correctly.

PROPOSED METHODOLOGY

- Utilizing both exponential and sine functions in MATLAB, any melody can be recreated in MATLAB. However, to do this we will need to first choose the frequency for each of our notes, the length that each note will be played, and the order in which these notes will be played in the song. A common combination of notes is C-G-A-F.

Code:

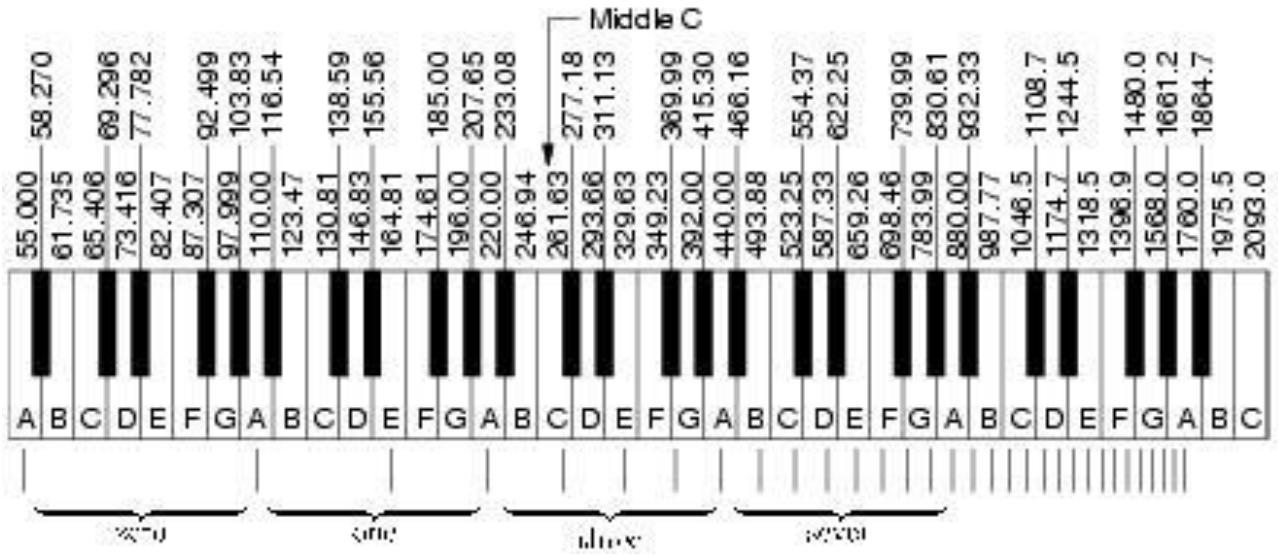
```
clear all; close all; clc;

% Define the notes in the melody

notes = {'C' 'C#' 'D' 'D#' 'E' 'F' 'F#' 'G' 'G#' 'A' 'A#' 'B' 'C1'};

% Define the corresponding frequencies

freq = [261.63 277.18 293.66 311.13 329.63 349.23 369.99 392 415.3 440 466.16 493.88
550.01];
```

PROPOSED METHODOLOGY

```
% Melody to be created
melody = {'G#' 'D#' 'G#' 'D#' 'A#' 'D#' 'A#' 'D#' 'B' 'D#' 'B' 'D#' 'A#' 'D#' 'A#' 'D#' 'G#' 'D#'
'G#' 'D#' 'A#' 'D#' 'A#' 'D#' 'C1' 'C1' 'A#' 'F#' 'G#'};
% Store the samples of the melody
a = [];
%For Loop
for k = 1:numel(melody)  %for loop which will create the melody
    note = 0:0.00020:1;  %note duration (which can be edited for length)
    a = [a sin(2*pi*freq(strcmp(notes,melody{k})).*note)];
%a will create the melody given variables defined above
end
```

APPLICATIONS

- Effective use of Fast Fourier Transform to determine frequency
- Can be used for audio matching
- Decode the musical note type for any unknown audio signal



FUTURE WORK

- There is still much room for future development that would enhance the system and increase its usage value. The following items are some suggestions:

- Advanced Note Detection: There are lot of ways we to improve and customize note detection. Most of them use variations in intensity, which is not the right way because strictly speaking a note is said to change when the frequency of the signal changes. It is not easy to keep track of change in frequency because the change is gradual and hence it is an existing challenge. Moreover, the frequency estimation for calculating note detection requires note detection in a crude sense which is paves way for development in this area.

- Non-Periodic Signal analysis: The process is relatively simple if the signal were sinusoidal or periodic. But the real-life musical notes or vocals are approximately periodic and the frequency itself changes with time because a sample may contain more than one note and that is how music is played. While Fourier Analysis is a nice solution to this problem, it is not sufficient. Theoretically it may be sufficient but its high-level implementation is not as there is resolution and run time limit. There is scope to overcome latter by designing algorithms especially for the purpose of frequency estimation and not focusing on phase detection.

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