Progress in Engineering Application and Technology Vol. 3 No. 1 (2022) 479–484

PEAT

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/peat
e-ISSN : 2773-5303

Singing Pitch Guide for Multiple Voice Pitch Offset Detector

Muhammad Hariz Azizan[1], Amirul Syafiq Sadun[1]*, Nor Anija Jalaludin[1]

[1]Department of Electrical Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 84600 Pagoh, Johor MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/peat.2022.03.01.048
Received 17 January 2021; Accepted 11 April 2022; Available online 25 June 2022

Abstract: Singing is a beautiful piece of art but singing without proper technique can be miserable to hear. A lot of people love to sing but not everyone has good skills to control their voice pitch in singing. Therefore, this research presents the works in designing and developing the voice pitch analysis system to assist singer to train their ability to control their voice pitch. Three volunteers who like to sing were inquired to do a test on the system which analyze voice pitch to see whether they will have an improvement after they start using the system. The results obtained shows that the ability of the volunteers to control and produce the right voice pitch are improved. Wider octave detection is recommended for further improvement.

Keywords: Voice, Pitch, Frequency

1. Introduction

As a singer, singing in the right pitch is one of the most important things to master. Learning and teaching how to sing has always been a challenge as it is one kind of knowledge that hardly shown by visual and cannot be written into books as a reference. Learning and teaching singing needs someone with good listening capabilities. But not everyone has the ability to compare the pitch of a sound and produce the pitch that are supposed to produce by the vocal cord.

1.1 The Function of Pitch in Music

Pitch is very important in music as everything that has melody, harmony, scales, and chords starts with pitch [1]. Voice and instrument are a sound wave and pitch are how the human ear hears and understand the frequency of the sound wave. The higher the frequency, the higher the pitch and the lower the frequency, the lower the pitch. When someone say a note is higher or lower than another note, it means that the note is higher or lower in frequency than the other note. Note is a pitch in music with a specific name and frequency. Pitch can be for any types of waves not just in music or singing. Pitch

*Corresponding author: amirul@uthm.edu.my

is the term of “high” or “low” the notes are. Pitch can be measured in terms of Hertz (Hz) or notation on a musical staff.

1.2 Frequencies of Musical Notes

The article by [2] shows the measured frequency value of all the musical notes from the first octave to the ninth octave. However, musical notes in octave three is chosen for the project because it has the range of frequencies which human can produce. Men can produce lower voice pitch or frequencies compared to women which belongs to the higher lower octaves and vice versa.

Table 1: Chord frequencies in third octave with 10 Hz of tolerance

Note	Frequency (Hz)
C3	130.81 ± 5
D3	146.83 ± 5
E3	164.81 ± 5
F3	174.61 ± 5
G3	196.00 ± 5
A3	220.00 ± 5
B3	246.94 ± 5

1.3 Microphone Polar Patterns

Selection of microphone is important because a microphone comes with various type of polar patterns. Microphone polar patterns is the sensitivity of the microphone acquiring signals from different angles. There are several types of microphone polar patterns. Dynamic microphone has a cardioid polar pattern which is ideal for the application on stage and the project. Cardioid polar patter will help to eliminate background noises. However, in order to acquire voice signal using microphone with cardioid polar pattern, the user need to remain close to the microphone in order keep their voice in range within the microphone.

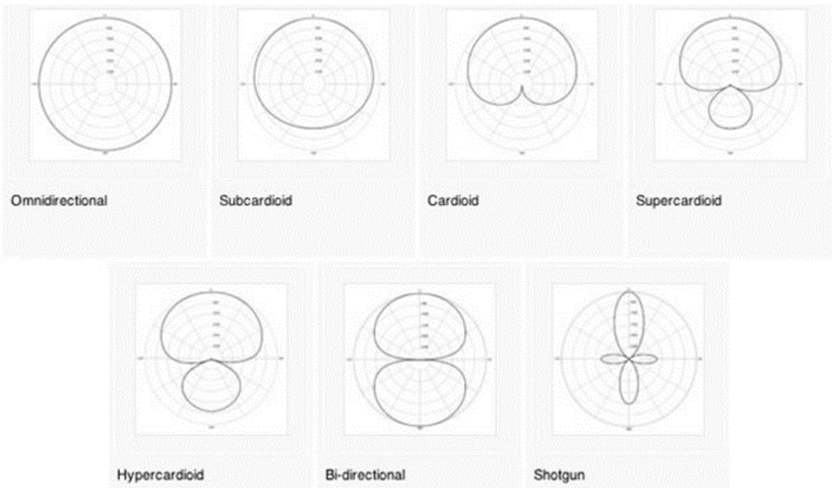

Figure 1: Microphone polar patterns [3]

2. Materials and Methods

This chapter discuss about the general block diagram, experimental setup and testing and analysis to explain the methods that have been used in the making of this project.

2.1 LabVIEW Block Diagram

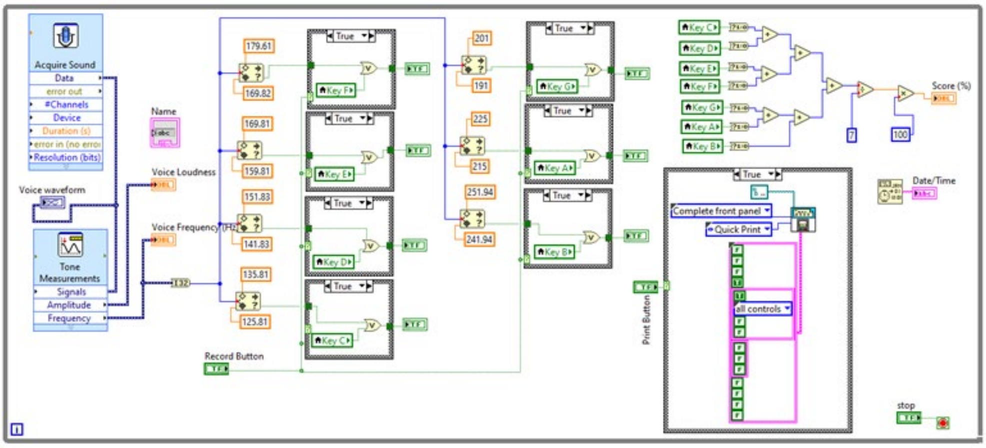

Figure 2: LabVIEW block diagram

The LabVIEW block diagram in Figure 2 is designed into four main functions which is signal acquiring, key identification, score calculation and print to pdf function. There will be a total of seven key detections which is key C, key D, key E, key F, key G, key A and key B.

2.2 LabVIEW GUI Panel

The LabVIEW GUI panel in will be used by the user to control the program function. It is designed to be user friendly to enhance user experience.

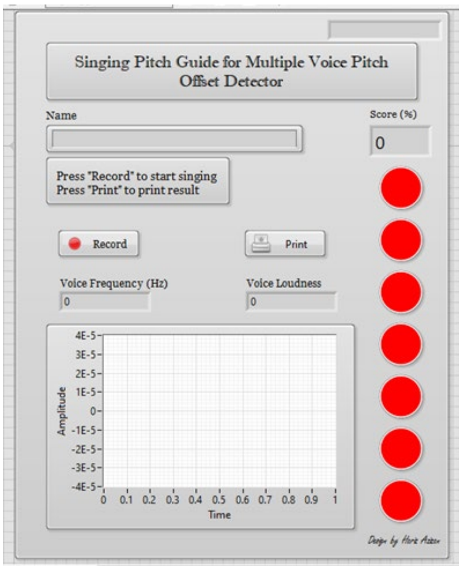

Figure 3: LabVIEW GUI front panel

Starting from the top left corner on Figure 3 will be the date and time of the training session. Below the date is the title of the project so that the user aware of the software function. There will be a specify space for the user to fill in their name under the title for progress report purposes. On the right side of the user's name will be the score value of the training session which will be in a percentage of 100. The guideline to run the software is located below the user's name so that the user knows how to operate the software. The button to start recording is located below the software guideline. The user needs to press the record button to start their singing attempt. There will be a dedicated button to print the result in PDF format on the right side of the record button for tracking the user's progress. User can monitor their voice frequency and amplitude (loudness) output so that they know their voice level. Their voice frequency and amplitude will also be show in graph format as visual indicator. The right side of the panel is a row of LEDs with assigned musical key from C to B. The LED will light up and hold it condition every time the user hit the assigned pitch (frequency). The LED will only turn off when the recording button is pressed once again after the singing attempt has finished.

2.3 In range and coerce block

The sound wave is measured by tone measurements block before key identification process. Using the in range and coerce block in Figure 4, the input sound signal frequency will be classified to the frequency range that has been assigned to the block. For example, the in range and coerce block in key C detection will be set as 135.81 Hz as the upper limit and 125.81 Hz as the lower limit. 10.00 Hz of tolerance is set based on the frequency of the key. The delay respond time to detect each key measured is 500 ms. The in range and coerce block is assigned to detect all 7 musical keys based on Table 1.

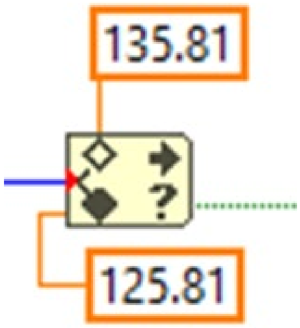

Figure 4: In range and coerce block

3. Results and Discussion

The results and discussion section present data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

3.1 Sampling for Reliability Test Using Frequency Sound Generator

Frequency Sound Generator can produce a constant sound output and it is available for free in Google Play Store. From the observation on the accuracy of sensor acquiring the data, the acquired results show that the LabVIEW able to measure the frequency with tolerable accuracy when compared to the frequency signal set on the Frequency Sound Generator app.

Figure 5: Frequency Sound Generator producing a 130.81 Hz of sound wave

In order to ensure that the software is reliable to use in terms of consistency in measuring voice pitch, Frequency Sound Generator is used to produce constant sound wave frequency output for the software to measure and analyze. The reliability test is done with five repetitions on key C (130.81 Hz) as shown in Figure 5. The value of Frequency Sound Generator frequency output and the frequency reading on the LabVIEW GUI is recorded. The test finds out that the LabVIEW GUI recorded accurate results and reliable to use

3.2 Test on Guitar Strings

Guitar strings however will be a little bit different compared to the sound signal output provided by the Frequency Sound Generator app as it is not as consistent and the Frequency Sound Generator app sound signal output. The guitar has been used is a basic Yamaha F310 equipped with an Elixir 1047 extra light strings. All the six guitar strings have been tuned using GuitarTuna app from Google Play store. The goal of this test is to get a measurement close to the tuned guitar string's frequencies by referring to string frequencies of standard tuning. After all the six strings of the guitar has been tuned according to the standard tuning, the sound waves acquired will be measured using LabVIEW and compare the results to standard tuning. To avoid any unwanted noise from interrupting the sound waves needed, the data is taken in a partially isolated room inside a laboratory. Take note that the measurement obtained does not need to be 100.00 % accurate as there is a tolerance in guitar tuning.

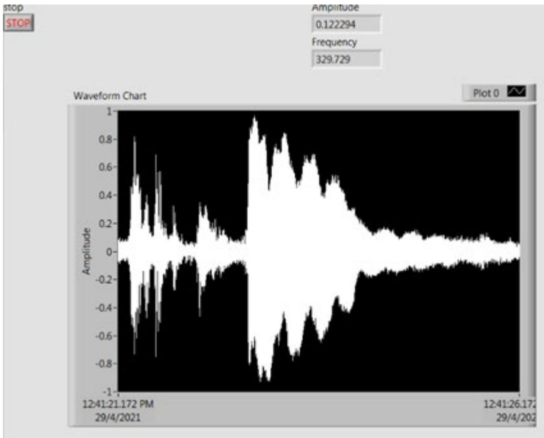

Figure 6: String 1 (E4) pitch reading on LabVIEW

The reading taken for String 1 (E4) is 329.729 Hz compared to 329.63 Hz on Figure 6 which only off by a 0.099 and the measurement taken is accepted.

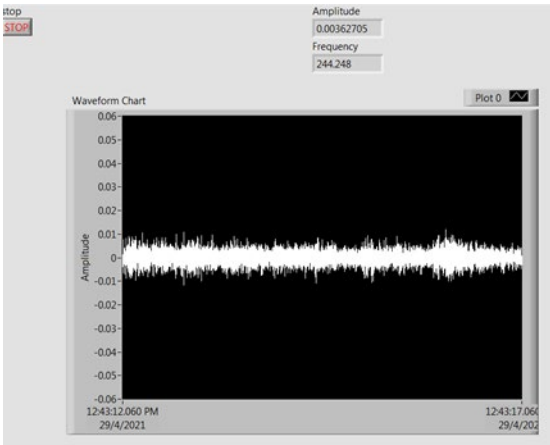

Figure 7: String 2 (B3) pitch reading on LabVIEW

The reading taken for String 2 (B3) is 244.248 Hz compared to 246.94 Hz on Figure 6 which only off by a 0.692 Hz and the measurement taken is accepted.

3.3 Functionality test

This test is constructed to observe whether the LabVIEW GUI make the subjects having an improvement in terms of singing in the right pitch. Three male subjects are selected to make five singing attempts using the LabVIEW GUI. The subjects are not allowed to redo the attempt that have been done to get accurate result. The scores of the subject attempt are recorded in the table below. Take note that the test is done continuously so that the subjects can get the idea of controlling their voice pitch during earlier attempts.

Table 2: Subject test scores (limited to 5 attempts)

Subject	Attempt 1	Attempt 2	Attempt 3	Attempt 4	Attempt 5
1	57.14 %	57.14 %	57.14 %	85.71 %	85.71 %
2	28.57 %	57.14 %	28.57 %	71.43 %	85.71 %
3	42.86 %	28.57 %	85.71 %	71.43 %	100.00 %

Table 1 shows that there is a significant improvement in terms of scoring for all the subject test scores. This indicates the improvement of the subject ability to control their output voices.

4. Conclusion

The LabVIEW GUI can measure user voice output frequency and there is a significant improvement shown by the user in terms of their scoring in every training session. Once the users can get used to the sounds that he/she produced, they are able to control their output voice frequency better compared to the earlier attempts. To be concluded, the software does improve the users' singing capabilities as they learned to control their voice output frequency by using the LabVIEW GUI.

Acknowledgement

This research was made possible by funding from research grant number H521 provided by the Ministry of Higher Education, Malaysia. The author would also like to thank the Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia for its support.

References

[1] S. Chase, "Hello Music Theory," Hello Music Theory, 8th October 2020. [Online]. Available: https://hellomusictheory.com/learn/pitch/. [Accessed 2 6 2021]

[2] Michigan Technological University. (n.d.). Tuning. Retrieved from Physics of Music Notes: https://pages.mtu.edu/~suits/notefreqs.html

[3] M. Ottewill, "Planet of Tunes," Planet of Tunes, [Online]. Available: http://www.planetoftunes.com/sound-recording/microphones.php. [Accessed 10 6 2021].