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Self-tuning tanpura: an electronic tuning module to aid the usage of natural tanpura among students of Indian classical music

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Abstract

Indian classical music has the concept of ādhāra ṣaḍja, the tonic note. Tanpura, a drone instrument, provides this ādhāra ṣaḍja on which the melodic rāga framework is developed. The influence of technology has had positive and negative impacts on the students of Indian classical music. Particularly, with the invention of electronic and digital versions of tanpura, the usage of the natural tanpura among students has been declining over generations. As established by scientific research, the rich tone of the natural tanpura is due to multiple harmonics and subjective tones generated, which an electronic tanpura cannot accurately reproduce. Therefore, the natural tanpura is preferred by traditional musicians. However, using the natural tanpura poses a challenge of manual tuning of the strings which requires skill that gets better only with experience. Research survey suggests the inability of a student in tuning the tanpura as one among the primary causes for the decline in its usage. This paper aims to propose an electronic self-tuning module that can be coupled externally to a natural tanpura. This module shall tune the strings of the tanpura automatically for a given ādhāra ṣaḍja. Thus, the study would facilitate tuning of the natural tanpura easily, thereby leading to its increased usage among the student community of Indian classical music.

Keywords : Self-tuning tanpura, Tanpura tuner, Electronic tanpura, Automatic Tanpura tuner, Digital tanpura

Research Paper

Introduction

Indian Classical Music is predominantly rooted and structured upon the concept of ādhāra ṣaḍja. Because of this, tanpura plays an important role among all the instruments in Indian music as it provides the basic platform upon which the rāga music is developed. Considering practical constraints yet keeping up the usage of natural tanpura has always been a study of research, and the result of which several variants of the natural tanpura viz., foldable tanpura,[1] box tanpura,[2] or smaller sized tanpura[3] were developed and are in use today (Levy).

With globalisation, Indian classical music has been able to reach the far ends of the world. Because of this, there has been an ever increase in demand and rather a need for tanpuras across the student community pursuing Indian classical music. With advancements in technology, various alternatives to natural tanpuras were developed to aid the musical journey of these students such as the electronic tanpura, later the digital variants and then the software applications. This study explores and describes the usage of tanpura among the students. Further, the study proposes a novel idea, design, and process of creating a self-tuning tanpura with an aim to increase the usage of natural tanpura among the student community pursuing Indian classical music.

Objectives

- To explore and describe the usage of natural and electronic tanpura among the students of Indian Classical Music
- To propose an electronic self-tuning module that can be coupled externally to a natural tanpura

Scope and limitation

- The online survey employed for this study is restricted to the usage of natural and electronic/ digital tanpura among the students pursuing Hindustāni and Karnāṭaka classical music
- The focus of the study is on proposing the idea, design, and procedure of developing an electronic self-tuning module for natural tanpura
- The survey is limited by the integrity of students in responding to the survey

Methodology

This study is exploratory and descriptive involving quantitative and qualitative approaches. The study initially employs a descriptive survey method to quantitatively analyse the usage of tanpura among the students pursuing Hindustāni and Karnāṭaka classical music. As a result of the survey, the study explores the gap between the usage of natural and electronic tanpura, further qualitatively focussing on proposing the idea and design of electronic self-tuning module for natural tanpura.

Survey

A descriptive survey was conducted among the students pursuing Hindustāni and Karnāṭaka classical music. The sample considered was random in nature to avoid bias in the data collected through the survey. This anonymous survey received data across various age groups as shown in Figure 1.

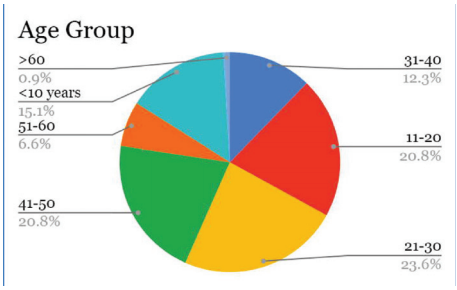

Figure 1: Age groups of the survey respondents

The questionnaire designed for the survey involved multiple-choice questions. The aim of the survey was to quantitatively analyse the below parameters and the following results were obtained:

i. The kind of tanpura used by music student

The student was prompted with three multiple choice options whether he/she used a natural tanpura, electronic tanpura or both. Figure 2 provides information about the percentage usage of the above-mentioned types. It is prominent to note that 73.6% of students pursuing Indian classical music use only electronic tanpura.

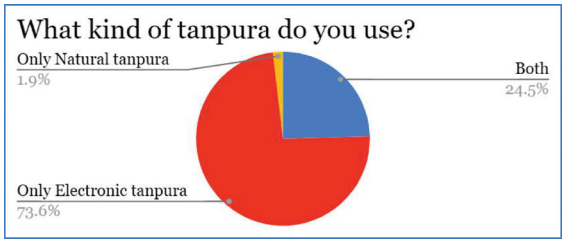

Figure 2: Types of tanpura used by students of Indian classical music

ii. If student can tune a natural tanpura

The student was prompted with two multiple choice options whether he/she can tune a natural tanpura. Figure 3 provides information about the percentage of students who can tune a natural tanpura. It is prominent to note that 67% of students pursuing Indian classical music cannot tune a natural tanpura.

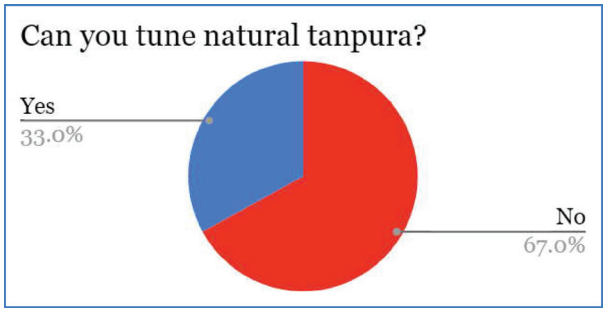

Figure 3: Percentage of students learning Indian classical music who can tune natural tanpura

iii. Assistance in tuning and training

The student was prompted with multiple choice options if he/she feels that assistance in tuning a natural tanpura and the related training shall lead to the increased usage of tanpura. Figure 4 provides information about the same.

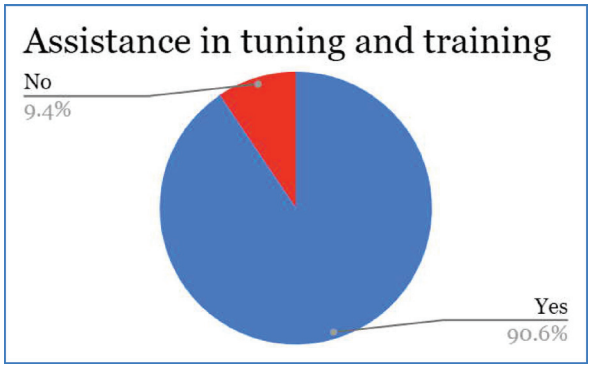

Figure 4: Percentage of students learning Indian classical music who feel the need for assistance in tuning and training of a natural tanpura

In a snapshot, there are 3 prominent take-aways from the above survey

1. 73.6% of students use only electronic tanpura
2. 67% of students do not know how to tune a natural tanpura
3. 90.6% students have responded that assistance in tuning a natural tanpura and the related training shall lead to the increased usage of tanpura.

So, in just around 50yrs of its invention, the influence of the electronic tanpura on students can be evidently

observed. It is high time that the music gurus, researchers, and teachers introspect and raise questions whether we are moving in proper direction, by keeping students away from natural tanpura!

Discussing the importance of natural tanpura, B. C. Deva describes, "Harmonics which have nodes at the point of plucking are also produced in the strings of tambura, thus giving rise to a very rich series of harmonics not usually present in any of the common stringed instruments. In the case of the tambura, it has been shown that there are thirteen different tones in the physical spectrum. Each of these will give rise to many combination tones with every other tone in the spectrum, besides its own aural harmonics (together termed as subjective tones). Thus, tambura has proved to be an excellent drone, by its emphasis of the tonic and the creation of a very rich tonal background" (Deva).

Here are the views of certain other esteemed scholars and musicians regarding the usage of tanpura. According to N. Ramanathan, "The fundamentals and the harmonics in a tanpura produce combination tones in the ear, called aural harmonics, creating a tonal platform which for an artist is more a melodically ornamental support than just a life support" (Ramanathan). According to Martin Spaink, "Tanpura does not provide only fundamentals but that which enhances the character of the chosen raga. Continuous usage of synthesized tanpura will ruin the true artistic nature of Music, as it spoils our sense of hearing and perception" (Spaink). According to Antara Chakravarthy, ''आज के समय में विद्यार्थी वर्ग सरल होने के कारण इलेक्ट्रॉनिक उपकरणों का ही प्रयोग अधिक कर रहा है जिससे बहुत से विद्यार्थियों को मैनुअल तानपूरे को मिलाना तो दूर उसे छेड़ने के तरीके का भी ज्ञान नहीं हो पा रहा है।''(Chakravarthy). Sanjoy Bandopadhyay mentions, "I wonder if anybody disagrees with the richness of tone that we get from a nicely tuned Tanpura. But you require a pair of trained ears to do it. The electronic machine is good for those who don't have such master ears" (Bandopadhyay). According to T. M. Krishna, "In the internal absorption of the natural tanpura's resonance, the music happens. The practice of substituting the tanpura by electronic devices also in the classroom has worked to the detriment of śruti" (Krishna).

So, when the prominence of the usage of natural tanpura is known, and from Figure 4 when 90.6% of students have responded that they need assistance in tuning the natural tanpura, then can technology not be used only to resolve the above issue? Rather than replacing the complete natural tanpura with an electronic variant? This thought further lead to the idea and design of an electronic self-tuning module that can be coupled externally to any natural tanpura.

Electronic self-tuning module

The manual procedure of tuning a natural tanpura follows a three-step process viz., to capture the sound from tanpura, analyse the deviation from the required pitch, and to rotate the tuning pegs until the tanpura is accurately tuned. The below Figure 5 shows this process of manual tuning of a natural tanpura.

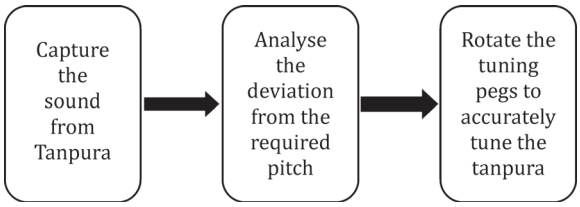

Figure 5: Manual process of tuning a natural tanpura

The electronic module (discussed in further sections) aims to create a stand-alone self-tuning module which can be coupled externally to any natural tanpura. This module takes frequency (pitch) input from the strings, measures the deflection from the required pitch and accordingly directs the motor which then shall turn the tunings pegs until the string is tuned to the required pitch. The aim of developing this module is to assist the students of Indian classical music in tuning their natural tanpuras during their training period. It can also be utilised by artists to reduce the time of manual tuning during concerts.

Block diagram

The block diagram of the electronic self-tuning module for tanpura is shown in the Figure 6. The entire tuning system can be divided into various stages viz. user input, tanpura string, microphone, amplification, filter, frequency analyser, micro-controller, servo motor and tuning pegs.

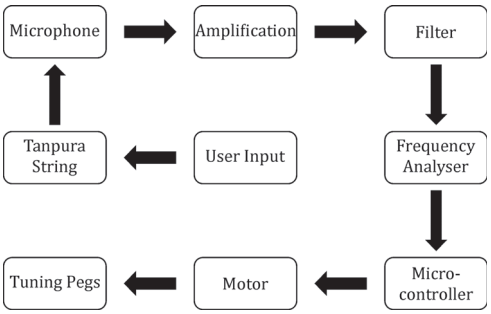

Figure 6: Block diagram of the electronic tuning module for tanpura

- **User input:** In this stage, the user provides input regarding the pitch of the ādhāra ṣaḍja to which the tanpura must be tuned. The user also provides an input of the svara to which the first string of the tanpura must be tuned i.e., pañcam, madhyam, niṣād, or ṣaḍja.
- **Tanpura string:** In this stage, the user plucks the strings of the tanpura.
- **Microphone:** In this stage, the sound from the strings will be captured by an electret microphone that converts the mechanical sound waves into electrical signals.
- **Amplification:** This stage amplifies the signals received from the microphone to make sure no frequencies are being lost.
- **Filter:** This stage will filter the unwanted frequencies to eliminate the harmonics, overtones, and noise frequencies that have been captured from the microphone, depending upon the cut-off frequency pre-decided for a particular tanpura string.
- **Frequency analyser:** This stage converts the filtered analog signal into digital signal so that it can further be understood by the micro-controller for processing.
- **Micro-controller:** In this stage, the input signal is analysed w.r.t the deviation of the pitch of the tanpura string from the desired pitch to be tuned, based on the user input. Accordingly, a Pulse Width Modulated signal is directed to the motor.
- **Motor:** This stage receives the signal from the microcontroller and accordingly actuates the tuning mechanism of tanpura by physically rotating the tuning pegs, thereby adjusting the tension of the tanpura string, due to which the pitch of the string is adjusted.

Self-tuning process

While Figure 6 displays the various stages involved in the design of the electronic self-tuning module, the step-by-step process of the working of this module is as follows:

- Step 1 - Provide inputs for the pitch of ādhāra ṣaḍja and the svara of the first string
- Step 2 - Play the string required to be tuned
- Step 3 - Capture the vibrations of the string through microphone
- Step 4 - Amplify the signal
- Step 5 - Convert voltage to frequency
- Step 6 - Filter the undesired frequencies
- Step 7 - Detect the fundamental frequency of the string
- Step 8 - Measure the frequency deviation w.r.t. the required frequency to be tuned
- Step 9 - Convert the frequency deviation value into PWM signal required to direct the motor
- Step 10 - Send the value to the motor
- Step 11 - The motor turns the tuning pegs accordingly
- Step 12 - Repeat steps 3 to 11, until the string is tuned to the required frequency
- Step 13 - Follow steps 2 to 12 for the other strings of tanpura

Summary

This study has two prominent segments viz. Survey on the usage of tanpura and proposal of an electronic self-tuning module. The survey on the usage of tanpura among the students of Indian classical music reported major findings as below:

1. 73.6% of students use only electronic tanpura
2. 67% of students do not know how to tune a natural tanpura
3. 90.6% students have said that assistance in tuning a natural tanpura and the related training shall lead to the increased usage of tanpura.

Further to this, the study analyses how technology, particularly electronics could be employed to resolve the issue of tuning a tanpura. Proposal of an idea, design, and the detailed working procedure of the self-tuning electronic module has been described to aid the usage of natural tanpura among the students pursuing Indian classical music.

Acknowledgements

The researcher would like to express gratitude towards his father Sh. Arun Dani for initiating an idea of blending music and technology which further lead to this study. The researcher would also like to thank his supervisor Dr. Arati N. Rao for the interesting discussions.

Footnotes

1. https://www.musiciansmallusa.com/r-a-sitarmaker-female-tanpura-folding-2-piece/
2. https://www.indiamart.com/proddetail/box-tanpura-indian-musical-instrument-4-string-tambura-tanpuri-with-padded-bag-24906901912.html
3. https://www.youtube.com/watch?v = AsXDTUF0bDQ & ab_channel=MusicalBazaar

4. "When two tones of sufficient strength reach the ear, tones having the frequencies of mh±nl are also generated in the ear, where h and l are the two tones and m and n are integers. For instance, if two tones of frequencies 100 and 200 are the two primary tones, then the tones generated are 100 + 200 = 300, 2x 100 + 200 = 400, 100 + 2 x 200 = 500, etc. (summation tones) and 200 - 100 = 100, 2x200 - 100 = 300, etc. (difference tones). Such tones, both summation and difference, are called the combination tones." (Deva)
5. "If a tone 'f' of sufficient intensity falls on the ear, the auditory mechanism reports not only 'f' but tones of frequency 2f, 3f, 4f, and so on. These are called the aural harmonics." (Deva)
6. Pulse Width Modulation (PWM) is a control mechanism that outputs signals in analog format from digital devices like microcontrollers.

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