Music Wave Comparing & String Instrument Tuning


Abstract — The Research of Music Wave Comparing & String Instrument Tuning System (MWCSITS) useful for music industry. During the research, it solves some problems in music industry. It covers common problems in music reality shows & string instrument tuning process. Research area based on Fast Fourier Transform (FFT) audio analyzing to resolve that problems. By reading through this document, you will receive an understanding of the fundamental core concepts of Music Wave Comparing & String Instrument Tuning System. In system methodology, first capture the sound wave from outside and store in database. Then retrieve sound wave from database to analyzing and plot graphs. By using Fast Fourier Transform method to analyzing sound waves. Finally produce a result that indicate the similarities and differentiates between sound waves. The generated results are impact on music apprentice and instrument players.

Keywords — Music Wave Comparing & String Instrument Tuning System, Fast Fourier Transform (FFT).

I. INTRODUCTION

Music is an art from whose medium is sound and silence. Musicians can use for own song creations how song is singing with the timing and tempo. Musicians can do light exercise before doing singing and vocal exercises. System gives natural feedback of singing. It gives how to handle correct vocal tone in the song [13].

This product is help to apprentice singers to improve singing skills by comparing with the professional singers singing ability. In reality shows, many new singers get the opportunities to enter the music industry, these apprentices singing ability is judge by a judge panel. There for some mistakes can be occurring due to human nature. For an example some song variation can be missed out.

To avoid this kind of mistakes and improve the accuracy of the judgments create a software base solution for music industry. And also currently there are no similar systems that simulate the research project. Base on above reason this research project is worth more. Firstly captures filtered original (professional singers vocal) analog vocal signal from input device (microphone) and converts to digital bit stream (sound card) [5]. Then according to the digital bit stream, generate a wave graph of amplitude vs. time using the filtered vocal [11].

Secondly input apprentice analogue vocal signals to the system. Then according to the digital bit stream, generate a wave graph of amplitude vs. time. After analysing two wave patterns, then output a percentage value how closely apprentice sing according to the correct music theorems.

The major problem in this system is separate a voice from a song. There is no any exact mechanism to achieve this goal. But there are some relevant mechanisms to separate a voice from a song. For an example, Audacity is the software tool for separate voice from a song. Audacity is a program that manipulates digital audio waveforms. Actually this mechanism cannot give correct result.

Apart from this system, there is another major approach. There is string instrument tuner for string instrument players [12]. While tuning the instrument, software will captured that analog signal and generate the wave graph. It will compare with the redefine note (particular frequency of string), which related the correctly tuned note and prepare an output how closely tuned the expected note.

II. METHODOLOGY.

1) The focus of this preliminary study was analysis and aim for apprentice singer of actual singing behaviour. There are two major tasks in proposed solution.

a) Sound wave analyser.

b) String instrument tuner.

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A. SOUND WAVE COMPARISON AND ANALYZING FUNCTION.

a) Capture the sound from the apprentice vocal and professional singers vocal. Then store the database as a .wav file.
b) Plot the graphs for each vocal.
c) Analyse the waves and compare the both sound waves.
d) Generate a result (How closely related both the sound waves are).

![Diagram](image1)

Figure 1. System Architecture.

2) CAPTURE THE AUDIO VOICE AND CONVERT THAT VOICE INTO A MACHINE READABLE WAY.

The main outcome of this project is comparing two waves. To achieve that goal, system must firstly capture the vocal sound from the outside as an input. Whole approach is based on capture the only voice signal from the singer and converts that analog audio signal to digital signal and save this digital signal as a .wav file in a database. There is a very complex process behind this concept [5]. Software provides a sound recorder to capture audio signal. Important thing is separate voice and music from original song. For achieve that want to use special technique. This proposed system do not provides a function for that. User must input only vocals to this system. Otherwise problems can be occurred in final result.

3) PLOT THE GRAPHS FOR EACH SOUND WAVE.

When captured the voice from recorded music, then plot the graphs according to original sound .wav file and recorded sound .wav file. Fast Fourier Transform (FFT) algorithm [7, 16] is used for plot these two wave graphs. Input two .wav files to the FFT algorithm. Then the FFT algorithm divides this wave files in to large number of samples. Sample rate and frequency decide according to vocal sound. If sample rate is high, then results are very much accurate. If the samples are large means, the graphs are very sensitive.

FFT algorithm gets the frequency for each divided samples [8, 10]. According to these frequencies, FFT algorithm plots the graphs [6]. Frequency (Hz) gets to the y axis and time (milliseconds) get to the x axis (Refer Figure 2).

In the FFT algorithm, have some mechanism for get the frequencies from .wav file.

![Diagram](image2)

Figure 2. Plotted two different vocals.

4) ANALYZE THE SOUND WAVES AND COMPARE BOTH SOUND WAVES.

In here use special software tool called MATLAB [6]. FFT algorithm is using inside the MATLAB [2, 6]. When input two sound waves to the FFT algorithm, it will divide the .wav file to samples (Samples per second). After that want to get the different between these two waves according to that samples [14]. Therefor get the correlation of these waves according to the samples [3].

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1  \omega_{i,w} \leftarrow \text{waveread}(i) \quad i \in \omega_{i,w}
2  t_i \leftarrow \text{timespan}(\omega_{i,w})
3  s \leftarrow \min(t_i)
4  k = s / n \quad \triangleright \quad \text{no of devides}
5  \text{for } i,j = 1:8
6     v_{ij} = \max(i,k)
7     [\omega_{ij}, f_{ij}] \leftarrow \text{waveread}(\omega,v_{ij})
8     [w_{ij}, f_{ij}] \leftarrow \text{waveread}(w,v_{ij})
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\[ \text{fft}(\omega_{ij}) \quad \text{wfft}(w_{ij}) \quad R_j \leftarrow \text{correlation}(\text{fft}(\omega_{ij}), \text{wfft}(w_{ij})) \quad R_j \in \mathbb{R} \]

A Fast Fourier Transform (FFT) is an efficient algorithm to compute the Discrete Fourier transform (DFT) and its inverse. Above algorithm is used for achieve this analytical goal.

5) GENERATE A PERCENTAGE VALUE AS A RESULT. (HOW CLOSELY RELATED BOTH THE SOUND WAVES ARE)

This scenario is the most important factor of the research. There is a facility to generate percentage value to user. To get this percentage value, compare the correlation value time by time. Compare correlation values and assign some average values. For an example, if get a correlation value closer to 1, then system decides 100% average mark. System shows, apprentice singing ability is 100% accurate according to that correlation value [3]. This rating system is depending on correlation value of between two wave signals [15].

B. STRING INSTRUMENT TUNNER.

1) Capture the Sound signals from a string instrument.
2) Generate the Wave for the input sound.
3) Generate the Wave for prerecorded sound signal.
4) Analyze and comapare the two waves.
5) Generating the Results.

1) CAPTURE THE SOUND SIGNALS FROM A STRING INSTRUMENT.

The instrument sound signals are collected by the microphone and lead to the sound card. Inside the sound card it is converted into series of digital pulses (bit stream) [5], which eventually are saved in a file (small .wav file which holds a digital recording of the sound which reached the microphone). To achieve this goal the system will take samples from input stream. A sampling is analog-to-digital conversions that take place in sound card [5]. The number of kilohertz tells how many thousand times per second the sound will be recorded. Record the sound by sampling many times per second. The more frequently it is done, the better quality user can get. This proposed software application will give the facility for the user to select the sample rate that the user required.

2) GENERATE THE WAVE FOR THE INPUT SOUND.

Audio analog to digital converters work by repeatedly measuring the amplitude (volume) of an incoming electrical pressure soundwave (an electrical voltage), and outputting these measurements as a long list of binary bytes [1]. In this way, a mathematical "picture" of the shape of the wave is created. When the bit strem is in put to the software it will generate a graph that represent a sound signal captured from a string instrument.

3) GENERATE THE WAVE FOR PRERECORDED SOUND SIGNAL.

The properly tuned guitar sounds are prerecorded and stored inside the system database. When the user need to tune a specific string, user must select the instrument tone [12]. According to the instrument type user must select the string number going to tune. As the next step user must select the tuning type. Then the system will automatically generate the sound wave for the user selected tone. Using both create sound wave system can move to the Analyzing part of the sound waves.

4) ANALYZE AND COMPARE THE TWO WAVES.

So far system generate two sound waves according to the its original sound. In this stage the system is going to compare those two waves each other and generate a result how closly two waves are related. In the previous step we take guitar tuning as the example (Standard guitar tuning) [4]. When the guitar is properly tuned the system will generate a two wave appear like same. in that situation system will simply search for similar byte patterns inside the two wav files.
But it is not enough to say that the two sound waves are similar or not.

5) GENERATING THE RESULTS.

After analysing the two waves system will generate a result as a percentage value. This percentage value indicates how closely instrument is tuned to the actual tuning tone. If the value is close to the 100% then the instrument is properly tuned otherwise user can decide how to change the string tension to get a proper tuned instrument. To generate the results the system will use a third party tool (MATLAB) [6, 9]. This will apply the FFT to the two wave files (.wav) and do the sampling in the both the wav files [10, 16]. Then it will calculate the correlation value of the both the graphs [3, 15].

III. RESEARCH FINDINGS.

The main research goals of project Music wave comparison & string instrument tuning system is to develop a system that can be used in the music industry that provide many facilities to the musicians and string instrument players. This project is worth doing, because many people can get advantages by using this software. People who getting benefits from this software,

1. Beginners can self-improve their singing ability.
2. If the competitors song that belong to another musician. Then, they can check their singing melody (pitch, rhythm, dynamic) with the original singer’s melody. In this way beginners can self-improve their singing ability.
3. In a singing reality shows, judges can take their decisions accurately and easily by using this system.
4. Music preceptor can use system features for music activities.
5. This system gives the facilities for instrument players. Instrument players can tune their string instruments by applying this software.
6. To operate the string instrument tuner user not required any experience or knowledge about tuning an instrument can tune the instrument very efficient and simple way.

IV. CONCLUSION & FUTURE WORKS.

MWCSITS mainly focus on introducing a software application that can be used in music industry. It can be easily adapted to music industry and its entities, education, Training and Tuning to provide many valuable services with low cost with high efficiency and scalability. The ability to use the components with very easy, user-friendly and interesting way. Other than the mentioned advantages it has more feature that user can use experience and feel the music. Music wave comparison & string instrument tuning system also inherit the services that provide by the currently available products and provide a much user friendly features than existing systems provided to the user. A successful implementation and continuation of this software application is expected to introduce new training and education behaviours to the music industry. And Performance is very important when talking about singing evaluation and the string instrument tuning. The quality and the performance of the result generating is the main factor of a software performance. Major performance improvements should be considered when developing the musical wave analysing functionality, since several singers use the software at the same time it is connected with database to store and retrieve singer’s details when needed. Other than the singers’ information’s instruments details and corresponding tones also stored inside the database for efficient performance of the software application and user must have the ability to install user applications easily and without errors to the windows base computer. The background service functionality is developed in a way that every possible windows operating system supports. The presented system can be improved in following ways.

1. Can add the background music removal function.
2. Add song pitch checking function.
3. Add facility to check the rhythm of the song.
To achieve above mentioned future goals this research project covers the most of the basic theorems. Based on current implemented components future references can extend the current system.

REFERENCES


