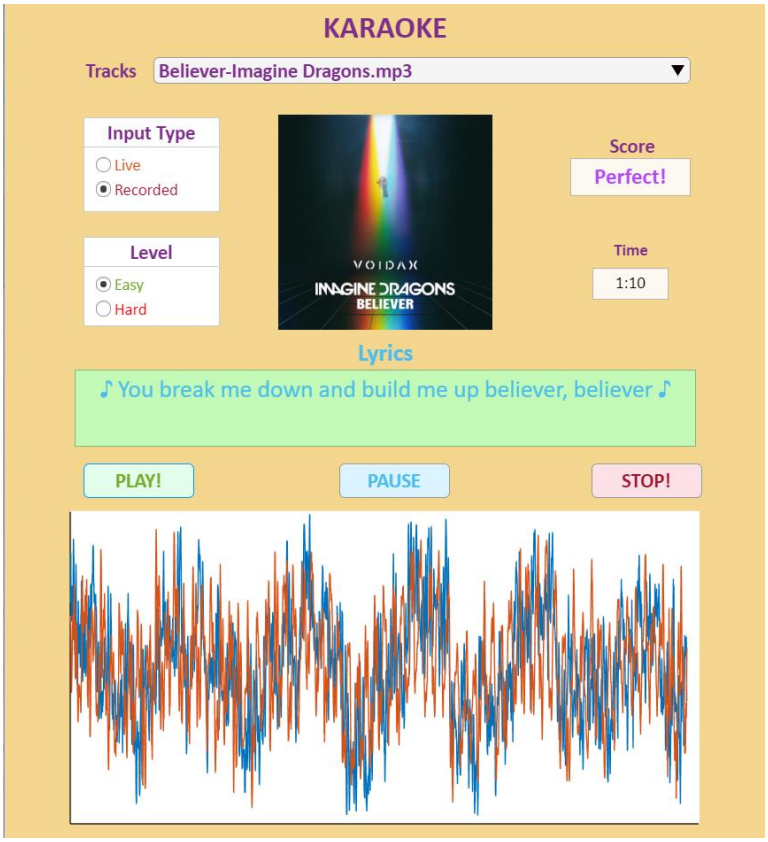
EE473 PROJECT

IMPLEMENTATION OF A KARAOKE SYSTEM

E. Gizem Güngör Fehmi Ayberk Uçkun

2017401285 2015401009

In this project, we have designed a karaoke game. It is a well-known game and it is based on the similarity between our voice and the singer's voice of the song that we can choose. This karaoke system contains four different tracks and they can be chosen in the drop-down menu. The album cover will change according to your choice. There are two kinds of input type: live and recorded. Live mode is the standard karaoke mode as usual and the system will compare your live voice with the vocal of the song. We have added another mode to evaluate your already recorded song concerning the original song. We have developed this mode to test our scoring methods and used the covers of these four tracks. It was more convenient method since we were not able to sing a song every time. It has also become a new feature we added to karaoke game. We have applied two sorts of comparison to signals which are energy comparison and pitch detection. When singing a song, it is harder to match the tone of the original song for the player. Therefore, we have employed energy comparison in easy mode and pitch detection in hard mode. You need to see lyrics in sync with the tracks in the karaoke game. The score is calculated for each lyric frame and shown after the corresponding lyric. You will see four different scores according to your success. The panel shows "Perfect" for above 75%, "Good" for 50-75%, "Meh :(" for 25-50% and "Bad…" for below 25%. You can look at the time simultaneously. Three main buttons are to play, to pause/resume and to stop. The name of the pause/resume button is changed according to its functionality. The graphic illustrates the magnitude of the vocal of the song and the player's voice in the time domain for each frame. Blue and orange represent the original song and the player, respectively.



We found and downloaded the tracks and the covers for the recorded mode from YouTube. The tracks that we used in this project:

1) Believer - Imagine Dragons
2) Counting Stars - OneRepublic
3) Girls Like You - Maroon 5
4) Something Just Like This - The Chainsmokers

Technical Tools

In this project, we used MATLAB as the main programming tool for both backend and frontend. Under the hood, we utilized several toolboxes which are Audio Toolbox, DSP System Toolbox and Signal Processing Toolbox. To achieve real-time signal processing, Audio Toolbox System Objects *audioDeviceReader* and *audioDeviceWriter* are utilized. DSP Toolbox is used for the *Audiofileread* object and Signal Processing Toolbox is used for *hamming* function. To build a shippable product, we used MATLAB App Designer which is the sequel of the MATLAB GUIDE.

Synchronization

First of all, we tried to separate the vocal and the background. In stereo audio, the vocal is recorded equally in both right and left channels. Thus, we can obtain the background of the song by subtracting from each other. Then, we sang the song with this background and compared with the original song. Yet, the background dominates the player's voice and the score was high even though we did not sing. At the same time, we could not get a pure background since the tracks downloaded may not be recorded in stereo. Therefore, we decided to compare the player's voice without background with the acapella (only vocal) version of the song. To make an accurate comparison, the acapella version and the original track should be in sync. Cross-correlation has been employed to measure the similarity between these two signals. The delay was calculated by finding the maximum correlated time and this process kept performing until zero delay was obtained. The audio was shifted and trimmed to remove this delay and then the lengths of two signals were equalized. After that, we arranged the time of the lyric shown to make the player's voice and the acapella in sync. We wrote the "sync" function for this process and also use it to synchronize the cover and the track in recorded mode. Before using the cross-correlation, we tried to find the index of the audio matrix where the track and cover start and we trim the cover. It worked successfully for some songs. Yet, it was not a general method for all songs. Therefore, we determined to apply the cross-correlation and saved the sync audio files.

Real-Time Signal Processing

Both "Recorded" and "Live" parts of the project use synchronous real-time signal processing. The difference is while former one uses an existing audio file for input, latter uses live audio from the microphone as input to the Karaoke. Summary of the whole live process is given below:

After the necessary options are set by the player at the front-end, selected song is uploaded into the program. First, sampling frequencies of the audios are checked to ensure the accuracy of the algorithm which requires resolutions of both audios the be equal. Then, original track and its vocal part are synchronized to ensure lyrics are going to be sync with the song playing. Sync audios are saved and re-uploaded using *Audiofilereader*. *Audiofilereader* takes the pre-determined size

frames one-by-one from the audio file and feeds the loop. At the same time, *audioDeviceReader* takes the input singing audio from the player through the microphone. Player audio is also taken one-by-one and the length of the frame is the same as the others.

Also, one could wonder the communication process of these objects with the computer hard drives. The process happens like this: First input sound is taken by the microphone and sent to sound card. Analog/Digital conversion is performed at the sound card using our specified sampling rate. Then, A/D converter puts the converted signal to sound card's buffer, ready to be taken by *audioDeviceReader.* If the sound card's buffer is full, meaning that *audioDeviceReader* did not take the previous sample from the card buffer, new samples are destroyed. This situation is called as overrun and can be prevented by increasing frame size, sound card quality, computer performance and a better-structured algorithm coding. For outputting the sound, *audioDeviceWriter* sends the signal to the sound card buffer. The sound card this time applies D/A conversion and send the analogue signal to speakers. When the sound card tries to take input from the buffer, if the buffer is empty, meaning that *audioDeviceWriter* was not able to send the next input and the next input it is still in the loop, a silence can be observed which is called underrun. This can be prevented using similar steps.

To guarantee no audio input is lost in the process, which means guaranteeing no overruns, we initialized our system objects before starting the loop via *setup* function. The system is tested monitoring both numbers of overruns and underruns (to ensure the sound quality). Tests showed that Windows default sound driver *DirectSound* has enough capacity for our chosen frame size 4410 (100ms). This frame rate is chosen to ensure low latency and enough input size for scoring signal processing applications.

After capturing the input voice, this audio is processed by a finite impulse response (FIR) smoothing filter which is called *Savitzky-Golay.* This filter is used to "smooth out" the noisy signal but order of the polynomial chose small for not destroying descriptive features of the singing. This filter was not our first choice at first and we wanted to use adaptive filters for noise-cancelling. However, MATLAB LSM/RLS and Frequency domain adaptive filters require the desired signal to train their filters coefficients and we do not have a basic way of sending known signals through the microphone to the algorithm. This requires another step to use the Karaoke such as environment/microphone setup, which requires players to send certain sounds through the microphone. We decided this is not feasible and any delay in real-time harms the quality of the process and continued with the aforementioned filter.

In the loop, both frames are processed by two different scoring algorithms. First one is the Frame-Based Energy Comparison Algorithm which is a time-domain signal processing algorithm that utilizes total frame energy similarities between human singings and the second one Frame-Based Pitch Comparison Algorithm is a frequency domain algorithm which compares the fundamental frequencies of the frames.

Frame-Based Energy Comparison

This method is classified as the easy mode in the game because according to tests, one's ability to adapt their voice's energy to the singer's is usually easier. In this method, a 100ms window of audio is taken as a frame and multiplied with a hamming window function. We used the hamming window to reduce the discriminative importance of edges of the frame because when

we take the 100ms of the singing we don't know whether we cut an identifying feature to half or not thus in such a case edges of the frame contains less information than its centre. After this smoothing step, energies of the frames are calculated and thresholded. Success score is given according to how close the energy of the frame, given that it is in the threshold interval. The calculation is given below.

$$success = 100 * \left(1 - \frac{|Recorded_{mean} - Vocal_{mean}|}{Vocal_{mean} * threshold}\right)$$

This calculation continues cumulatively until the verse change. That is the energy of each frame saved until the verse change and then the thresholded mean score is showed to the player. Score and energies are reset after each verse. This also means that the length of each calculation is different considering the different length of verses in the song.

Frame-Based Pitch Comparison

This method is classified as the hard mode in the game. Pitch corresponds to the fundamental frequency in human speech. Human singing (or speech) is constituted by different frequencies and the dominant one is called the fundamental frequency. Because we are comparing the singing frame by frame, the player should give great attention to synchronizing their voice with the singer. This comparison is hard because singers usually change the pitch of their voice through the words and verses. Moreover, we are comparing only 100ms frames with each other. Taking longer frames is counterintuitive to real-time processing and creating a memory for saving previous frames and then overlappingly applying the pitch detection is just too much overhead work for the algorithm and can cause serious delays.

We tried 2 different pitch detection method: Audio Toolbox built-in *pitch and speech detection* functions and our custom pitch detection algorithm. The tests showed us our custom algorithm performs better than built-in methods for reasons should be investigated. Our method constitutes taking *FFT* of the signals, applying *fftshift* and then finding the max amplitude frequency. Rest of the scoring is the same with energy comparison and again scores reset after each lyric change. Trials showed us even though the player sings well, without proper pitch change of their voice according to the singer's gender, scoring a good score is nearly impossible.

Future Work

We can save the player's voice in the live mode as well to be able to use later. The two methods that we used in scoring could be more accurate and precise. We can enhance energy comparison and pitch detection by using the overlapping windows for future extraction. This approach could compensate for timing delays and synchronization errors at the same time. The noise reduction can be focused on since there are many noises due to the environment and the quality of the microphone, especially in live mode. A general procedure could be found to isolate the vocal from the original songs and to obtain the vocal and the background separately. Finally, this MATLAB application can turn into a mobile application to have fun for all ages.

References

1. A. Mohapatra and P. K. Sethy," Implementation of a Karaoke System for Stereo Audio Signal," *International Journal of Advanced Research in Information and Communication Engineering*, vol. 3, no. 2, pp. 14-16, Feb. 2015.
2. G. S. Magnússon and K. Atladóttir, "Virtual Karaoke System," M.S. thesis, Dept. Informatics and Mathematical Modelling, Tech. Univ. Denmark, Lyngby, Denmark, 2005.
3. W.-H. Tsai and H.-C. Lee, "Automatic Evaluation of Karaoke Singing Based on Pitch, Volume, and Rhythm Features," *IEEE Transactions on Audio, Speech, and Language Processing*, vol. 20, no. 4, pp. 1233–1243, May 2012.
4. D. Qiu, "Development of Scoring Algorithm for Karaoke Computer Games," M.S. thesis, Dept. Elect. Eng., Royal Institute of Technology (KTH), Stockholm, Sweden, 2012.
5. B. Pawate, "Method and System for Karaoke Scoring," U.S. Patent 5719344A, Feb. 1998.

APPENDIX

Properties that correspond to app components 5

Methods 6

Callbacks that handle component events 44

Record Mode 45

Live Mode 48

Component initialization 53


```
classdef Karaoke_v0_exported < matlab.apps.AppBase
```

Properties that correspond to app components

```
    properties (Access = public)
        UIFigure             matlab.ui.Figure
        Image                matlab.ui.control.Image
        TracksDropDownLabel  matlab.ui.control.Label
        TracksDropDown       matlab.ui.control.DropDown
        InputTypeButtonGroup matlab.ui.container.ButtonGroup
        LiveButton           matlab.ui.control.RadioButton
        RecordedButton       matlab.ui.control.RadioButton
        PLAYButton           matlab.ui.control.Button
        STOPButton           matlab.ui.control.Button
        PAUSEButton          matlab.ui.control.Button
        LyricsTextAreaLabel  matlab.ui.control.Label
        LyricsTextArea       matlab.ui.control.TextArea
        Clock                matlab.ui.control.TextArea
        ScoreTextAreaLabel   matlab.ui.control.Label
        ScoreTextArea        matlab.ui.control.TextArea
        TimeLabel            matlab.ui.control.Label
```

```
        KARAOKELabel          matlab.ui.control.Label
        LevelButtonGroup      matlab.ui.container.ButtonGroup
        EasyButton            matlab.ui.control.RadioButton
        HardButton            matlab.ui.control.RadioButton
        UIAxes                matlab.ui.control.UIAxes
    end


    properties (Access = private)
        % ASIO Driver if necessary.
        SamplesPerFrame = 4410;  % Increase it to reduce overrun and underrun and decrease it to
reduce latency.

        % Initializations

        threshold_s = 0.6;
        threshold_b = 1.4;

        isStop = 0;
        isPaused = 0;

    end
```

Methods

```
    methods (Access = private)
        % Synchronization
        function sync(~, name1, audio1, Fs1, name2, audio2, Fs2)
            [c, lags] = xcorr(audio2(:, 1), audio1(:, 1));
            [~, index] = max(c);
            delay = lags(index);

            audio2 = (audio2(:, 1) + audio2(:, 2))/2;
            audio1 = (audio1(:, 1) + audio1(:, 2))/2;

            while delay ~= 0
                if delay > 0
                    audio2 = audio2(delay+1:end);

                    if length(audio1) < length(audio2)
                        audio2 = audio2(1:length(audio1));
                    else
                        audio1 = audio1(1:length(audio2));
```

```
            end

            [c2, lags2] = xcorr(audio2, audio1, 'normalized');
            [~, index2] = max(c2);
            delay = lags2(1, index2);
        else
            audio2 = [zeros(abs(delay), 1); audio2];

            if length(audio1) < length(audio2)
                audio2 = audio2(1:length(audio1));
            else
                audio1 = audio1(1:length(audio2));
            end

            [c2, lags2] = xcorr(audio2,audio1,'normalized');
            [~, index2] = max(c2);
            delay = lags2(1, index2);
        end
    end

    audiowrite(strcat('Sync\', name1, '.wav'), audio1, Fs1);
    audiowrite(strcat('Sync\', name2, '.wav'), audio2, Fs2);

end

% Lyrics
function [energies_vocal, energies_record] = lyrics(app, counter, score, energies_vocal,
energies_record)

    seconds = counter/10;
    if app.TracksDropDown.Value == "Believer-Imagine Dragons.mp3"
        if app.LiveButton.Value==1
            seconds = seconds - 0.5;
        else
            seconds = seconds - 2;
        end

        if seconds == 1
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪♪♪';
```

```
            elseif seconds == 7.6
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ First things first ♪';

            elseif seconds == 9.2
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I''ma say all the words inside my head ♪';

            elseif seconds == 11.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I am fired up and tired of the way that things have
been, oh-ooh ♪';

            elseif seconds == 17.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ The way that things have been, oh-ooh ♪';

            elseif seconds == 22.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Second thing second ♪';

            elseif seconds == 24.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Don′t you tell me what you think that I could be ♪';

            elseif seconds == 27.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I''m the one at the sail I''m the master of my sea, oh-
ooh ♪';
```

```
        elseif seconds == 33.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ The master of my sea, oh-ooh ♪';

        elseif seconds == 37.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I was broken from a young age ♪';

        elseif seconds == 39.7
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Taking my sulkin" to the masses ♪';

        elseif seconds == 41.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Writing my poems for the few ♪';

        elseif seconds == 43.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ That look at me took to me, shook at me, feelin" me
♪';

        elseif seconds == 45.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Singing from heartache from the pain ♪';

        elseif seconds == 47.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Taking my message from the veins ♪';
```

```
            elseif seconds == 49.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Speaking my lesson from the brain ♪';

            elseif seconds == 51.2
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Seeing the beauty through the... ♪';

            elseif seconds == 54.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Pain! ♪';

            elseif seconds == 55.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ You made me a, you made me a believer, believer ♪';

            elseif seconds == 62.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Pain! ♪';

            elseif seconds == 63.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ You break me down and build me up believer,
believer ♪';

            elseif seconds == 69
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Pain! ♪';
```

```
            elseif seconds == 70.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Oh, let the bullets fly, oh, let them rain ♪';

            elseif seconds == 74.6
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ My life, my love, my drive, it came from... ♪';

            elseif seconds == 77.6
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Pain! ♪';

            elseif seconds == 78.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ You made me a, you made me a believer, believer ♪';

            elseif seconds == 84.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Third things third ♪';

            elseif seconds == 85.6
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Send a prayer to the ones up above ♪';

            elseif seconds == 88.6
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ All the hate that you"ve heard has turned your spirit to
a dove ♪';
```

```
elseif seconds == 92.5
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Oh-ooh ♪';

elseif seconds == 94.6
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Your spirit up above ♪';

elseif seconds == 96.3
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪  Oh-ooh ♪';

elseif seconds == 99.3
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I was chokin" in the crowd ♪';

elseif seconds == 101
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Building my rain up in the cloud ♪';

elseif seconds == 103
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Falling like ashes to the ground ♪';

elseif seconds == 104.9
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Hoping my feelings, they would drown ♪';
```

```
            elseif seconds == 106.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ But they never did, ever lived, ebbin" and flowin" ♪';

            elseif seconds == 109
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Inhibited, limited till it broke open ♪';

            elseif seconds == 111
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ And rained down it rained down, like... ♪';

            elseif seconds == 115.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Pain! ♪';

            elseif seconds == 117.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ You made me a, you made me a believer, believer ♪';

            elseif seconds == 123.6
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Pain! ♪';

            elseif seconds == 125.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ You break me down and build me up believer,
believer ♪';
```

```
elseif seconds == 130.3
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Pain! ♪';

elseif seconds == 132.2
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Oh, let the bullets fly, oh, let them rain ♪';

elseif seconds == 135.8
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ My life, my love, my drive, it came from... ♪';

elseif seconds == 139
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Pain! ♪';

elseif seconds == 140.4
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ You made me a, you made me a believer, believer ♪';

elseif seconds == 145.5
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Last things last ♪';

elseif seconds == 147
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ By the grace of the fire and the flames ♪';

elseif seconds == 149.9
```

```
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ You"re the face of the future ♪';

    elseif seconds == 152.3
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ The blood in my veins, oh-ooh ♪';

    elseif seconds == 156
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ The blood in my veins, oh-ooh ♪';

    elseif seconds == 160.6
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ But they never did, ever lived, ebbin" and flowin" ♪';

    elseif seconds == 162.7
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Inhibited, limited till it broke open ♪';

    elseif seconds == 164.6
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ And rained down it rained down, like... ♪';

    elseif seconds == 169.6
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Pain! ♪';

    elseif seconds == 170
        app.ScoreTextArea.Value = score;
```

```
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ You made me a, you made me a believer, believer ♪';

        elseif seconds == 177.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Pain! ♪';

        elseif seconds == 178.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ You break me down and build me up believer,
believer ♪';

        elseif seconds == 184.1
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Pain! ♪';

        elseif seconds == 185.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Oh, let the bullets fly, oh, let them rain ♪';

        elseif seconds == 189.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ My life, my love, my drive, it came from... ♪';

        elseif seconds == 192.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Pain! ♪';

        elseif seconds == 193.9
            app.ScoreTextArea.Value = score;
```

```
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ You made me a, you made me a believer, believer ♪';

        elseif seconds == 199.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪♪♪';
        end

    elseif app.TracksDropDown.Value == "Counting Stars-OneRepublic.mp3"

        if seconds == 0.1
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Lately, I have been I have been losing sleep ♪';

        elseif seconds == 4.7
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';

        elseif seconds == 8.9
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Baby I have been I have been praying hard ♪';

        elseif seconds == 13.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Said no more counting dollars ♪';

        elseif seconds == 15.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ We'll be counting stars ♪';
```

```
            elseif seconds == 18.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Yeah we'll be counting stars ♪';

            elseif seconds == 37.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I see this life like a swinging vine ♪';

            elseif seconds == 39.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Swing my heart across the line ♪';

            elseif seconds == 41.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ And my face is flashing signs' newline 'Seek it out
and you shall find ♪'];

            elseif seconds == 45.9
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Old but I am not that old' newline 'Young but I am
not that bold ♪'];

            elseif seconds == 49.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ I don't think the world is sold' newline 'I am just
doing what we are told ♪'];

            elseif seconds == 53.9
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
```

```
        app.LyricsTextArea.Value= '♪ I feel something so right ♪';

    elseif seconds == 58.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doing the wrong thing ♪';

    elseif seconds == 62
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I feel something so wrong ♪';

    elseif seconds == 66.4
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doing the right thing ♪';

    elseif seconds == 69.8
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I couldn''t lie, couldn''t lie, couldn''t lie ♪';

    elseif seconds == 73.4
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Everything that kills me makes me feel alive ♪';

    elseif seconds == 77.3
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Lately I have been I have been losing sleep ♪';

    elseif seconds == 81.3
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';
```

```
            elseif seconds == 85
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ But baby I have been I have been praying hard ♪';

            elseif seconds == 89
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Said no more counting dollars' newline 'We'll be
counting stars ♪'];

            elseif seconds == 92.9
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Lately I have been I have been losing sleep ♪';

            elseif seconds == 97.1
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';

            elseif seconds == 100.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ But baby I have been I have been praying hard ♪';

            elseif seconds == 104.9
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Said no more counting dollars ♪';

            elseif seconds == 106.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ We'll be we'll be counting stars ♪';
```

```
            elseif seconds == 116.1
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I feel the love and I feel it burn ♪';

            elseif seconds == 118.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Down this river every turn ♪';

            elseif seconds == 120.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Hope is our four-letter word ♪';

            elseif seconds == 122.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Make that money watch it burn ♪';

            elseif seconds == 124.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Old but I am not that old' newline 'Young but I am
not that bold ♪'];

            elseif seconds == 128.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ I don't think the world is sold' newline 'I am just
doing what we are told ♪'];

            elseif seconds == 132.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
```

```
        app.LyricsTextArea.Value= '♪ I feel something so wrong ♪';

    elseif seconds == 137.1
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doing the right thing ♪';

    elseif seconds == 140.7
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I couldn''t lie, couldn''t lie, couldn''t lie ♪';

    elseif seconds == 144.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Everything that drowns me makes me wanna fly ♪';

    elseif seconds == 148.4
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Lately I have been I have been losing sleep ♪';

    elseif seconds == 152.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';

    elseif seconds == 155.8
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ But baby I have been I have been praying hard ♪';

    elseif seconds == 159.9
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Said no more counting dollars ♪';
```

```
            elseif seconds == 161.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ We'll be counting stars ♪';

            elseif seconds == 163.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Lately I have been I have been losing sleep ♪';

            elseif seconds == 167.9
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';

            elseif seconds == 171.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ But baby I have been I have been praying hard ♪';

            elseif seconds == 175.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Said no more counting dollars ♪';

            elseif seconds == 177.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ We'll be we'll be counting stars ♪';

            elseif seconds == 183.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];
```

```
            elseif seconds == 187.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

            elseif seconds == 191.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

            elseif seconds == 195.2
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

            elseif seconds == 199.2
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Everything that kills me makes me feel alive ♪';

            elseif seconds == 206.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Lately I have been I have been losing sleep ♪';

            elseif seconds == 210.2
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';

            elseif seconds == 213.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
```

```
            energies_record = [];
            app.LyricsTextArea.Value= '♪ But baby I have been I have been praying hard ♪';

        elseif seconds == 217.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= ['♪ Said no more counting dollars' newline 'We'll be
counting stars ♪'];

        elseif seconds == 221.7
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Lately I have been I have been losing sleep ♪';

        elseif seconds == 225.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Dreaming about the things that we could be ♪';

        elseif seconds == 229.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ But baby I have been I have been praying hard ♪';

        elseif seconds == 233.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Said no more counting dollars ♪';

        elseif seconds == 235.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ We'll be we'll be counting stars ♪';

        elseif seconds == 238.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
```

```
            energies_record = [];
            app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

        elseif seconds == 241.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

        elseif seconds == 245.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

        elseif seconds == 249.2
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= ['♪ Take that money Watch it burn' newline 'Sink in the
river The lessons are learnt ♪'];

        elseif seconds == 257.2
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪♪♪';
        end

    elseif app.TracksDropDown.Value == "Girls Like You-Maroon 5.mp3"
        if app.LiveButton.Value==1
            seconds = seconds+1.5;
        end

        if seconds == 2.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪♪♪';
```

```
            elseif seconds == 9.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ SPENT 24 HOURS, I NEED MORE HOURS WITH
YOU ♪';

            elseif seconds == 17.2
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ YOU SPENT THE WEEKEND GETTING EVEN,
OOH ♪';

            elseif seconds == 24.9
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ WE SPENT THE LATE NIGHTS MAKING
THINGS RIGHT BETWEEN US ♪';

            elseif seconds == 32.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ BUT NOW IT''S ALL GOOD, BABE ♪';

            elseif seconds == 34.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ ROLL THAT BACK WOOD, BABE ♪';

            elseif seconds == 36.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ AND PLAY ME CLOSE ♪';

            elseif seconds == 40.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
```

```
            app.LyricsTextArea.Value= '♪ "CAUSE GIRLS LIKE YOU RUN" ROUND WITH
GUYS LIKE ME ♪';

        elseif seconds == 44
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ "TIL SUN DOWN WHEN I COME THROUGH ♪';

        elseif seconds == 45.9
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

        elseif seconds == 48.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ GIRLS LIKE YOU LOVE FUN, AND YEAH, ME
TOO ♪';

        elseif seconds == 51.7
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ WHAT I WANT WHEN I COME THROUGH ♪';

        elseif seconds == 53.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

        elseif seconds == 57.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ YEAH YEAH YEAH, YEAH YEAH YEAH ♪';

        elseif seconds == 61.2
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
```

```
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

        elseif seconds == 65.1
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ YEAH YEAH YEAH, YEAH YEAH YEAH ♪';

        elseif seconds == 69
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU ♪';

        elseif seconds == 71
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I SPENT LAST NIGHT ON THE LAST FLIGHT TO
YOU ♪';

        elseif seconds == 78.9
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ TOOK A WHOLE DAY UP TRYNA GET WAY
UP, OOH ♪';

        elseif seconds == 86.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ WE SPENT THE DAYLIGHT TRYNA MAKE
THINGS RIGHT BETWEEN US ♪';

        elseif seconds == 94.2
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ BUT NOW IT''S ALL GOOD, BABE ♪';

        elseif seconds == 95.8
```

```
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ ROLL THAT BACK WOOD, BABE ♪';

            elseif seconds == 97.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ AND PLAY ME CLOSE ♪';

            elseif seconds == 101.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ "CAUSE GIRLS LIKE YOU RUN" ROUND WITH
GUYS LIKE ME ♪';

            elseif seconds == 105.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ "TIL SUN DOWN WHEN I COME THROUGH ♪';

            elseif seconds == 107.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

            elseif seconds == 109.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ GIRLS LIKE YOU LOVE FUN, AND YEAH, ME
TOO ♪';

            elseif seconds == 113.1
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ WHAT I WANT WHEN I COME THROUGH ♪';
```

```
elseif seconds == 115
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

elseif seconds == 118.9
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ YEAH YEAH YEAH, YEAH YEAH YEAH ♪';

elseif seconds == 122
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

elseif seconds == 126.5
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ YEAH YEAH YEAH, YEAH YEAH YEAH ♪';

elseif seconds == 130.4
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

elseif seconds == 138.4
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

elseif seconds == 146
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU ♪';

elseif seconds == 148.7
```

```
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ MAYBE IT"S 6:45 ♪';

        elseif seconds == 150.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ MAYBE I"M BARELY ALIVE ♪';

        elseif seconds == 152.6
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ MAYBE YOU"VE TAKEN MY SHIT FOR THE
LAST TIME, YEAH ♪';

        elseif seconds == 156.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ MAYBE I KNOW THAT I"M DRUNK ♪';

        elseif seconds == 158.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ MAYBE I KNOW YOU"RE THE ONE ♪';

        elseif seconds == 160.2
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ MAYBE YOU"RE THINKING IT"S BETTER IF
YOU DRIVE ♪';

        elseif seconds == 165
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ OH "CAUSE GIRLS LIKE YOU RUN" ROUND
WITH GUYS LIKE ME ♪';
```

```
            elseif seconds == 169
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ "TIL SUN DOWN WHEN I COME THROUGH ♪';

            elseif seconds == 170.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH ♪';

            elseif seconds == 175.1
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ OH "CAUSE GIRLS LIKE YOU RUN" ROUND
WITH GUYS LIKE ME ♪';

            elseif seconds == 178.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ "TIL SUN DOWN WHEN I COME THROUGH ♪';

            elseif seconds == 180.3
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

            elseif seconds == 182.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ GIRLS LIKE YOU LOVE FUN, AND YEAH, ME
TOO ♪';

            elseif seconds == 186.1
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
```

```
            app.LyricsTextArea.Value= '♪ WHAT I WANT WHEN I COME THROUGH ♪';

        elseif seconds == 188.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU, YEAH YEAH ♪';

        elseif seconds == 191.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ YEAH YEAH YEAH, YEAH YEAH YEAH ♪';

        elseif seconds == 195.8
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU YEAH YEAH♪';

        elseif seconds == 199.5
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ YEAH YEAH YEAH, YEAH YEAH YEAH ♪';

        elseif seconds == 203.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I NEED A GIRL LIKE YOU ♪';

        elseif seconds == 207
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪♪♪';
        end

    elseif app.TracksDropDown.Value == "Something Just Like This-The
Chainsmokers.mp3"
        if seconds == 1
        app.ScoreTextArea.Value = score;
```

```
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪♪♪';

            elseif seconds == 8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ I have been reading books of old ♪';

            elseif seconds == 10.4
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ The legends and the myths ♪';

            elseif seconds == 12.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Achilles and his gold ♪';

            elseif seconds == 15.1
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Hercules and his gifts ♪';

            elseif seconds == 17.5
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ Spiderman′s control ♪';

            elseif seconds == 19.7
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
                energies_record = [];
                app.LyricsTextArea.Value= '♪ And Batman with his fists ♪';

            elseif seconds == 22.8
                app.ScoreTextArea.Value = score;
                energies_vocal = [];
```

```
        energies_record = [];
        app.LyricsTextArea.Value= '♪ And clearly I don't see myself upon that list ♪';

    elseif seconds == 26.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ She said Where'd you wanna go ♪';

    elseif seconds == 29.1
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ How much you wanna risk ♪';

    elseif seconds == 31.1
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I am not looking for somebody ♪';

    elseif seconds == 33.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ With some superhuman gifts ♪';

    elseif seconds == 35.9
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Some superhero ♪';

    elseif seconds == 38.3
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Some fairytale bliss ♪';

    elseif seconds == 40.6
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
```

```
        app.LyricsTextArea.Value= '♪ Just something I can turn to ♪';

    elseif seconds == 43
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Somebody I can kiss ♪';

    elseif seconds == 45.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I want something just like this ♪';

    elseif seconds == 47.7
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

    elseif seconds == 50
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo ♪';

    elseif seconds == 52.3
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

    elseif seconds == 54.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

    elseif seconds == 57
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';
```

```
elseif seconds == 59.3
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Doo doo doo doo doo ♪';

elseif seconds == 61.6
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

elseif seconds == 63.6
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

elseif seconds == 73.3
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I want something just like this ♪';

elseif seconds == 82.8
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I have been reading books of old ♪';

elseif seconds == 85.1
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ The legends and the myths ♪';

elseif seconds == 87.3
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ The testaments they told ♪';
```

```
elseif seconds == 89.7
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ The moon and its eclipse ♪';

elseif seconds == 92
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ And Superman unrolls ♪';

elseif seconds == 94.2
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ A suit before he lifts ♪';

elseif seconds == 97.8
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ But I''m not the kind of person that it fits ♪';

elseif seconds == 101
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ She said Where′d you wanna go ♪';

elseif seconds == 103.6
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ How much you wanna risk ♪';

elseif seconds == 105.6
    app.ScoreTextArea.Value = score;
    energies_vocal = [];
    energies_record = [];
    app.LyricsTextArea.Value= '♪ I am not looking for somebody ♪';

elseif seconds == 108
```

```
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ With some superhuman gifts ♪';

    elseif seconds == 110.7
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Some superhero ♪';

    elseif seconds == 112.9
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Some fairytale bliss ♪';

    elseif seconds == 115.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Just something I can turn to ♪';

    elseif seconds == 117.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Somebody I can miss ♪';

    elseif seconds == 119.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I want something just like this ♪';

    elseif seconds == 129.1
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I want something just like this ♪';

    elseif seconds == 138.1
        app.ScoreTextArea.Value = score;
```

```
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

    elseif seconds == 141
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

    elseif seconds == 143.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo ♪';

    elseif seconds == 145.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

    elseif seconds == 147.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

    elseif seconds == 150.2
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

    elseif seconds == 152.4
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo ♪';

    elseif seconds == 154.8
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
```

```
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Doo doo doo doo doo doo ♪';

    elseif seconds == 157.6
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Where d'ya wanna go ♪';

    elseif seconds == 159.7
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ How much you wanna risk ♪';

    elseif seconds == 161.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ I am not looking for somebody ♪';

    elseif seconds == 163.8
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ With some superhuman gifts ♪';

    elseif seconds == 166.5
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Some superhero ♪';

    elseif seconds == 168.8
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
        app.LyricsTextArea.Value= '♪ Some fairytale bliss ♪';

    elseif seconds == 171.1
        app.ScoreTextArea.Value = score;
        energies_vocal = [];
        energies_record = [];
```

```
            app.LyricsTextArea.Value= '♪ Just something I can turn to ♪';

        elseif seconds == 173.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Somebody I can kiss ♪';

        elseif seconds == 175.4
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ I want something just like this ♪';

        elseif seconds == 194
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

        elseif seconds == 212.7
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

        elseif seconds == 231.3
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪ Oh I want something just like this ♪';

        elseif seconds == 235.7
            app.ScoreTextArea.Value = score;
            energies_vocal = [];
            energies_record = [];
            app.LyricsTextArea.Value= '♪♪♪';
        end
    end
  end
end
```

Callbacks that handle component events

```
methods (Access = private)

    % Code that executes after component creation
    function startupFcn(app)
        tracks = struct2cell(dir('Tracks\*.mp3'));
        tracks_name = tracks(1,:);
        app.TracksDropDown.Items = tracks_name;

        if isempty(app.TracksDropDown.Items) == 1
            uialert(app.UIFigure,...
                ['Your current folder does not contain any audio files'],...
                'Info','Icon','info');
        end

        app.Image.ImageSource = strcat(app.TracksDropDown.Value, '.jpeg');
    end

    % Button pushed function: PLAYButton
    function PLAYButtonPushed(app, event)

        clc;
        counter = 0;

        energies_vocal = [];
        energies_record = [];
        pitches_vocal = [];
        pitches_record = [];

        app.Clock.Value = '0';
        app.LyricsTextArea.Value = {'Karaoke is Loading...'};

        % Directories
        track_directory = strcat('Tracks\', char(app.TracksDropDown.Value));
        cover_directory = strcat('Covers\', char(app.TracksDropDown.Value));
        vocal_directory = strcat('Vocals\', char(app.TracksDropDown.Value));

        % Load Sounds
        [track_audio, Fs_t] = audioread(track_directory);

        Hs = hamming(app.SamplesPerFrame, 'symmetric'); % Hamming window
```

Record Mode

```
if app.RecordedButton.Value == 1
    [cover_audio, Fs_c] = audioread(cover_directory);

    sync(app, 'sync_track', track_audio, Fs_t, 'sync_cover', cover_audio, Fs_c);

    % Set Readers and Writers
    Track = dsp.AudioFileReader('Filename', 'Sync\sync_track.wav', ...
        'OutputDataType', 'double', 'SamplesPerFrame', app.SamplesPerFrame);

    Cover = dsp.AudioFileReader('Filename', 'Sync\sync_cover.wav', ...
        'OutputDataType', 'double', 'SamplesPerFrame', app.SamplesPerFrame);

    Speaker = audioDeviceWriter('SampleRate',Track.SampleRate);

    % Check Sample Rates
    Fs_t = Track.SampleRate;
    Fs_c = Cover.SampleRate;

    if Fs_t ~= Fs_c
        uialert(app.UIFigure,'Tracks have different sample rates!',...
            'Error','Icon','error');
    end

    % Pre Execute 1-time tasks before loop
    setup(Track)
    setup(Cover)
    setup(Speaker, zeros(Track.SamplesPerFrame, 1))

    app.LyricsTextArea.Value = {'Ready for Singing!'};

    while(~isDone(Cover))
        counter = counter + 1;

        if mod(counter, 10) == 0
            if counter > 599
                second = mod(counter, 600);
            else
                second = counter;
            end
            app.Clock.Value = strcat(int2str(floor(counter/600)), ':', int2str(second/10));
```

```
end

my_track = Track();
my_cover = Cover();

my_vocal = my_track;
my_record = my_cover; % we use cover instead of our voice in recorded mode

my_output = my_cover;

plot(app.UIAxes,[my_track, my_cover])
drawnow();

if app.EasyButton.Value == 1
   % Single Energy
   smoothed_my_record =  my_record .* Hs;
   energy_my_record = sum(sum(smoothed_my_record.^2))/2;

   smoothed_my_vocal = my_vocal .* Hs;
   energy_my_vocal = sum(sum(smoothed_my_vocal.^2))/2;

   % Total Energy
   energies_vocal = [energies_vocal energy_my_vocal];
   energies_record = [energies_record energy_my_record];

   mean_vocal = mean(energies_vocal);
   mean_record = mean(energies_record);

   success_energy = 100*(1 - (abs(mean_record-mean_vocal)/(mean_vocal*0.6)));
   if success_energy < 0
      success_energy = 0;
   end

   if success_energy > 75
      score = 'Perfect!';
   elseif success_energy > 50
      score = 'Good!';
   elseif success_energy > 25
      score = 'Meh :(';
   else
      score = 'Bad...';
   end
```

```
                [energies_vocal, energies_record] = lyrics(app, counter, score, energies_vocal,
energies_record);

            elseif app.HardButton.Value == 1
                % Pitch
                Y = fft(my_track);
                fftSignal1 = fftshift(Y);
                [mag1, f0] = max(fftSignal1);

                Y = fft(my_cover);
                fftSignal2 = fftshift(Y);
                [mag2, f1] = max(fftSignal2);

                if mag1 < 1
                    f0 = 1;
                end

                if mag2 < 1
                    f1 = 1;
                end

                 % Alternative Pitch Method
%                 speechIndices = detectSpeech(smoothed_my_vocal,Fs_t);
%                 f0 = [];
%                 for ii = 1:size(speechIndices,1)
%                     speechSegment =
smoothed_my_vocal(speechIndices(ii,1):speechIndices(ii,2));
%                     f0 = [f0;pitch(speechSegment,Fs_t)];
%                 end
%
%                 speechIndices = detectSpeech(smoothed_my_record,Fs_t);
%                 f1 = [];
%                 for ii = 1:size(speechIndices,1)
%                     speechSegment =
smoothed_my_record(speechIndices(ii,1):speechIndices(ii,2));
%                     f1 = [f1;pitch(speechSegment,Fs_t)];
%                 end
%                 f0 = pitch(smoothed_my_vocal,Fs_t);
%                 f1 = pitch(smoothed_my_record,Fs_t);

                % Total Pitch
                pitches_vocal = [pitches_vocal; f0];
                pitches_record = [pitches_record; f1];
```

```
                mean_vocal = mean(pitches_vocal);
                mean_record = mean(pitches_record);

                success_pitch = 100*(1 - (abs(mean_record-mean_vocal)/(mean_vocal* 0.3)));
                if success_pitch < 0
                    success_pitch = 0;
                end

                if success_pitch > 75
                    score = 'Perfect!';
                elseif success_pitch > 50
                    score = 'Good!';
                elseif success_pitch > 25
                    score = 'Meh :(';
                else
                    score = 'Bad...';
                end

                [pitches_vocal, pitches_record] = lyrics(app, counter, score, pitches_vocal,
pitches_record);
            end

            Speaker(my_output);

            if app.isStop == 1
                break;
            end
        end
        app.LyricsTextArea.Value = {'END!'};

        release(Track)
        release(Cover)
        release(Speaker)
        app.isStop = 0;
```

Live Mode

```
    elseif app.LiveButton.Value == 1
        [vocal_audio, Fs_v] = audioread(vocal_directory);

        sync(app, 'sync_track', track_audio, Fs_t, 'sync_vocal', vocal_audio, Fs_v);
```

```
% Set Readers and Writers
Track = dsp.AudioFileReader('Filename', 'Sync\sync_track.wav', ...
   'OutputDataType', 'double', 'SamplesPerFrame', app.SamplesPerFrame);

Vocal = dsp.AudioFileReader('Filename', 'Sync\sync_vocal.wav', ...
   'OutputDataType', 'double', 'SamplesPerFrame', app.SamplesPerFrame);

Recorder = audioDeviceReader('NumChannels', 1, 'SampleRate', Track.SampleRate, ...
   'OutputDataType', 'double', 'SamplesPerFrame', app.SamplesPerFrame);

Speaker = audioDeviceWriter('SampleRate',Track.SampleRate);

% Check Sampling Rates
Fs_t = Track.SampleRate;
Fs_v = Vocal.SampleRate;

if  Fs_t ~= Fs_v
   uialert(app.UIFigure,'Tracks have different sampling rates!',...
      'Error','Icon','error');
end

% Pre Execute 1-time tasks before loop
setup(Track)
setup(Vocal)
setup(Recorder)
setup(Speaker, zeros(Recorder.SamplesPerFrame, Recorder.NumChannels))

while(~isDone(Track))
   counter = counter + 1;

   if mod(counter, 10) == 0
      if counter > 599
         second = mod(counter, 600);
      else
         second = counter;
      end
      app.Clock.Value = strcat(int2str(floor(counter/600)), ':', int2str(second/10));
   end

   my_track = Track();
   my_vocal = Vocal();
   my_record = Recorder();
   my_record = my_record.*1.5; %to amplify voice
```

```
            my_record = sgolayfilt(my_record, 2, 3);  % Noise Cancellation

            my_output = my_track;

            plot(app.UIAxes,[my_vocal, my_record])
            drawnow();

            if app.EasyButton.Value == 1
               % Single Energy
               smoothed_my_record =  my_record .* Hs;
               energy_my_record = sum(sum(smoothed_my_record.^2))/2;

               smoothed_my_vocal = my_vocal .* Hs;
               energy_my_vocal = sum(sum(smoothed_my_vocal.^2))/2;

               % Total Energy
               energies_vocal = [energies_vocal energy_my_vocal];
               energies_record = [energies_record energy_my_record];

               mean_vocal = mean(energies_vocal);
               mean_record = mean(energies_record);

               success_energy = 100*(1 - (abs(mean_record-mean_vocal)/(mean_vocal*0.6)));
               if success_energy < 0
                  success_energy = 0;
               end

               if success_energy > 75
                  score = 'Perfect!';
               elseif success_energy > 50
                  score = 'Good!';
               elseif success_energy > 25
                  score = 'Meh :(';
               else
                  score = 'Bad...';
               end

               [energies_vocal, energies_record] = lyrics(app, counter, score, energies_vocal,
energies_record);

            elseif app.HardButton.Value == 1
               % Pitch
```

```
                Y = fft(my_vocal);
                fftSignal1 = fftshift(Y);
                [mag1, f0] = max(fftSignal1);

                Y = fft(my_record);
                fftSignal2 = fftshift(Y);
                [mag2, f1] = max(fftSignal2);

                if mag1 < 1
                   f0 = 1;
                end

                if mag2 < 1
                   f1 = 1;
                end

                 % Alternative Pitch Method
   %               speechIndices = detectSpeech(smoothed_my_vocal,Fs_t);
   %               f0 = [];
   %               for ii = 1:size(speechIndices,1)
   %                  speechSegment =
smoothed_my_vocal(speechIndices(ii,1):speechIndices(ii,2));
   %                  f0 = [f0;pitch(speechSegment,Fs_t)];
   %               end
   %
   %               speechIndices = detectSpeech(smoothed_my_record,Fs_t);
   %               f1 = [];
   %               for ii = 1:size(speechIndices,1)
   %                  speechSegment =
smoothed_my_record(speechIndices(ii,1):speechIndices(ii,2));
   %                  f1 = [f1;pitch(speechSegment,Fs_t)];
   %               end
   %               f0 = pitch(smoothed_my_vocal,Fs_t);
   %               f1 = pitch(smoothed_my_record,Fs_t);

                % Total Pitch
                pitches_vocal = [pitches_vocal; f0];
                pitches_record = [pitches_record; f1];

                mean_vocal = mean(pitches_vocal);
                mean_record = mean(pitches_record);

                success_pitch = 100*(1 - (abs(mean_record-mean_vocal)/(mean_vocal* 0.3)));
```

```
                    if success_pitch < 0
                        success_pitch = 0;
                    end

                    if success_pitch > 75
                        score = 'Perfect!';
                    elseif success_pitch > 50
                        score = 'Good!';
                    elseif success_pitch > 25
                        score = 'Meh :(';
                    else
                        score = 'Bad...';
                    end

                    [pitches_vocal, pitches_record] = lyrics(app, counter, score, pitches_vocal,
pitches_record);
                end

                Speaker(my_output);

                if app.isStop == 1
                    break;
                end
            end
            app.LyricsTextArea.Value = {'END!'};

            release(Track)
            release(Vocal)
            release(Recorder)
            release(Speaker)
            app.isStop = 0;
        else
            uialert(app.UIFigure,...
                ['Something is wrong!'],...
                'Error','Icon','error');
        end

    end

    % Button pushed function: STOPButton
    function STOPButtonPushed(app, event)
        app.isStop = 1;
        app.PAUSEButton.Text = 'PAUSE';
```

```
            app.isPaused = 0;
            uiresume(app.UIFigure);
        end

        % Button pushed function: PAUSEButton
        function PAUSEButtonPushed(app, event)
            if app.isPaused == 0
                app.PAUSEButton.Text = 'RESUME';
                app.isPaused = 1;
                uiwait(app.UIFigure);
            else
                app.PAUSEButton.Text = 'PAUSE';
                app.isPaused = 0;
                uiresume(app.UIFigure);
            end
        end

        % Value changed function: TracksDropDown
        function TracksDropDownValueChanged(app, event)
            app.Image.ImageSource = strcat(app.TracksDropDown.Value, '.jpeg');
        end
    end
```

Component initialization

```
    methods (Access = private)

        % Create UIFigure and components
        function createComponents(app)

            % Create UIFigure and hide until all components are created
            app.UIFigure = uifigure('Visible', 'off');
            app.UIFigure.Color = [0.9608 0.8392 0.5569];
            app.UIFigure.Position = [100 100 688 754];
            app.UIFigure.Name = 'MATLAB App';

            % Create Image
            app.Image = uiimage(app.UIFigure);
            app.Image.Position = [248 423 194 272];
            app.Image.ImageSource = 'Believer-Imagine Dragons.mp3.jpeg';

            % Create TracksDropDownLabel
            app.TracksDropDownLabel = uilabel(app.UIFigure);
```

```
            app.TracksDropDownLabel.HorizontalAlignment = 'right';
            app.TracksDropDownLabel.FontName = 'Calibri';
            app.TracksDropDownLabel.FontSize = 18;
            app.TracksDropDownLabel.FontWeight = 'bold';
            app.TracksDropDownLabel.FontColor = [0.4941 0.1843 0.5569];
            app.TracksDropDownLabel.Position = [68 684 52 24];
            app.TracksDropDownLabel.Text = 'Tracks';

            % Create TracksDropDown
            app.TracksDropDown = uidropdown(app.UIFigure);
            app.TracksDropDown.ValueChangedFcn = createCallbackFcn(app,
@TracksDropDownValueChanged, true);
            app.TracksDropDown.FontName = 'Calibri';
            app.TracksDropDown.FontSize = 18;
            app.TracksDropDown.FontWeight = 'bold';
            app.TracksDropDown.FontColor = [0.4941 0.1843 0.5569];
            app.TracksDropDown.Position = [135 684 486 24];

            % Create InputTypeButtonGroup
            app.InputTypeButtonGroup = uibuttongroup(app.UIFigure);
            app.InputTypeButtonGroup.ForegroundColor = [0.4941 0.1843 0.5569];
            app.InputTypeButtonGroup.TitlePosition = 'centertop';
            app.InputTypeButtonGroup.Title = 'Input Type';
            app.InputTypeButtonGroup.BackgroundColor = [1 1 1];
            app.InputTypeButtonGroup.FontName = 'Calibri';
            app.InputTypeButtonGroup.FontWeight = 'bold';
            app.InputTypeButtonGroup.FontSize = 18;
            app.InputTypeButtonGroup.Position = [72 568 123 86];

            % Create LiveButton
            app.LiveButton = uiradiobutton(app.InputTypeButtonGroup);
            app.LiveButton.Text = 'Live';
            app.LiveButton.FontName = 'Calibri';
            app.LiveButton.FontSize = 15;
            app.LiveButton.FontColor = [0.851 0.3255 0.098];
            app.LiveButton.Position = [11 32 58 22];
            app.LiveButton.Value = true;

            % Create RecordedButton
            app.RecordedButton = uiradiobutton(app.InputTypeButtonGroup);
            app.RecordedButton.Text = 'Recorded';
            app.RecordedButton.FontName = 'Calibri';
            app.RecordedButton.FontSize = 15;
```

```
            app.RecordedButton.FontColor = [0.6353 0.0784 0.1843];
            app.RecordedButton.Position = [11 10 80 22];

            % Create PLAYButton
            app.PLAYButton = uibutton(app.UIFigure, 'push');
            app.PLAYButton.ButtonPushedFcn = createCallbackFcn(app, @PLAYButtonPushed,
true);
            app.PLAYButton.BackgroundColor = [0.8902 1 0.9216];
            app.PLAYButton.FontName = 'Calibri';
            app.PLAYButton.FontSize = 18;
            app.PLAYButton.FontWeight = 'bold';
            app.PLAYButton.FontColor = [0.4667 0.6745 0.1882];
            app.PLAYButton.Position = [72 310 100 31];
            app.PLAYButton.Text = 'PLAY!';

            % Create STOPButton
            app.STOPButton = uibutton(app.UIFigure, 'push');
            app.STOPButton.ButtonPushedFcn = createCallbackFcn(app, @STOPButtonPushed,
true);
            app.STOPButton.BackgroundColor = [0.9882 0.8824 0.902];
            app.STOPButton.FontName = 'Calibri';
            app.STOPButton.FontSize = 18;
            app.STOPButton.FontWeight = 'bold';
            app.STOPButton.FontColor = [0.6353 0.0784 0.1843];
            app.STOPButton.Position = [531 310 100 31];
            app.STOPButton.Text = 'STOP!';

            % Create PAUSEButton
            app.PAUSEButton = uibutton(app.UIFigure, 'push');
            app.PAUSEButton.ButtonPushedFcn = createCallbackFcn(app, @PAUSEButtonPushed,
true);
            app.PAUSEButton.BackgroundColor = [0.8588 0.9569 1];
            app.PAUSEButton.FontName = 'Calibri';
            app.PAUSEButton.FontSize = 18;
            app.PAUSEButton.FontWeight = 'bold';
            app.PAUSEButton.FontColor = [0.302 0.7451 0.9333];
            app.PAUSEButton.Position = [303 310 100 31];
            app.PAUSEButton.Text = 'PAUSE';

            % Create LyricsTextAreaLabel
            app.LyricsTextAreaLabel = uilabel(app.UIFigure);
            app.LyricsTextAreaLabel.HorizontalAlignment = 'center';
            app.LyricsTextAreaLabel.FontName = 'Calibri';
```

```
            app.LyricsTextAreaLabel.FontSize = 22;
            app.LyricsTextAreaLabel.FontWeight = 'bold';
            app.LyricsTextAreaLabel.FontColor = [0.302 0.7451 0.9333];
            app.LyricsTextAreaLabel.Position = [317 428 56 29];
            app.LyricsTextAreaLabel.Text = 'Lyrics';

            % Create LyricsTextArea
            app.LyricsTextArea = uitextarea(app.UIFigure);
            app.LyricsTextArea.Editable = 'off';
            app.LyricsTextArea.HorizontalAlignment = 'center';
            app.LyricsTextArea.FontName = 'Calibri';
            app.LyricsTextArea.FontSize = 22;
            app.LyricsTextArea.FontColor = [0.302 0.7451 0.9333];
            app.LyricsTextArea.BackgroundColor = [0 1 0];
            app.LyricsTextArea.Position = [64 356 562 70];

            % Create Clock
            app.Clock = uitextarea(app.UIFigure);
            app.Clock.Editable = 'off';
            app.Clock.HorizontalAlignment = 'center';
            app.Clock.FontName = 'Calibri';
            app.Clock.FontSize = 15;
            app.Clock.Position = [532 489 69 29];

            % Create ScoreTextAreaLabel
            app.ScoreTextAreaLabel = uilabel(app.UIFigure);
            app.ScoreTextAreaLabel.HorizontalAlignment = 'right';
            app.ScoreTextAreaLabel.FontName = 'Calibri';
            app.ScoreTextAreaLabel.FontSize = 18;
            app.ScoreTextAreaLabel.FontWeight = 'bold';
            app.ScoreTextAreaLabel.FontColor = [0.4941 0.1843 0.5569];
            app.ScoreTextAreaLabel.Position = [543 616 46 24];
            app.ScoreTextAreaLabel.Text = 'Score';

            % Create ScoreTextArea
            app.ScoreTextArea = uitextarea(app.UIFigure);
            app.ScoreTextArea.Editable = 'off';
            app.ScoreTextArea.HorizontalAlignment = 'center';
            app.ScoreTextArea.FontName = 'Calibri';
            app.ScoreTextArea.FontSize = 20;
            app.ScoreTextArea.FontWeight = 'bold';
            app.ScoreTextArea.FontColor = [0.7176 0.2745 1];
            app.ScoreTextArea.Position = [512 583 109 34];
```

```
% Create TimeLabel
app.TimeLabel = uilabel(app.UIFigure);
app.TimeLabel.HorizontalAlignment = 'center';
app.TimeLabel.FontName = 'Calibri';
app.TimeLabel.FontSize = 15;
app.TimeLabel.FontWeight = 'bold';
app.TimeLabel.FontColor = [0.4941 0.1843 0.5569];
app.TimeLabel.Position = [549 524 36 22];
app.TimeLabel.Text = 'Time';

% Create KARAOKELabel
app.KARAOKELabel = uilabel(app.UIFigure);
app.KARAOKELabel.HorizontalAlignment = 'center';
app.KARAOKELabel.FontName = 'Calibri';
app.KARAOKELabel.FontSize = 28;
app.KARAOKELabel.FontWeight = 'bold';
app.KARAOKELabel.FontColor = [0.4941 0.1843 0.5569];
app.KARAOKELabel.Position = [286 717 118 38];
app.KARAOKELabel.Text = 'KARAOKE';

% Create LevelButtonGroup
app.LevelButtonGroup = uibuttongroup(app.UIFigure);
app.LevelButtonGroup.ForegroundColor = [0.4941 0.1843 0.5569];
app.LevelButtonGroup.TitlePosition = 'centertop';
app.LevelButtonGroup.Title = 'Level';
app.LevelButtonGroup.BackgroundColor = [1 1 1];
app.LevelButtonGroup.FontName = 'Calibri';
app.LevelButtonGroup.FontWeight = 'bold';
app.LevelButtonGroup.FontSize = 18;
app.LevelButtonGroup.Position = [72 465 123 81];

% Create EasyButton
app.EasyButton = uiradiobutton(app.LevelButtonGroup);
app.EasyButton.Text = 'Easy';
app.EasyButton.FontName = 'Calibri';
app.EasyButton.FontSize = 15;
app.EasyButton.FontColor = [0.4667 0.6745 0.1882];
app.EasyButton.Position = [11 27 58 22];
app.EasyButton.Value = true;

% Create HardButton
app.HardButton = uiradiobutton(app.LevelButtonGroup);
```

```
            app.HardButton.Text = 'Hard';
            app.HardButton.FontName = 'Calibri';
            app.HardButton.FontSize = 15;
            app.HardButton.FontColor = [1 0 0];
            app.HardButton.Position = [11 5 65 22];

            % Create UIAxes
            app.UIAxes = uiaxes(app.UIFigure);
            app.UIAxes.Toolbar.Visible = 'off';
            app.UIAxes.PlotBoxAspectRatio = [2.32876712328767 1 1];
            app.UIAxes.FontName = 'Calibri';
            app.UIAxes.YLim = [-1 1];
            app.UIAxes.XTick = [];
            app.UIAxes.YTick = [];
            app.UIAxes.ColorOrder = [0 0.4471 0.7412;0.851 0.3255 0.098;1 0 0;0.4941 0.1843
0.5569;0.4667 0.6745 0.1882;0.302 0.7451 0.9333;0.6353 0.0784 0.1843];
            app.UIAxes.FontSize = 18;
            app.UIAxes.HandleVisibility = 'off';
            app.UIAxes.BusyAction = 'cancel';
            app.UIAxes.Interruptible = 'off';
            app.UIAxes.PickableParts = 'none';
            app.UIAxes.Position = [55 10 579 293];

            % Show the figure after all components are created
            app.UIFigure.Visible = 'on';
        end
    end

    % App creation and deletion
    methods (Access = public)

        % Construct app
        function app = Karaoke_v0_exported

            % Create UIFigure and components
            createComponents(app)

            % Register the app with App Designer
            registerApp(app, app.UIFigure)

            % Execute the startup function
            runStartupFcn(app, @startupFcn)
```

```
            if nargout == 0
                clear app
            end
        end

        % Code that executes before app deletion
        function delete(app)

            % Delete UIFigure when app is deleted
            delete(app.UIFigure)
        end
    end

end
```

Published with MATLAB® R2020b