An Analytical Study of the Folk Musical Instruments of North-Eastern Part of India

THESIS

Submitted in the partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

by

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Under the supervision of

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Dedication

To:

God Almighty,

My Parents,

My Sisters and Brothers-in-law,

My Brothers and Sisters-in-law,

Loving Wife,

Little Rakhi, Abhipsa, Titikshya, Anviksha, Adriti & Debanka

and

Best friends,

Along with all hardworking and respected

Teachers,

who instilled in me perseverance and commitment and relentlessly encouraged mr to strive for the excellence

BIRLA INSTITUTE OF TECHNOLOGY& SCIENCE
PILANI-333031 (RAJASTHAN) INDIA

CERTIFICATE

This is to certify that the thesis entitled, **"An Analytical Study of the Folk Musical Instruments of North-Eastern Part of India"** submitted by **Mr. Joyanta Sarkar**, ID No. **2019PHXF0103P** for award of Ph.D. of the Institute embodies original work done by him under my supervision.

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ABSTRACT

North Eastern India has a wide range of musical instruments, including variety of wind instruments, string instruments, and percussion instruments. The North East's musical abilities can also be seen in their inventiveness in creating unusual and original musical instruments such as percussion, tabla, flutes, mouth-organs, clarinets, harmoniums, guitars, trumpets, fiddles, Jews-harps, leaf instruments, and many more. A careful examination of these devices shows yet another aspect of people's relationship with nature. Nature encourages them and also provides them with the tools they need to make these instruments. This thesis discusses the main features of the performance of Folk Instrumental Music (FIM). In public concert the instruments belonging to the North Eastern part of our country address different components of the FIM conducted. The research will include the new and unknown instrument of the North Eastern Part along with the usual instruments which are commonly not popular and concealed from the outside world. The research also examines the components historically recommended by FIM performers and the results provided by music in performances such as raga mood, tranquilly, scalability and astonishments. We will discuss about the Shape, Size, Structure, body mechanism, range, mathematical applications and the utilitarian values of Saroj Veena, Tipara Flute, Sumui and all other instruments of the area. Finally, we suggest an NSGA-II-based northeast folk music recommendation system based on user interest, popularity of an instrument and total cost.

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Joyanta Sarkar

Abbreviations

LSHD	Laced Single-Headed Drums
LDHD	Laced Double-Headed Drums
WLD	Wedge-Laced Drums
STD	Screw-Tensioned Drums
TFW	Terminology of Flutes and Whistles
EBF	End-Blown Flutes
TFR	Transverse Flute at a Right-angle
TBA	Thigh-Bone Trumpet
FMRS	Folk Music Recommendation System
G-POP	Greedy Most Popular
G-RAND	Greedy Random
G-NEAR	Greedy Near
RLE	Real-life Evaluation
CMP	Crossover and Mutation Process
SDE	Shawm and drum ensembles
SCT	Split-bamboo concussion tube
SAH	Struck animal horn

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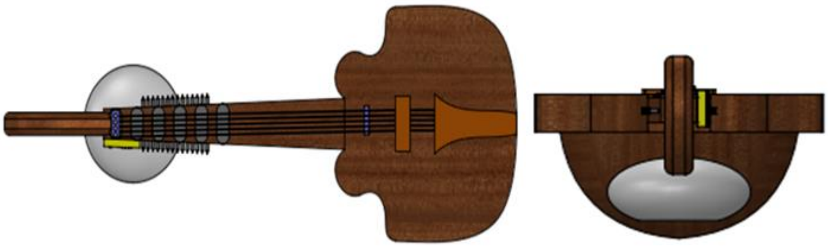
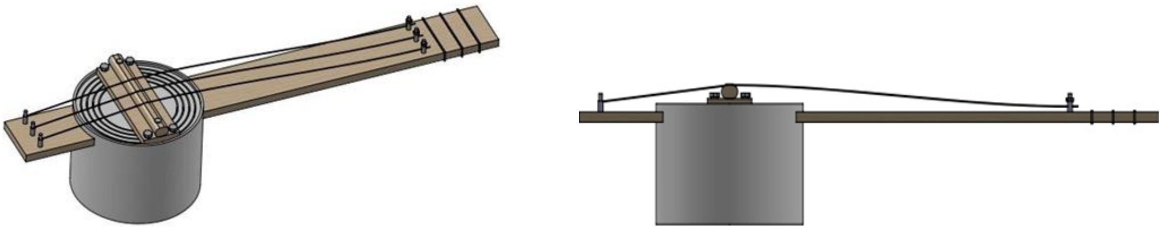


AI based Musical instrument (Saroj Veena)



Tripuri Folk Guitar

Tipara Guitar

Rameshwar Veena

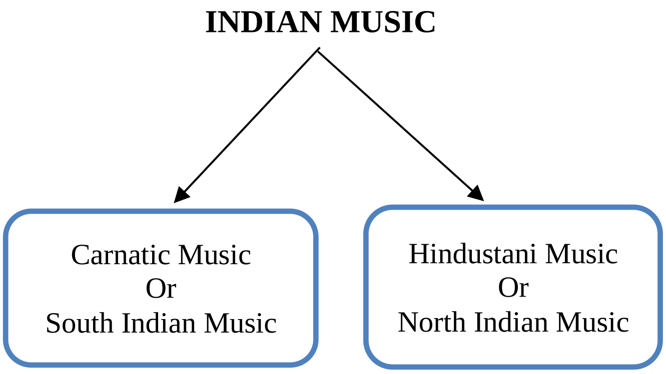
Tripureshwari Guitar

Chapter 1

Introduction

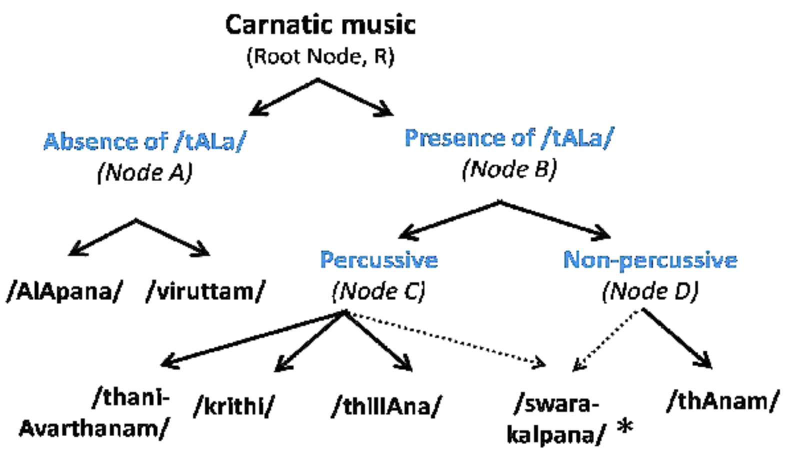
1.1 Indian classical music

Apart from its profound spiritual significance, listening to music may also be a social activity. Indian classical music originated from the ancient Indians' profound admiration for the spiritual force of music. Therefore, classical music requires unwavering devotion and a lifetime commitment from those who take it seriously. However, one of the great things about music is that it can be enjoyed either physically, mentally or spiritually. No matter how much or how little you are involved, it is a gratifying experience. One of the various types of art music with origins in specific geographical cultures is Indian classical music (Pantev et al., 2003). The classical music of the Indian subcontinent, which encompasses India, Pakistan, Bangladesh, Sri Lanka, and Nepal, is known as Indian classical music. It is the most widely listened-to genre of classical music. It has two main traditions: the South Indian which is known as Carnatic, while the North Indian classical music style is known as Hindustani. These customs did not become distinct until the 16th century, approximately. The traditions diverged and took on new shapes while the Indian subcontinent was ruled by the Mughals. The emphasis of Hindustani music is on improvisation and exploring all facets of a raga, whereas Carnatic concerts are typically brief, fixed, rigid and composition-based. The similarities between the two systems continue to outweigh the differences, though (Schlaug et al., 1995). The Hinduism's Vedic literature and the antiquity Natyashastra, Bharata Muni's classic Sanskrit work on performing art, are the sources of Indian classical music. Both the Hindustani music tradition and the Carnatic music tradition hold the Sangita-Ratnakara of Sarangadeva from the thirteenth century to be the ultimate text. Raga and tala are the two fundamental components of Indian classical music. The tala measures the time cycle, whereas the raga, which is based on swara (notes including half tones amd microtones), creates the framework of a melodic structure. The tala offers a flexible framework for rhythmic improvisation employing time, while the raga allows an artist a palette to create the melody from sounds. With a little use of notions from Western classical music like harmony, counterpoint, chords, or modulation, Indian classical music frequently emphasises the space between the notes more than the sounds themselves (Pantev et al., 2003).



1.2 Carnatic music:

The music system typically associated with South India, which includes the contemporary Indian states of Karnataka, Andhra Pradesh, Telangana, Kerala, and Tamil Nadu, is called carnatic music, also known as Karnāṭaka saṃgīta or Karnāṭaka saṅgītam in the languages of the region. Primarily derived from ancient Hindu writings and traditions, especially the Samaveda, it is one of two primary subgenres of Indian classical music (Schon et al., 2004; Magne et al, 2006).

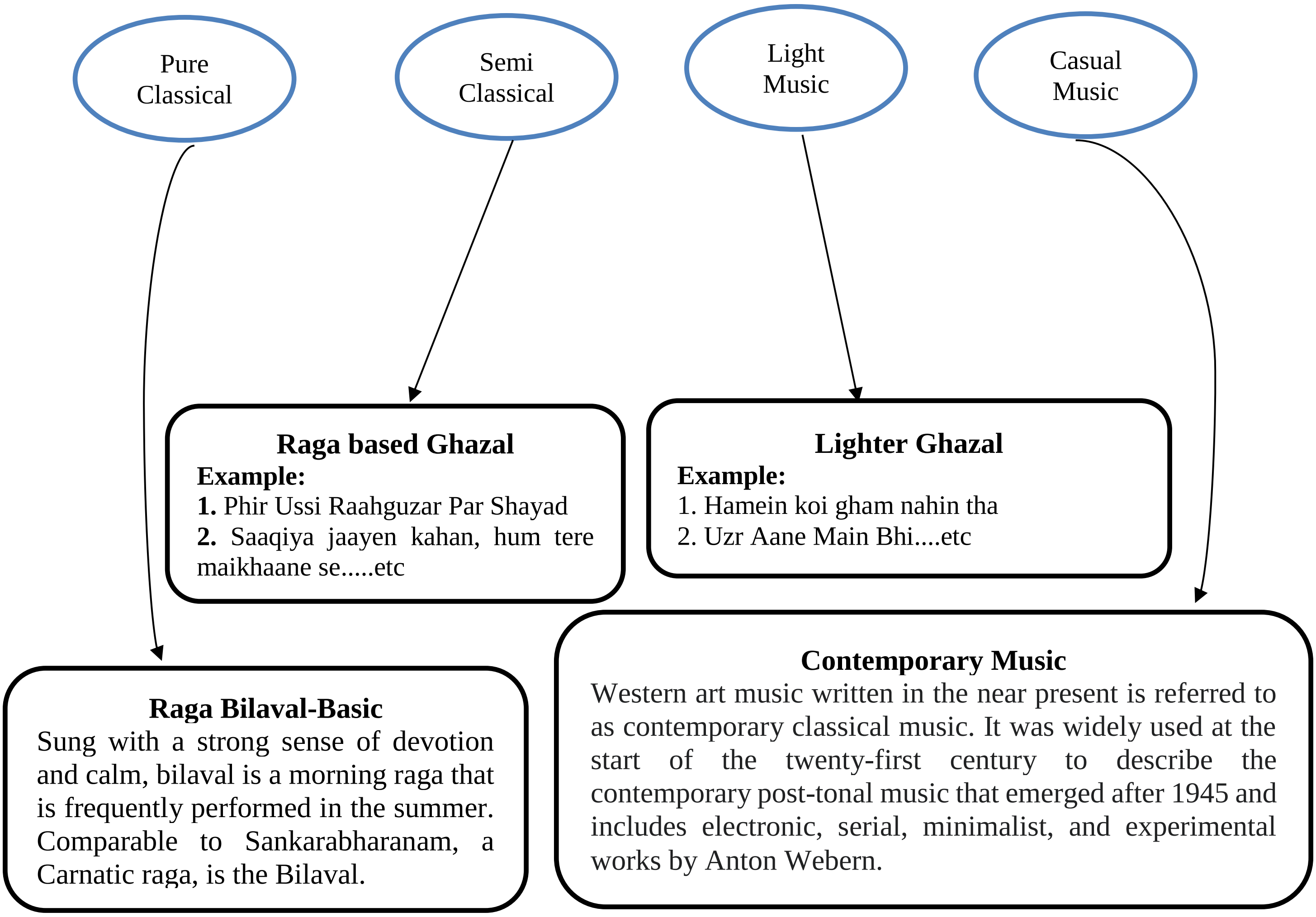


1. 3 Hindustani Music

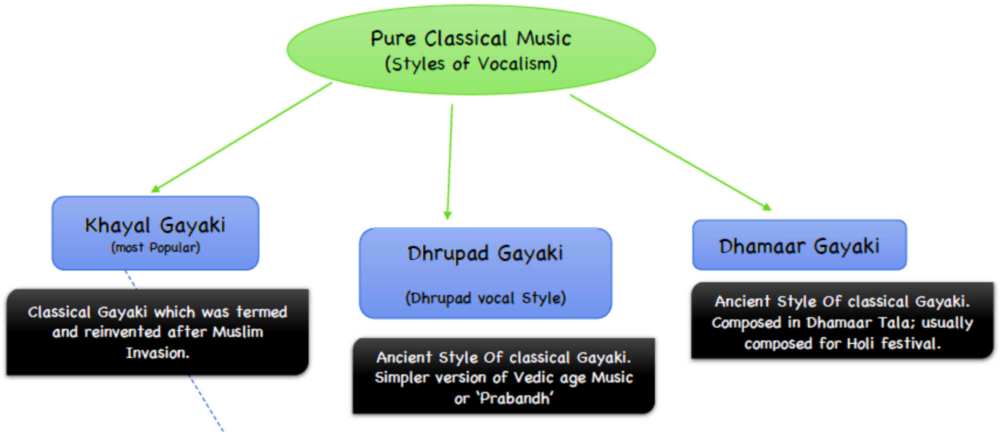
The classical music of the northern parts of the Indian subcontinent is known as Hindustani classical music. It is also known as shastriya sangeet in Hindustani or North Indian classical music. In addition to referring to Indian classical music generally, the term "shastriya sangeet" literally means "classical music" (Standley and Hughes, 1997). The teaching of Hindustani classical music takes place inside the gharana, a distinctively cultural system of classical music education. India's culture is deeply ingrained in Hindustani classical music, which is played both domestically and abroad.

1.3.1 Types of Compositions

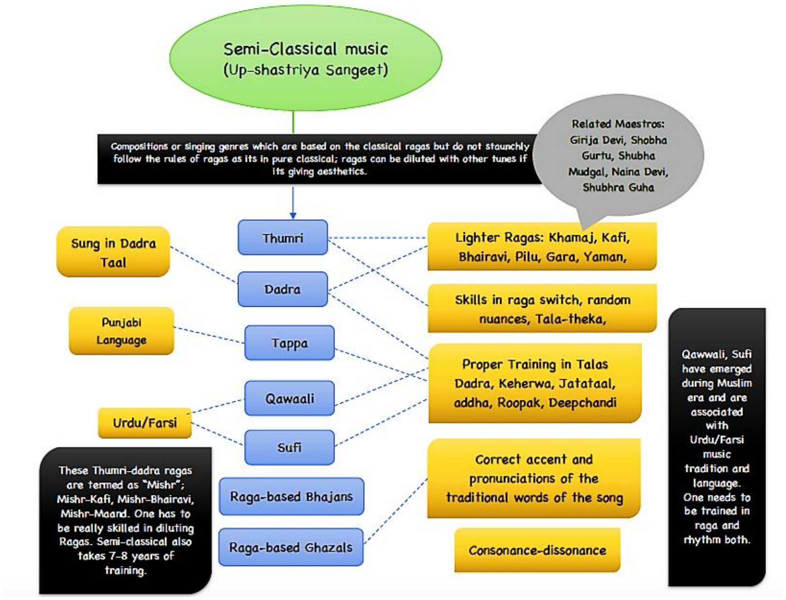
Dhrupad, khyal, and tarana are the three main vocal genres or styles connected with Hindustani classical music. Dhamar, Trivat, Chaiti, Kajari, Tappa, Tap-khayal, Ashtapadis, Thumri, Dadra, Ghazal, and Bhajan are examples of light classical genres that do not follow the strict guidelines of classical music (Rafferty, 2003).



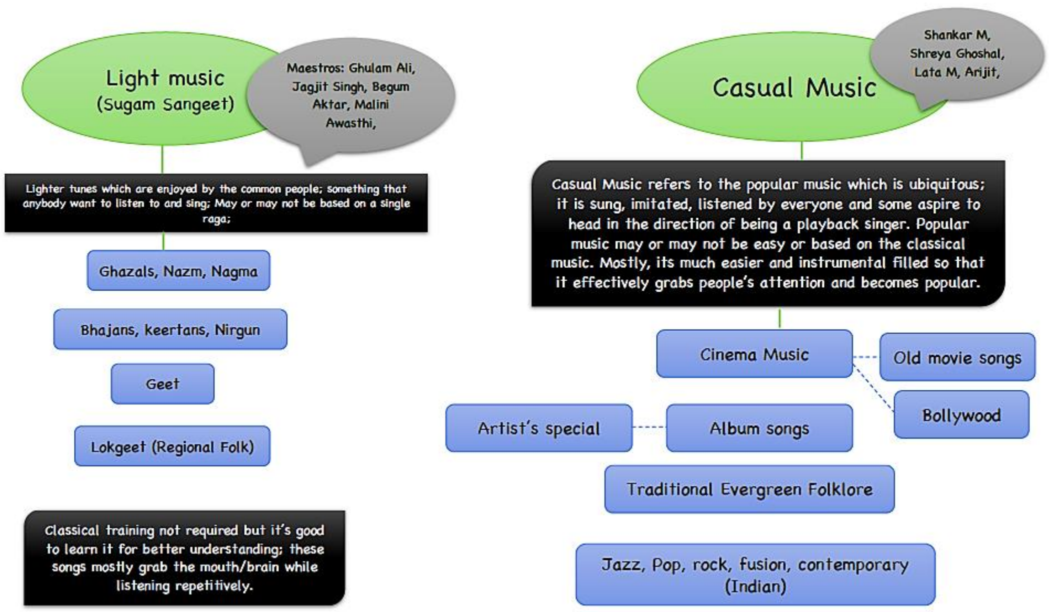
Below is a chart of Pure Classical Music (Haley, 2001):



Semi-classical music is shown below in the form of a chart (Standley and Hughes, 1997).



Moreover, Light Music and Casual Music are shown through a chart:



1.4 Origin of Instrumental Music

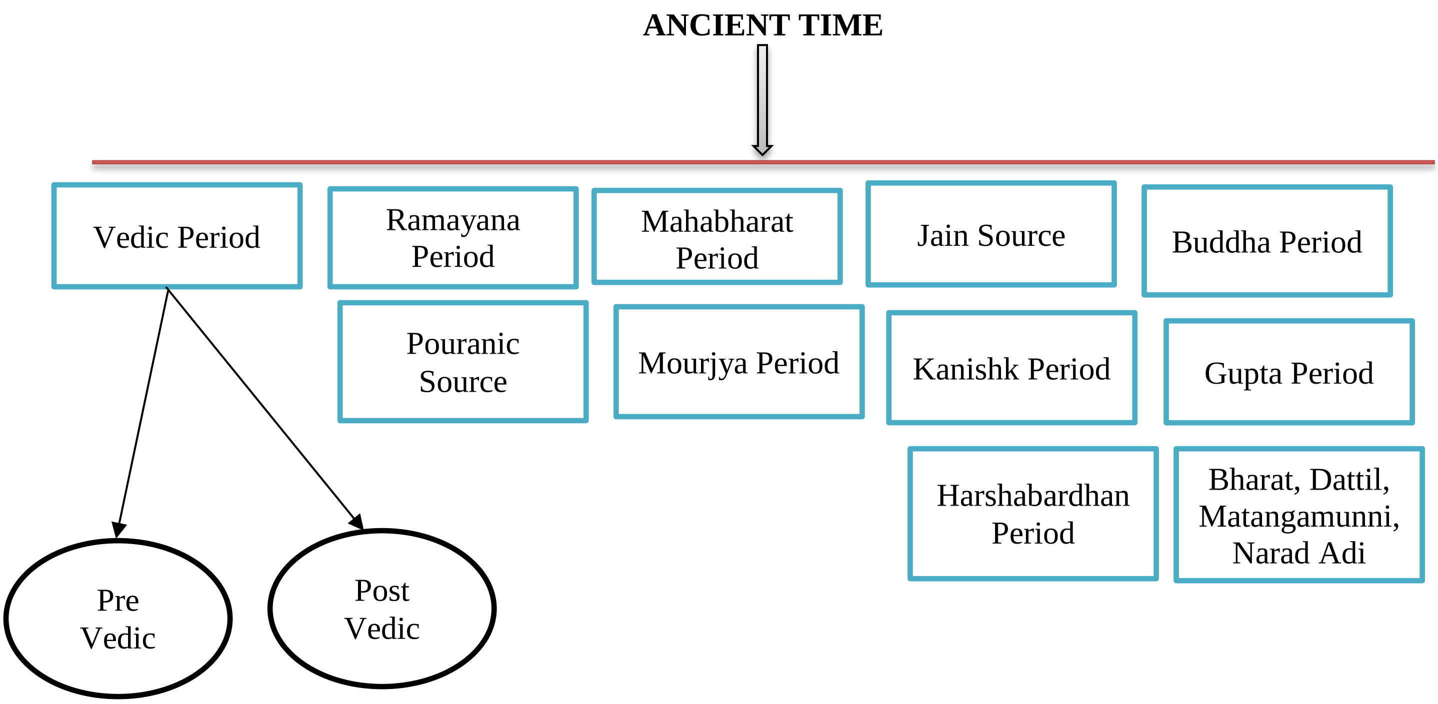
This wonderful world is full of music. A musical instrument serves as a vehicle for expressing the musical "Nada," which has global significance, just as every other kind of art requires a powerful medium to convey its essence and individuality. Indian music gives a lot of importance to instrumental music. It is one of the three facets of music—vocal, instrumental, and dance—also referred to in Indian music as "Sangeet." "Vadhya Sangeet" is the term for the instrumental music. Two elements have been crucial to instrumental music from its inception: the instrument and the instrumentalist, also known as the artist. Without at least one of the aforementioned elements, music cannot be considered art. Music has long been recognised as a direct means of communicating emotions. Strong words, regardless of language, and musical notes, commonly referred to as "Swaras," make up vocal music. While Boles have replaced every language that uses words, Swaras remain the same in instrumental music. Musical instruments create music by playing the boles on the musical notes. For instance, boles like Da, Dir, Dara, and so forth are played in the compositions for plucked instruments. As previously said, the main characteristic of Indian classical music is individualism. For this reason, our instruments are also made to be performed solo. Indian musicians practise swarasadhana, or tone culture, when singing or playing an instrument because they believe that music is a means of achieving divinity. He loses all sense of reality because to his intense concentration on his practise, and his personality becomes one with "Nadabrahma." Our musical instruments' solitary nature is consistent with a strictly individualised viewpoint. Given that Indian classical music does not have any set or prewritten pieces. Since each musician is also a composer, they are all allowed to use any media they want as long as it stays within the parameters that a raga's exposition establishes. Renowned artists have recently attempted, but unsuccessfully, to create an orchestral effect using a set of Indian instruments in the style of Western orchestral composition. Due to their intended solo performance alone, most instruments are weak and unimpressive when played in a group setting. As a result, they are unable to produce the required musical impact.

1.5 History and Development of Instrumental Music

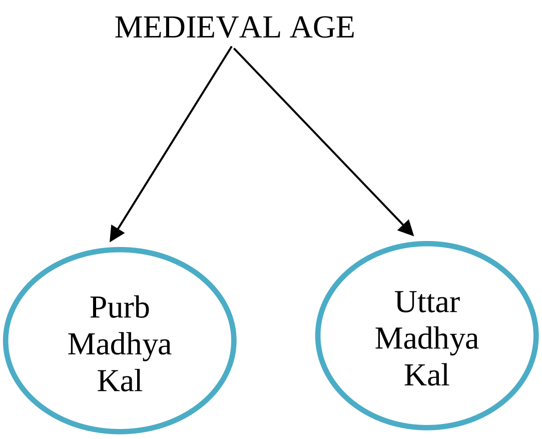
The usage of musical instruments has greatly contributed to the development and evolution of Indian classical music. The evolution and history of Indian instrumental music are well documented (Bilhartz et al, 2000; Graziano et al., 1999; Orsmond and Miller, 1999; Rauscher and Zupan, 2000; Rauscher, 2002; Costa-Giomi, 1999). An attempt has been made to separate this massive image into segments based on past, middle, and present periods, such as ancient time, mediaeval time, and modern time, in order to better understand it.

A) Ancient Age:

It is divided into so many periods. It is shown in a chart below.



B) Medieval Age: 1300 to 1800 A.D.



Moreover, there are other well-known granthas from the middle Age. One of the first known literary works is Sangit Makrand by Narada, which dates back to the ninth century. Other granthas that came after it include Sarangdeva's Sangita-Ratnakara, Jayadeva's Geetgovindam, and Nanyadeva's Bharat Bhashyam. The categories for the mediaeval era are as follows (Kreutz et al, 2004; Kuhn, 2002; Beck et al., 2000; 2006):

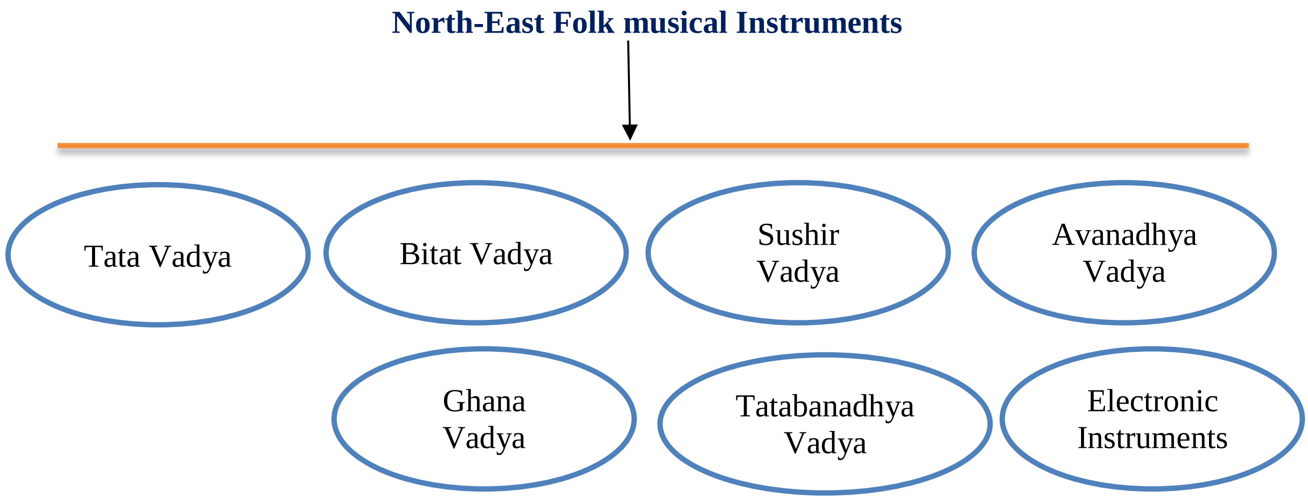
- Sultanat Period
- ii) Bhakti-Saint Period
- iii) Akbar Period
- iv) British Period

C) Modern Age

It may be argued that the development of music-notation occurred throughout the first ten years of the twentieth century. Dahyabhai of Bhavnagar's book has the earliest illustration of such a system. A significant development in the realm of music education was the development of unique notational systems by Bhatkhande (1860–1936 A.D.) and Paluskar (1972–1931 A.D.) (Spychiger, et al., 1993; Zulauf, 1993). Before then, oral tradition was the sole method for learning a composition of other musical nuances. Musical compositions might be kept in writing thanks to the development of notation systems. After the 1930s, instrumental music saw a significant increase, and by the 1950s, it had established itself alongside its vocal counterpart. In those 20 years, a great group of excellent instrumentalists, especially from the Allaudin Khan Gharana, became well-known. Among them were pioneers like Nikhil Banerjee, Ali Akbar Khan, and Ravi Shankar, whose approaches attracted a broader audience. The complex competition and jugalbandi (duet) of numerous instruments with the rhythmic accompanist were well-liked. The formation of the ensemble Akashvani Vadya Vrinda gave instrumental music even more momentum. A Big numbers of instruments were needed for the film soundtrack, thus the production firms began hiring a big number of instrumentalists. The popularity of the song skyrocketed after independence (Hallam and Prince, 2000).

1.6 Musical Instruments of North-Eastern India

We can divide North-East folk music instruments into different categories. It is shown in the form of a chart below:



Northeastern India's musical instruments are an essential component of the nation's cultural legacy. These musical instruments enhance the vibrancy of the local music by accompanying it. Many wind, string, and percussion instruments are among the many musical instruments that are often used in North Eastern India. The inventiveness with which the people of the North East have created novel and distinctive musical instruments, such drums, tablas, flutes, mouth organs, clarinets, harmoniums, guitars, trumpets, violins, Jewish harps, leaf instruments, etc., is another indication of their musical prowess. Both singing and dancing are performed with these native instruments. A detailed examination of these devices shows us yet another facet of the people's deep relationship with the natural world. Nature serves as both a source of inspiration and the source of the materials needed to make these instruments. They make and design the majority of their instruments themselves (Arnett-Gary, 1998; Shobo, 2001; Yoon, 2000).

The folk musical instruments of North-East India are diverse. Many musical instruments in North-East Region of India are less known to people. The scientific properties, mathematical structure, characteristics, practicality, and range of these musical instruments in the musical domain are unknown, nevertheless. This thesis has focused on a variety of folk musical instruments and provides comprehensive descriptions of each one of them, including information on the shape and size of various parts of instruments, the material that was used, the sound quality that the instruments generated, and the range of applications for these instruments.

1.7 Research Objectives

This work has the following objectives:

1. To investigate musical instruments of North-Eastern part of India which are completely unknown to people by surveying different places of North-East.
2. To analyze the detailed descriptions such as the shape and size of various parts of the instruments, material used, quality of sound produced, cultural similarities, scientific characteristics of those musical instruments and also find out the characteristics, utility and the scope of such musical instruments in the field of music, mainly in the present era.
3. To inquire how musical instruments are used in various fields.

1.7.1 Work performed under objective-1

- A detailed description of different Folk Muiscal Instruments of North East India has been presented and their origin and characteristics are also discussed.
    - ***Publication: Sarkar, Joyanta; Rai, Anil, "An Analytical Study of the Folk Musical Instruments of Meghalaya", Studia Universitatis Babes-Bolyai, Musica, June2021, Vol. 66 Issue 1, p23-38. 16p, 10.24193/subbmusica.2021.1.02***

1.7.2 Work performed under objective-2

- We have discussed the shape and size of various parts of the instruments, material used, quality of sound produced, cultural similarities, characteristics, utility and the scope of such musical instruments in the field of music.
    - ***Publication: Sarkar, Joyanta; Rai, Anil, Verma Rajesh Kumar, Sarkar Joylal, Majumder Bibek "An Analytical Study of folk musical instruments of the rural area of Tripura", Research Journal in Advanced Humanities,4(2), https://doi.org/10.58256/rjah.v4i2.1064***

- ***Publication: Sarkar, Joyanta; Rai, Anil, "The Physics of Electric Saroj Veena: A folk musical instrument from India's North Eastern Region)", Research Journal in Advanced Humanities, 4(1), https://doi.org/10.58256/rjah.v4i1.1090***

1.7.3 Work performed under objective-3

- We have discussed the acoustic part of the musical instrument and its mathematical structure, Harmonics, Amplitude.

- ***Publication: Sarkar, Joyanta; Rai, Anil, "The Physics of Electric Saroj Veena: A folk musical instrument from India's North Eastern Region)", Research Journal in Advanced Humanities, 4(1), https://doi.org/10.58256/rjah.v4i1.1090***
- ***Publication: Sarkar, J., Rai, A., Kumar, K. K., Thatha, V. N., Manisekaran, S., Mandal, S., Sarkar, J. L. & Das, S. (2023). Folk Music Recommendation Using NSGA-II Optimization Algorithm. Journal of Computer Science, 19(12), 1541-1548. https://doi.org/10.3844/jcssp.2023.1541.1548***

1.8 Research Methodology

I visited mainly the rural areas of Tripura, Meghalaya, Manipur, and Arunachal Pradesh of the north-eastern part of the country to collect the data for folk musical instruments basically popular in those areas and performed by the folk artists by using the Participatory Rural Apprisal (PRA) method. I made myself acquainted with the traditions, customs, festivals and the folklores performed by the local artists and also played some folk tunes on their traditional instruments. In this survey, I got two types of performances:

1. Based on some story regarding some eminent personalities.
2. Based on the descriptions of the nature.

I carried out the scientific study of the folk instruments of those areas, their scope, range and utilatirian values and also compared them with the classical instruments.

I visited many libraries in the north-eastern region and studied many musical treatises based on musical instruments during my research work and came to know how changes in the manufacturing of the musical instruments in the ancient, medieval and the modern periods of music came into existence. I also visited several museums in north-eastern region to collect information regarding musical instruments.

1.9 Chapterization

Chapter 1- This chapter provides the brief history of Indian Music. We have discussed the origin of instrumental music and also the North-East folk instrumental music in this chapter.

Chapter-2- We have given the description of the new folk instruments that we found through PRA survey method in different places of North-East in this chapter.

Chapter 3- This chapter mainly focuses on a new folk instrument of Tripura known as **"SUMUI"** and describes its structure, playing technique, construction, technique for producing tune, and fingering chart.

Chapter 4- We have discussed the physical structure and scientific analysis of a new musical instrument of North-East known as "**TIPARA FLUTE**".

Chapter 5- This chapter contains mainly the physics of an Artificial Intelligance (AI) based Musical string instrument "**SAROJ VEENA**" for which we have got patent.

Chapter 6- In this chapter mathematical application of Saroj Veena, i.e- it's Amplitude, Tonal sequences, Harmonics, timber quality and pitch have been described.

Chapter 7- The scientific studies done about all 15 folk musical instruments found in Tripura, have been discussed that describe mainly the sound quality of the instruments. Tranquilly, Scalability, and Astonishments, as well as the effects that music has on performances is also discussed.

Chapter 8- An NSGA-II-based north-east folk music recommendation system based on user interest, popularity of an instrument and total cost have been described.

Chapter 9- This chapter gives conclusion and also discusses the future scope of the study.

Chapter 2

2. Literature Review

Northeast India has a convoluted system of naming musical instruments. By compiling vernacular names from many languages, it is usually possible to ascertain how instruments were passed from one culture to another and to ascertain the extent to which they may be reconstructed in certain linguistic subgroups.

2.1 Musical forms

It is challenging to generalise about musical forms across such a broad spectrum, and the scarcity of thorough research makes this task much more challenging. However, there are certain general trends that are worth describing that may be inferred from performance and records.

- Pentatonic and tetratonic scales are frequently utilised in this area, since the range of scales is typically relatively limited. A significantly greater variety, including complicated and heptatonic scales linked to Indian artistic traditions is used in the classically inspired music of the Assamese and Arakanese.
- The range of melodies seldom goes over an octave and is often even more constrained, with the ambit being typically highly constrained. The classically influenced music, once more, is exempt from this.
- The majority of music is monodic, with octaves or in unison singing.
- Larger ensembles are heterophonic, which means that while they all play the same melody on top of one another, the individual players change the tune or the rhythm.
- Some Naga and Kuki-Chin communities use choral polyphony, or singing in parallel chords. These are occasionally employed in call-and-response systems, such as when the chords of a mouth organ reply to the chords of a single whistle. This looks to be quite uncommon, though.
- The popular Jew's harp and the Kuki right-angle flute are examples of instruments with a notable capacity to produce overtones and so form drone plus melody frameworks. This

does not translate into singing styles, unlike throughout Central Asia.

The general ethnolinguistic history of the area is very well captured by this pattern. Throughout most of East and Southeast Asia, monophony and heterophony are prevalent. The limited sizes and vistas are typical of the forager populations, which are a recent memory in this region. What is most notable is the occurrence of parallel chordal singing, which is unique for both SE Asia and subcontinental India. Although South China contains a lot of vocal polyphony, the Melanesian region is largely characterised by parallel chords. This strongly shows a prehistoric connection between these locations—a link that is still poorly understood—as well as the presence of extraordinarily large slit-goings.

2.2 Idiophones

Idiophones are "self-sounding," which means that instead of using a stretched membrane, vibrating string, or air to create sound, they do it by vibrating themselves. They comprise a number of instruments, such as bells, gongs, slit-drums, rattles, and others. Clapping hands is most likely the simplest instrument because it is practically universal and isn't typically seen as a "musical" instrument. Tuned and untuned idiophones represent a fundamental distinction. The majority of sounding objects have a distinct pitch, and these can either be considered as being out of tune or ordered in sets in accordance with a scale system. The Moga people of Tripura utilise an exceedingly rare tuned xylophone and metallophone, which is the only one of its kind in Northeast India. In struck idiophones, it is also important to distinguish between percussion and concussion. A piece of music is considered a percussion instrument when the sounding body is hit with a different instrument, such a beater or stick. Instruments that cause concussions are ones that involve striking two comparable things at once. Pairs of wooden clappers, bells, or other metal items that generate noise when they contact, such when they're fastened around the ankle, are common concussion instruments. The way an instrument is used may also affect its classification. For instance, the Monpa tribe of Arunachal Pradesh accompanied their ritual music with cymbals with domes that they crashed together.

However, the performers have also refined a technique that involves rubbing the cymbals against one another. This technique causes the air trapped between the two chambers to generate an aerophonic sound with a sliding pitch component. This highlights the importance of carefully evaluating performance techniques and carefully inspecting instrument specimens.

2.3 Percussion

2.3.1 Gongs

Gongs are the most popular hit vessel type in this area (Lu, 1986; Montgomery, 1997; Bowles, 2003; Kemmerer, 2003). To create gongs, which have a resonant, long-lasting sound, bronze was utilised in the casting process. The majorities of those in Northeast India were imported from Southeast Asia and are generally considered as treasured family heirlooms, coveted goods, and more than simply musical instruments. Three distinct gong types may be found there;

a) Bossed gongs

b) Shallow gongs with a straight rim and no bosses

c) Deep-sided gongs with an out curving rim and no bosses

Bossed gongs have a centre protrusion that enhances resonance while giving the instrument a unique appearance. The Nocte of Arunachal Pradesh play traditional bossed gongs, as seen in mentioned Photo. These gongs are presumably imported from Burma because the Nocte do not produce them. Despite the fact that gongs are not frequently employed in Buddhist music, they may be found in several of the monasteries in northern Arunachal Pradesh. They likely came from Tibet and are imported. A bossed gong, or khar, is seen in fig. 2.1 being used in the Tawang monastery.

Fig. 2.1. Bossed gong, Nocte in Arunachal Pradesh

Fig. 2.2. Bossed gong, the Tawangmonastery and the khar ŋa

In China, during excavations, the first shallow round gongs dating to 100 BC were found. The Mizo and Garo areas of northeast India are home to a large number of them. It is fairly uncommon to find a deep-sided gong without a boss and a rim those outcurves. As a matter of fact, they are not normally made in SE Asia, and it's possible that this is a bronze vessel that was once created for a different purpose before being transformed into a gong. Fig. 2.3 shows a Garo musician in the Shillong area playing one of these deep-sided gongs, also known as rangs with an everted rim. By using a single stick to beat the instrument on its base.

Fig. 2.3 Garo bowl-gong, Rang

Fig. 2.4 The Deep Garo bowl-gong, Rang

2.3.2 Struck animal horn

Another type of hit vessel is an animal horn that has been struck (Butzlaff et al., 2000). A mithun or other horn is cleaned out and beaten with a stick to create rhythm. In fig. 2.5, we can notice a stunning mithun horn among the Thado Kuki;

Fig. 2.5 Mithun horn struck, Thado Kuki

2.3.3 Slit-gongs

Slit-gongs, which generate two distinct notes when hit with a stick, are made of hollowed logs or bamboo pieces with lengthways slits and usually with resonator holes at the extremities of the slits. Slit-gongs are found all over the world, however they are mostly found in Central and South America, SE Asia, and much of Africa. They come in a variety of sizes, from tiny hand-held models to ones up to five metres long. The Naga-speaking peoples of Northeast India are known for their use of slit-gongs. In certain communities, you may find examples that are up to 5 metres long, and carving a new drum is seen as having significant ritual and social significance. Many of these earlier drums were destroyed when the Indian army set fire to Naga villages in the 1950s and 1960s. We have at least two excellent graphic accounts of this procedure, which is fortunate because they are currently being recarved. Saul (200x) displays a comparable procedure among the Naga in adjacent Myanmar, while Vattoth (2006) depicts the felling, transportation, and cutting of a new drum among the Wancho. Ao (2005) also provides a description of how a new drum is made and a transcription of some of the tunes that are played during the process, but sadly without any images.In different parts of the area, Naga slit-gongs have quite different sounding bodies and forms. A slit-gong with a cylindrical sounding body and a form like a tiger, for instance, is seen in mentioned figure.

Fig. 2.6 Chang's teramorphic slit-gong

Fig. 2.7 shows a Sema slit-gong with the appearance of an open tube that has had its surface cut away at an angle and in an oblique manner to increase resonance.

Fig. 2.7 The Sema slit-gong

Large slit-gongs are also played in an unusual way. The beaters on a Nocte slit-gong are shown in fig. 2.8. They have two heads, and each end may be used to play them. The performers vertically hit the slit-gong lips while holding the beaters in the centre of their hands. Usually, there are several performers. The comparatively small slit on the Nocte instruments only allows for two performers. However, some Naga tribes utilise drums that have a slit that extends the whole length of the drum (fig. 2.9), allowing many players to beat the slit-gong at once.

Fig. 2.8. Nocte slit-gong, beaters

Fig. 2.9 Wancho slit-gong

This kind of performance has a remarkable resemblance to the way New Guineans beat their distinctive garamuts, enormous slit-gongs. It is unknown if there is a historical connection between the two. The purpose of these big slit-gongs is mainly for use as signalling devices than as a rhythmic dancing accompaniment. The Mizo play a different kind of hollowed wood, one that is hit. These are thin, hefty hardwood logs that have been cut in half or have had portions of their tops hollowed out. To keep time in ensembles, two beaters are used to strike them. Two distinct examples of this kind of striking bar are shown in fig. 2.10.

Fig. 2.10 Struck hollowed logs, Mizo

The little slit-gong seen in figure 2.11 is another fascinating kind. It is used by Bengali musicians. A sizable internode of bamboo with a slit along the length of one side makes up the instrument. In a manner similar to chopsticks, the player is holding two sticks together. He uses the bamboo tube to create a broad range of percussion sounds with various timbres by repeatedly beating it while rotating it in his palm. Three-piece sets of single bamboo internode slit-gongs are played among the Khasi, and one performer beats each instrument with a pair of wooden sticks. These are referred to as kdor. For the enjoyment of ranchers and hunters, it was often played in the fields.

Fig. 2.11 Bamboo slit-gong in Bengali

2.3.4 Clapper-bells

Any bell with an internal striker linked to the bells inside is referred to as a clapper bell (Piro and Ortiz, 2009). Church and school bells, for instance, are clapper-bells. These bells, which are frequently fashioned of bronze, are used in rituals by the Monpa and Memba people of Arunachal Pradesh. These bells have a close connection to Tibetan religion. Bells are still another item that the Tibetans trade in; these items have been utilised as jewels or decorations in a variety of non-Buddhist countries. In Arunachal Pradesh's figure 2.12, one of the Hill Miri is a little bronze clapper bell.

Fig. 2.12 Arunachal Pradesh's Hill Miri has a little bronze clapper bell

Fihure 2.14 depicts a bronze bell, perhaps of Tibetan origin, used by shamans among the Hruso in Thrizino, Arunachal Pradesh. Figure 2.13 shows how the bell is used during performance.

Fig. 2.13 Hruso shamans utilise a bronze bell

Fig. 2.14 Shaman of the Hruso people, ringing a bronze bell

Oftentimes, enormous bronze bells are hung over entranceways at Buddhist temples. A 17th-century Tibetan-inscribed bronze bell known as chod dril that was suspended over the entryway of the Tawang monastery is seen in figure 2.15.

Fig. 2.15 Tawang large bronze bell dangling in the air

The ox-bells that are employed in many Mizo areas are yet another very distinctive sort of clapper-bell. They consist of a rectangular piece of wood that has been hollowed out and is hung on a rope with several wooden clappers attached from it. The animal walks with a lovely "klok" nose as it is slung around its neck. Southeast Asia uses cowbells a lot like these. A Mizo cowbell may be seen in figure 2.16.

Fig. 2.16 Mizo cow-bell made of wood

2.3.5 Pellet-bells

Pellet-bells have a container filled with rattles that is often constructed of metal (Movsesian, 1967). The vessel is frequently cut to raise the resonance of the bell. The most popular kind is an oval pellet-bell made of cast or hammered brass or bronze that is fastened to a leather strap and worn around the neck of a horse to notify its owner of its presence. Northeast India is where this design is most common. These pellet bells are often rather large and substantial. Figure 2.17 shows leather thong attached to a set of bronze pellet-bells that the Mey people of Rupa utilise.

Fig. 2.17 Horse bells made of bronze with a leather thong, Mey of Rupa

2.4 Rattles

The fundamental principle of a rattle is the combination of percussion and concussion caused by a large number of sounding things striking a vessel or one another, whether free or attached. Rattles are commonly attached to dancers' bodies, such as around the ankle or waist. A vessel rattle is produced when rattling pellets are contained inside it and agitated to produce a rhythmic sound. The South American maracas are made based on this concept. A rattle has been seen among the Tripuran populace, despite the fact that they are often fairly rare. It is made of a substantial cylindrical container held aloft by a wooden handle. The fundamental principle of a rattle is the combination of percussion and concussion caused by a large number of sounding things striking a vessel or one another, whether free or attached. Rattles are commonly attached to dancers' bodies, such as around the ankle or waist. A vessel rattle is produced when rattling pellets are contained inside it and agitated to produce a rhythmic sound. The South American maracas are made based on this concept.

A rattle has been seen among the Tripuran populace, despite the fact that they are often fairly rare.

Fig. 2.18 Ship rumbling, Mog, Tripura

It is made of a substantial cylindrical container held aloft by a wooden handle. This is banged on the palm of the hand in a slow, rhythmic manner when packed with rattling seeds. It is not shook as readily as other rattles. The Tripura ship's rattling is seen in Fig. 2.18;

2.5 Xylophones and Metallophones

With a tuned idiophone, the xylophone is the primary instrument. The hanging and frame types are by far the most popular in NE India (Movsesian, 1967). The hanging xylophone is played by the Thadou Kuki and the Anal Naga, and is made up of six wooden keys that are hung from two ropes. The player's big toe is encircled by a cable that is fastened to the instrument's opposite end. The player follows that by striking the keys with two wooden beaters. In Northern Thailand, where it is likely also played, this specific form of hanging xylophone is well-known. The frame-xylophone, which is exclusive to SE Asia, is only known to exist among the Mog people of Tripura in Northeast India. The instrument comprises two rubber-headed beaters and around twenty keys that are hung on ropes over a trough resonator. A flute and percussion group is led by one lead performer, who is often a female. It's unclear from a performance video if she frequently switches between the Jews' harp and other instruments. In the same ensembles, a metallophone with iron or bronze keys and an identical construction is also utilised. The metallophone and the xylophone are depicted in fig. 2.19 and 2.20, respectively;

Fig. 2.19 Metallophone, Mog Community

Fig. 2.20 Xylophone, Mog Community

2.6 Concussion

Since all concussion idiophones are untuned, a tuning-based division is not necessary.

2.6.1 Concussion sticks

Two sticks being hit together is the simplest example of ideophonic concussion. The sound may be utilised to generate an underpinning beat for a percussion group if an appropriate hardwood is used since it is fairly loud and penetrating. Assamese percussion bands employ pairs of wooden clappers to maintain beat (fig. 2.21). They have a somewhat oval shape, and the core of them is hollow. For the performers to securely hold the strings, holes are bored through the core of the strings.

Fig. 2.21 Assamese wooden clappers

2.6.2 Split-bamboo concussion tube

The Bodo people play a strange instrument of SE Asian origins called a split-bamboo concussion tube. A bamboo internode is split in half along its length at one end, and a triangle-shaped hole is carved out just next to the internode that remains unharmed. Using the two half-tubes and the natural flexibility of the bamboo, the performer may then hit simultaneously. One half of the tube is often placed on the palm of the performer's hand, while the other half is typically struck against it in a simple rhythmic pattern. In figure 2.22, we can see a split-bamboo concussion tube;

Fig. 2.22 Bodo split bamboo concussion tube

2.6.3 Concussion rattles

The multiple concussion rattle is a style that is quite popular. A frame is used to suspend bits of anything hard, and as the frame is moved, the suspended parts collide with one another, creating a rustling or jingling sound. The Assam metal jingling rod game is one instance of this (figure 2.23). A long rod with metal branches connected at the head serves as the rattle's main structural component. Metal items that are fastened to these crash into one another when the performer slams the stick against the ground. Similar devices called as "jingling Johnnys" were used in marching bands in both the European and Turkish traditions.

Fig. 2.23 Assamese Jingling stick

2.6.4 Cymbals

Cymbals are circular metal plates that are flat or slightly bossed and hollow, which are smashed together to produce a cutting rhythmic sound. The two types that are frequently employed in this area are small, heavy cymbals that the player holds near to the boss and larger cymbals with a long resonance time. Cymbals are widely used in religious music. For instance, both varieties are typical among Tibetan Buddhists in Arunachal Pradesh and are utilised in Buddhist rites. Figure 2.24 shows a cylindrical drum and a little pair of hefty cymbals with enormous bosses that are smashed vertically together as a background to the masked dances during the Choskor festival in Old Dirang. Figure 2.25 depicts a somewhat larger pair competing in the same event with a different shape.

Fig. 2.24 The Bossed cymbals, Monpa of Dirang

Fig. 2.25 Big vertical cymbals, Dirang Monpa

Cymbals, however, are also a staple of Indian music and are often used in Assamese drum groups. An example of Assamese tiny cymbals is seen in figure 2.26;

Fig. 2.26 Small cymbals, Assam

2.7 Membranophones

2.7.1 General

Drums can be categorised in a number of different ways based on their design, the number of heads, and the method by which each head is secured. Often, the method by which the head is linked to the body is the most distinctive feature. In Northeast India, these techniques are most frequently used to repair heads:

- Gimped or pinned. The skin is fastened to the body using wooden pegs, and more recently with nails or metal pins.
- Laced. The drum's body is attached with lace, the skins are fastened together, or a second skin is fastened to the bottom of the drum.
- Wedge-laced. Halfway down the body, another loop is connected to the laced head. To make the skin tighter, employ wedges.
- Glued. Simply using adhesive, the skin is attached to the drums outside. The Monpa utilise this technique for their ceremonial drums, even though it is not particularly effective and is rather uncommon.

- Screw-tensioned. A loop that around the drum head is where modern, manufactured screw tensioners are fastened. Churches are sometimes used to play imported drums, while villages are rarely used for such."

2.7.2 Pegged or nailed drums

In Northeast India, drum heads are often fixed with pegs or nails. To protect the hardwood pages from ripping skin-piercing holes, a network of cables is frequently passed over them. Figure 2.27 depicts a pegged bowl-drum used by the Tiwa people;

Fig. 2.27 Bowl-drum with pegs, Tiwa

Fig. 2.28 Drum with a single conical head in Khasi

2.7.3 Laced drums

2.7.3.1 Laced single-headed drums

One sort of linked single-headed drum, which is rather unusual, is the single-headed hourglass drum. The laces don't travel to a second head; instead, they go to the drum's base where they pass through holes and may be pulled firmly to tighten them. The Arabic word naqqara, which is used to describe kettledrums like those played by military bands, is where the name "nakers" from mediaeval Europe originates from. It is used in a different form by the Khasi. The player's extended legs support the tiny, conical drum, which is also conical. Two unadorned sticks are used to beat it.

2.7.3.2 Laced double-headed drums

2.7.3.2.1 Cylindrical drums

Fig. 2.29 Laced cylindrical drum by Thado Kuki

Fig. 2.30 Hruso's double-headed laced drum

Having two skins that are connected to one another is a very distinctive way of securing the head of drums. In NE India, they can be found in a variety of shapes and sizes. For instance, the enormous Thado Kuki drum in figure 2.29 has a web of laces tying the two heads together. The drummer strikes the drum with his palm after setting it down on the floor. Figure 2.30 depicts the Hruso of Arunachal Pradesh beating a double-headed drum with their hands. A fascinating performance approach is displayed in Photo 2.29, which depicts the Mey [Sherdukpen] people of Rupa playing such a drum. The drum is held by one person, while two performers alternately strike its two heads. The Meithei drum, on the other hand, is made for dancing and walking (figure 2.31). A string suspends the wide yet shallow drum from the neck of a performer who is standing. The drum is held vertically so that it may be pounded on the side like a bass drum, as is customary in European militaries. Instead of a network, single laces are used to connect the hammered heads together.

Fig. 2.31 Dama

The Garo play intriguing double-headed drum ensemble. A skin is attached to either end of the drum, which has a length of roughly 150 cm. A web of laces links the skins together. The performer sits on a stool and beats both ends simultaneously with the flat of the palm.

Fig. 2.32 Mey cylindrical double-headed drum

Double-headed braided drums are another instrument used in Buddhist temples to accompany special rituals. Such a drum can be seen in figure 2.33 being used in the Tawang monastery and hanging on a frame.

Fig. 2.33. Laced drum hanging from a ceiling, Tawang monastery

2.7.3.2.2 Barrel drums

The two heads of a barrel drum are connected by a web of laces and are hammered with either sticks or fists. Drums made of barrels have short, wide bodies. Usually, the two heads are around the same size, although occasionally, if the drum has a conical shape, the lower head could be smaller than the pounding head.

2.7.3.2.2.1 Conical drums

Similar to most traditional Indian drums, each head has a tensioning ring that the laces pass around.

Figure 2.34 shows a Meithei drum with a biconical lacing. It gets whacked with two sticks while lying on the ground.

Fig. 2.34 Shallow-laced cylindrical drum from Meithei

2.7.3.2.2.2 Biconical drums

When a drum curved down towards a skin at each end and swells in the center, the drum is said to be biconical. Skin laces are used to tighten the two heads. A Khasi performance on the syntheth barrel-drum is shown in figure 2.35. Similar to most traditional Indian drums, each head has a tensioning ring that the laces pass around. Figure 2.36 shows a Meithei drum with a biconical lacing. The drummer hits both heads of the drum with the palms of his hands as it is suspended from a string around his neck.

Fig. 2.35 Barrel-drum in Khasi

Fig. 2.36 Biconical laced Meithei drum

2.7.3.2.2.3 Kettle-drums

In addition to drums with straight walls, laced drums can also be spherical or almost so. Although the phrase is not entirely correct, in organology this is frequently referred to as a "kettle-drum." The two heads of paired kettle drums with an almost spherical form are tied together in Assam (Photo 2.37). In order enable a performer standing nearby to simultaneously beat two drums with a single stick, they are set up at an angle on the ground and held in place by fabric rings.

Fig. 2.37 Assamese kettledrums with a sphere

2.8 Wedge-laced-drums

Wedge-laced drums have a conical or bowl-shaped body, and the narrower portion of the drum is encircled by a web of laces. We may stiffen the skin of the drum by pounding wedges into it. The practise of fixing the head is popular throughout island SE Asia and some regions of Africa but is uncommon in northeastern India. Fig. 2.38 depicts two wedge-laced goblet drums that were used by the Karbi people. Each drum is constructed from a single piece of wood and has an opening at the base.

Fig. 2.38 Drums with wedge-laced karbis, burup

2.9 Glued drums

Due to the fact that it is not a particularly reliable way of securing the skin, glueing the skin to the body of a drum is not very popular. The head will come adrift if the adhesive dries up or if the player strikes it too hard.However, the drum can work if the pattern is consistent and the tone is gentle.

Fig. 2.39 Monpa of Dirang, shallow cylindrical drums with glue

Fig. 2.39 depicts one of the large, shallow, two-headed drums used by the Dirang Monpa. The drum is beaten with a complexly curved stick while being held aloft throughout most ceremonial events.

2.10 Screw-tensioned drums

In the New World, drums of the Northeast Indian style would have been the first to use screw tensioners, which are not common in Africa.

2.11 Chordophones

2.11.1 Raft-zither

One of the most unusual musical instruments in Northeast India is the idiochord raft-zither. The Garo and Mizo regions are particularly unusual for the area in that this instrument is typical of Africa and is not present there. How such identical instruments can be made in places so far apart from one another is, in fact, a bit of a mystery. Using a transverse stick, a bridge is constructed at each end of a raft of large, dried grass stalks. With the use of a knife and bridges, the grass's epidermis is raised to generate the strings. The pitch of a string is influenced by its breadth and tension, and it can be coiled with fibre to produce a deeper tone. However, tuning is not particularly precise. To accompany a song, the performer strums the instrument. Figure 2.40 shows two raft-zithers, one from the Khasi tribe and one from the Garo tribe. The Khasi instrument is known by the names dymphong and dinkhrang.

Fig. 2.40 The Raft-zithers, Garo and Khasi

The raft-zither may be built and played using a wide range of methods, although they are never used as actual melodic instruments in Africa with precisely tuned strings. The Garo raft-zither, which is seen in

Figure 2.41, has a little elevated platform on the side that faces the performer. A set of short strings that are tensioned across the elevated frame are strummed by the player while the instrument is held steady by two cords that have been wrapped around the zither's outer edge. The overall effect is comparable to the flamenco guitar since he also rhythmically slaps the back of the instrument at the same time.

Fig. 2.41 The Garo raft-zither, *dinkhrang*

2.11.2 Tube-zither

The striking idiochord tube-zither is a musical instrument with a distinctive SE Asian ancestry. Using a single internode from a type of enormous bamboo, this was created. Two tiny bridges are then placed beneath the string and the outer skin is raised, successfully tuning the instrument and preventing the string from slamming against the resonator's wall. Although the instrument may be plucking, sticks made of wood or bamboo are most frequently used to strike it? In certain instruments, the bamboo tube's wall has a hole drilled through it to boost resonance. On the eastern side of India's continent, such groups as the Muria, Reddi, and Bondo are known to have used these instruments. Along with other Austronesian regions, they can be found in Sumatra, the Philippines, and other places. Figure 2.43 displays two struck idiochord tube zithers from the Garo and Mizo civilizations. The Garo instrument appears to have additional resonating strings to the side, in addition to the main striking strings, which presumably resonate sympathetically. An illustration of the Garo instrument in use is seen in figure 2.42. The player rests one tube end on his lap while supporting the other on his shoulder. He then uses a pair of sticks to rhythmically strike the two strings. In order to stop the strings from vibrating, the player regularly reaches up and presses down on the bridge; as a result, it seems that the central bridge, which is missing from other instruments in this location, has a damping effect.

Fig. 2.42 Garo played the tube-zither's idiochor, chigring

Fig. 2.43The Idiochord tube-zithers, Garo and Mizo

In Tripura, the Mog group also performs music using struck tube zithers. A tube zither is shown being pounded with two sticks in figure 2.44. Two metal bands are used to secure the zither's body to a wooden stand, preventing it from moving while being played.

Fig. 2.44 The Struck tube-zither,Mog Community

The names of the struck idiochord zither are listed in Table 3;

ZitherEthnic group	Vernacular name
Garo Community	*chigring*
Mizo Community	*tutum dar*
Khasi Community	*singphong*

Table 1. Vernacular names of the struck idiochord

2.11.3 Stick-zither

The stick-zither is played by pushing down with the fingers on the string while it is being plucked. Strings are positioned over a long stick. The number of strings on a stick zither can vary, with some instruments having just one. Here, the player pauses the string and raises up wooden blocks from the stick to produce a variety of pitches. Instruments frequently have one or two gourd- or wood-based resonators. A stick-zither is a musical instrument similar to the South Indian vina, which is used in classical music. Figure 2.45 shows a representation of a Khasi stick-zither. It's likely that this is a folk rendition of a classical instrument.

Fig. 2.45 The stick-zither, Khasi Community

2.11.4 Lute

Strings on lutes pass from a stringholder at the base to the head over a soundbox and a stretched neck. They are held in place by tuning tools, most often pegs. In order to establish their sounding length, the strings travel across a bridge. By pushing the strings against the fingerboard, the musician often uses their fingers to halt the strings. The most well-known example of a lute is the guitar. Despite having a significant part in Indian classical music, lutes are not very widespread in NE India. The Assamese play the dotara lute, which is shown in figure 2.46. The name of the instrument—du Tara, which translates to "two strings"—indicates that it is of Persian origin. The majority of cases, nevertheless, really contain four strings. The Khasi also call this instrument duitara when they perform with it. (Fig. 2.47). Modernization has also been made to the lute.

Fig. 2.46 Dotara lute, Bengali Community

Fig. 2.47 Duitara lute, Khasi Community

In Photo 2.48, we can see a two-string lute that the Karbi people play. Because the body is a separate resonator made of a coconut, it stands apart from other lutes in a big way.

Fig. 2.48 The two-string lute

The Khasi marynthing is a five-string instrument with an oval soundbox and S-holes that is designed like a violin. The strings ascend to a pegbox from the raised frets on the neck. Such a device may be electrified, in all likelihood.

Fig. 2.49 One-string lute of Naga People

Among some Naga clans in Tripura, there is a very peculiar evolution of the lute principle. Using a gourd as the resonator and a skin table with pegs, a very long one-string lute that resembles a little drum is created. The instrument is then placed on its back and placed on the shoulder. A broad thrumming sound, like to the drone in classical Indian music, is produced by plucking the one string in order to accompany singing. The Tripuran Naga are seen in figure 2.50 playing single-string lutes. These instruments can also be used to play in mixed male-female ensembles, as illustrated in mentioned figure, where they are carried across the torso.

Fig. 2.50 The one-string lute ensemble of Naga People

2.11.5 Fiddles and viols

Since a bow is used to traverse the strings of a fiddle rather than a pick, it may be thought of as a bowed lute. Due to their striking resemblance to fiddles found elsewhere, Northeast India's several fiddle varieties may have just recently been introduced. Some Naga tribes play fiddles with one or two strings and gourd or coconut shell resonators, which resemble instruments from China and Yunnan that may have come from a separate source. The Hruso people of Arunachal Pradesh play the one-string violin, which is a similar instrument (Photo 2.51).

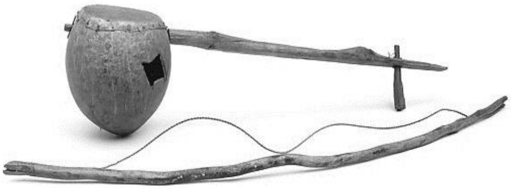


Fig. 2.51 Single-string fiddle by Hruso

Fig. 2.52 Three-string fiddle

Like a conventional spike-lute, the resonator is fashioned of coconut shell, and the neck transpierces the body. The string and bow hair are both quite thin, and they both only make a very little sound that can only be heard by the musician and people standing right near to him. The musician enjoys playing the instrument by themselves. Since this instrument is unique to Arunachal Pradesh and is maybe connected to Chinese fiddles made from coconut shells, its origin is a matter of debate.

Fig. 2.53 The Modernised viol, seria, Bodo

The seria, a musical instrument used by the Bodo, is similar to several folk fiddles found throughout India. Unusual for a violin, the sound-box is open, which lessens resonance. A single piece of wood that extends across the open sound-box serves as the fingerboard. A bridge that is attached to the tailpiece is where the strings cross. A Garo musician can be seen playing a traditional single-string sarenda in figure 2.54. Due to the violin's influence, these instruments have been updated, and contemporary models may be equipped with screw-tensioners akin to those on a mandolin in place of the conventional wooden pegs. The four-string seria, which the Bodo plays. It's possible that the profile's grained appearance reflects how European string instruments are perceived.

Fig. 2.54 Fiddle, Sarenda, Garo community

The saranga, a Tiwa variant of the sarangi, is another instrument that is more obviously a replica of a classical instrument. The instrument's flat wooden table and circular sound-box are attached to a single piece of wood that has been cut into a single block. Three strings are fed into a pegbox, which holds the massive wooden tuning pegs. The maryngod, a three- or four-stringed violin played by the Khasi people, features a waisted soundbox crafted from a single piece of wood.

2.11.6 Ektara

The Bengali ektara, or "one-string," is a musical instrument that is perhaps simpler to envision than to classify. The lower face of the spherical gourd used to make the resonator is chopped off, and a stretched skin is adhered to it using glue or pegs. The gourd has two linked limbs that extend upward from the side. They unite at a location through which a tuning peg is passed. From the tuning peg to the centre of the bottom skin, a single string runs. The single string is pulled by the musician, and the instrument's arms can be squeezed together while it is being played. As a result, the string's tension rises and the pitch rises. The musician may get a variety of tones from a single string by deftly adjusting the tension. An illustration of a Bengali ektara in performance may be seen in figure 2.55.

Fig. 2.55 Bengali Ektara

2.12 Aerophones

2.12.1 Flutes

2.12.1.1 Terminology of flutes and whistles

In terms of how they are played or their organology, there is no real differentiation between flutes and whistles. The player can hear both when they blow air across a sharp edge. Nevertheless, whistles often create notes with varied pitch heights but no regular relation, whereas flutes are typically thought of as instruments that produce a succession of consistently connected pitches, typically a scale. A middle case exists in Northeast India, as it does across most of Central Africa: groups of tuned whistles that, when played together, form a scale rather than just a single note when played separately. The form of the vessel—whether cylindrical, conical, or vessel-shaped—can also be used to classify flutes. Ocarinas are a common name for vessel-flutes.

2.12.1.2 End-blown flutes

End-blown, side-blown, and transverse flutes can all be categorised. Northeast India doesn't see many side-blown flutes. Three categories can be used to categorise end-blown flutes;

- blowing across chamfered ends, like the Arab ney, with flutes without mouthpieces
- Bevel-flutes are flutes in which the blowing end is cut at a 45° angle to generate the

blowing edge. In single-note polyphonic ensembles, they are also typical.

- flutes known as "notch-flutes," in which the player blows across a V-shaped notch carved out of the top of the instrument, similar to an Andean qena

2.12.1.2.1 End-blown flutes without embouchure

2.12.1.2.1.1 Cylindrical end-blown flutes without embouchure

The most popular end-blown flute either lacks a mouthpiece or has a little bevel on the upper end to help players place their lips correctly.

2.12.1.2.1.2 Bevel whistle

One type of whistle that is popular in other areas of the world, notably in Africa, but is unusual in Asia, is the one with a bevelled embouchure. By cutting off the end of a hollow cane at an angle and blowing over the top of the tube, a single pitched note, determined by the length of the tube, is created. Figure 2.56 shows an example of a Thado-Kuki bevel-whistle.

Fig. 2.56 Thado Kuki bevel whistle

2.12.1.3 Transverse flute

2.12.1.3.1 General

Northeast India frequently uses side-blown or transverse flutes. Depending on where they were originally made, these flutes appear to have several layers. The varieties that have thus far been found include;

- ***Transverse flute with six holes***
- ***Transverse flute with Three or four-hole***
- ***Transverse flute with Single-hole***
- ***transversal and fipple flutes combined***
- ***transverse flute at a right angle***

2.12.1.3.2 Transverse flute with six-hole

The six (6)-hole transverse flute has a striking resemblance to both the traditional bansari flutes of India and the European fife. The part nearest to the blowhole ceased, and the thumbhole was not present. These subcontinental flutes are undoubtedly the source of certain instruments, as their names suggest. The ka besli, a flute of this sort played by the Khasi (fig. 2.57), may have been adapted from Assamese music. They also have a shawiang, a longer, different-built six-hole flute that may be a more traditional instrument.

Fig. 2.57 The Six-hole transverse flute, Khasi Community

But the six-hole transverse Garo olongma, which can be played with either the mouth or the nose, is even more stunning (fig. 2.58).

Fig. 2.58 A transverse nose-flute known as the garo olongma

The identical flute is seen in figure 2.59 being mouth-blown as part of a performing ensemble.

Fig. 2.59 Performance group of Garo Community

2.12.1.3.3 Transverse flute with four-hole

Another type of transverse flute with a less clear origin is the three- and four-hole transverse flute, which is played by several indigenous groups. Although they could be an older kind, they have a construction that is similar to six-hole flutes. Figure 2.60 depicts a pair of these flutes, which are played by the Mey people of Rupa, Arunachal Pradesh.

Fig. 2.60 Transverse flutes with four holes, Mey of Rupa

2.12.1.3.4 Transverse flute with Single-hole

The Garo singatek single-hole transverse flute is a very beautiful transverse flute (fig. 2.61). There are no fingerholes on this since it is constructed from a short piece of bamboo. The end closest to the blowhole is closed, and the player's hand seals the distant end. By partially stopping and unstopping the open end as well as overblowing, several sounds can be produced.

Fig. 2.61 Singatek, a garo single-hole transverse flute

2.12.1.3.5 Transversal and fipple flutes combined

One of the most distinctive instruments used in Northeast India is a hybrid of a transverse flute and a duct flute. This instrument is played by both the Khasi and the Mog. The flute may be played similarly to a European recorder since it includes a duct. However, it features a sizable vent hole and may be blown like a transverse flute by turning the instrument at a right angle. This instrument is known as tanglod in Khasi.

2.12.1.3.6 Transverse flute at a Right-angle

The sapouli, a transverse flute with a right angle played by some Kuki communities, is among the most unique flutes used in the area. The flute is built from a naturally hollow plant stem that is attached at a sharp right angle to the main sounding tube to extend its effective length. The result is a polyphonic sound in which higher notes and low fundamentals both sound simultaneously. To add to the complexity of the chordal sounds, the musician will occasionally hum or sing into the instrument. This appears to be highly unusual from an organological perspective and requires extensive more research. A Kuki flute is demonstrated in figure 2.62;

Fig. 2.62 Transverse flute at a right angle, Kuki

2.12.1.4 Duct flute

The European recorder is a common example of a duct flute, which is a flute where a constrained tube directs the air through an edge. As previously mentioned, duct and transverse flute work together. However, most Naga groups play the common duct-flute. Six fingerholes and a prominent beak are typical features of the instrument.The duct-flute's common names are listed in Table 4;

Ethnic group	**Vernacular name**
Angami	*lou*
Ao	*jemji*
Khiamngan	*poipoi*
Konyak	*wewo*
Lhota	*phillili*
PhoM	*jemji*
ReNgma	*kheli*
Sangtam	*khongkholi*
Sema	*fulili*
Zeliang	*nthiam*

Table 2. Vernacular names of the duct-flute

A unique type of duct-flute is the external-duct flute, which is performed by the Hruso people of Arunachal Pradesh (fig. 2.63). It is made of cane and covered in a sticky black substance. The external duct is mounted outside, there are five fingerholes, and the pitch is also utilised to cover the external duct.

Fig. 2.63 Hruso flute's duct

2.12.2 Trumpets and horns

2.12.2.1 Trumpet, horns and others

The way the sound is created on trumpets and horns is different; the performer pushes their lips against an embouchure and forces air through them. They provide the function of a natural double-reed in this fashion. Trumpets and horns were "natural" instruments for the most of European music history, meaning that the player's ability to produce the natural harmonic sequence through lip tension was absolutely necessary. The majority of Northeast Indian instruments do not typically have fingerholes or keys, which are modern innovations from the seventeenth and eighteenth centuries. Although it is a little contrived, the distinction between "horn" and "trumpet" is meant to reflect one between a cylindrical bore (trumpet) and a conical bore in this context. Animal horns, which are naturally conical, are the most typical type of horn.

Fig. 2.64 Duct-flute external, Hruso

2.12.2.2 Trumpets

2.12.2.2.1 Thigh-bone trumpet

In the areas of Arunachal Pradesh that have a Buddhist influence, the thigh-bone trumpet is one of the most unique trumpets. Using a human thighbone that has been cleaned and cut at one end to form an embouchure, this object was made. This is commonly used in Buddhist ceremonial music together with an exclusive collection of instruments, including the drum, shawm, long trumpet, and cymbals. These tools are what Tibetan Buddhism is known for. In Rupa, West Kameng District, Arunachal Pradesh, one may observe the use of such a trumpet by the Mey [Sherdukpen] people (fig. 2.65).

Fig. 2.65 Human thighbone-based trumpet, Mey of Rupa

2.12.2.2.2 Long trumpet

The sort of long trumpet constructed from a naturally hollow plant stem is typical of this area. Some of these can reach lengths of several metres. The entire song is made up of exaggerated notes, much like the European bugle. The Kuki tribe may be seen playing one such trumpet in figure 2.66.

Fig. 2.66 The Long trumpet, Kuki

The Garo people play the adil, a different kind of long trumpet (fig. 2.67). A buffalo horn that has been hollowed down and fastened to one end of a piece of bamboo to serve as the adil's bell. Only brief bursts of soundlike impulses can be generated by the player.

Fig. 2.67 The Long trumpet, Garo, Adi

A trumpet from Assam is seen in figure 2.68. It was built by inserting a number of graded gourd sleeves one within the other.

Fig. 2.68 Fitted gourd sleeve trumpet from Assam

Long trumpets that are paired and fashioned of bronze or silver are prevalent in Tibetan Buddhist-influenced regions on the other side of the region. In Tawang and nearby gompas, they are audible every day. A pair of long trumpets are being blasted during the Choskor festival in Old Dirang, as shown in figure 2.69.

Fig. 2.69 Monpa of Dirang Long trumpets in pair

2.12.2.2.3 Short trumpet

Long and short trumpets are played in quite different situations, despite the fact that there is no real organological distinction between them. For this reason, they are separated here. An instrument similar to those used in Indian subcontinental temples is played in Assam—a small bronze trumpet (fig.2.70). It suggests that the Hindi name is likewise linked to the term "karranal."

Fig. 2.70 Assam short bronze trumpet

2.12.3 Horns

2.12.3.1 Side-blown or transverse horn

A Naga side-blown horn is seen in figure 2.71. The mouthpiece is a little hazy and appears to have been sliced across the horn at an angle.

Fig. 2.71 The Naga transverse buffalo horn

2.12.3.2 End-blown horn

2.12.3.2.1 Conical end-blown horn

In Northeast India, end-blown horns are uncommon, however they can be seen in Assam. A typical Assamese horn is seen in figure 2.72, complete with a little mouthpiece fashioned of buffalo horn.

Fig. 2.72 Assamese end-blown buffalo horn

The monks of Tawang monastery call people to assembly in the main prayer hall using the Wong end-blown horn, which is another end-blown horn (fig. 2.73).

Fig. 2.73 End-blown ox horn, wong, Tawang

The end-blown bronze horn with a flared bell that depicts a dragon is one of the most recognisable instruments in the Buddhist tradition. Also Tawang and Bhutan also play these, making them quite popular (fig. 2.74).

Fig. 2.74 bronze trumpet with end blowing, *kang ling*, with dragon mouth

2.12.3.2.2 End-blown vessel horn

The end-blown conch, in addition to conical horns, is a highly distinctive instrument of this region. Technically, this is a vessel-horn or globular. Blown conches are frequently used in Buddhist rituals, such as those held in the highlands of Arunachal Pradesh, and are closely tied with Buddhist ritual. They appear to be employed by those who have been influenced in some way by Hindu heritage, but they are also a very old instrument in Hindu imagery. The double conch, which requires the player to blow on two instruments at once, is a peculiar instrument used by the Meithei people. Such a tool is seen in figure 2.75;

Fig. 2.75 Meithei double end-blown conch

2.12.4 Double-reeds or shawms

When a musician blows through a double-reed instrument, two pinched reeds are brought together to create sound. The European oboe is the most well-known double-reed instrument, although the family of instruments that includes it is most commonly referred to as shawms.

These are common in Northeast India and appear to have various historical origins. Extensive shawms with enormous ornate silver bells are connected with Buddhist ceremonial music in the northern, Tibetan, and Buddhist-influenced regions. People like the Monpa play them along with cymbals and long trumpets. Typical pair of these shawms, together with cymbals and long trumpets, are shown in Old Dirang in bellow mentioned figure 2.78, where they were performing at the Choskor festival. The traditional North Indian shenai, a wooden shawm with seven fingerholes, is played in the middle Assam plains. There are several folk-shawms of unclear provenance among the Bodo-Garo and Khasi. The Khasi play a seven-hole shawm called tangmuri that contains a removable wooden bell. (Figure 2.76). A stunningly long shawl called a muri is used by the Dimasa, a Bodo-Garo tribe, to accompany dance-music.

Fig. 2.76 Khasi shawm, *tangmuri*

Fig. 2.77 A Long wooden shawm, Muri, Dimasa people

2.12.5 Single-reeds or clarinets

Single-reed instruments are those that have a single reed and are played by blowing through them to produce a sound on a surface. The idioglot clarinet, which employs a small reed that is sliced from the surface of a cane tube and is placed into a larger wooden or cane tube, is the sole single reed instrument type found in Northeast India. The same term as the shawms—muri—appear to be used to these instruments, which are apparently a kind of double-reed. In terms of organology, they are very unlike. The Karbi, also known as the Mikir people, are the main ethnic group that uses these clarinets.

Fig. 2.78 Paired shawms, Monpa of Dirang

Two specimens of Karbi idioglot clarinets are seen in figure 2.79, each having cane sounding tubes and bells made of wood or animal horn. The names of the instruments imply that there are two different regional variations; one has seven fingerholes and the other five.

Fig. 2.79 Wooden and horn bells, idioglot clarinets, and Karbi

2.12.6 Free reeds

The tongue of the free-reed is carved into a frame, typically made of the same material, making it a unique form of reed. The tongue trembles against the frame in the small space between them, agitating the atmosphere. Only civilizations in South and East Asia are known to use free-reed instruments, but since they were incorporated into the European instrumentarium, they have spread to other parts of the world in the form of the concertina, harmonica, accordion, and harmonium. Instruments' range is constrained since the free reed, in contrast to other reeds, does not overblow. Finding a means to sound several pipes of various lengths was the key to expanding the range. The mouth-organ is made up of several graded pipes, each of which has a single free reed that produces a distinct pitch. These tubes are put into a wind-chest and can have their ends within the chest or penetrate it. By blowing into an embouchure attached to the wind-chest, the musician simultaneously forces air through all of the pipes. The sound of the pipes can be reduced by blocking the fingerhole located above the wind chest. Thus, all pipes must be shut off save for one in order to play a single note. Because of this, the mouth-organ is well suited to playing chords and different kinds of polyphony, which creates its distinctive sound.Numerous instruments built on the free-reed concept may be found throughout SE Asia, but the seven-pipe mouth organ with a gourd resonator is the sole free-reed instrument that has been discovered in NE India, which is the westernmost location where this construction method has been used. Two rows—three and four pipes—each consist of seven pipes. The Kuki people are seen in figure 2.80 playing a mouth-organ with seven pipes.

Fig. 2.80 Mouth-organ of Kuki People

2.13 Lamellophones

A lamellophone is a musical instrument with a flexible tongue that produces sound and is fixed at one end. A musical box is an example of one. Northeast India only uses the Jews' harp variety of lamellophone. The air space between a frame and a vibrating tongue amplifies the sound when the tongue is enclosed in a frame. The Jewish harp resonates in the mouth, and by changing the shape of the lips, the musician may elicit a range of harmonics and therefore create a melody. Jews' harps come in two different varieties in Asia: those made of metal, often iron or bronze, and those made of bamboo or wood.

The vibrating tongue in the bamboo instruments is activated by a cable that is linked to its projecting tip. Both the Naga and parts of the Arunachal Pradesh inhabitants play the Jews harp in the region. The Hruso people of Sakhrin village may be seen playing a bamboo Jews' harp in figure 2.82. Figure 2.83 depicts a wooden Jews' harp from Bengal, whereas figure 2.81 depicts a metal Jews' harp from the Mog or Arakanese people of Tripura.

Fig. 2.81Mog metal jews' harp

Fig. 2.82 Bengali jews' harp

Fig. 2.83 Jews' harp of Hruso

2.14 Electrophones

All contemporary instruments that produce sound electrically rather than by the direct vibrating of the air are called electrophones (Thomson, 1993; Overy, 2000, 2003). Electronic pianos and organs are the only ones that are often utilised in Northeast India, despite the fact that many of these instruments were developed in Europe and America. The music of the community does not yet include them, though. Both religious and urban pop music groups use them. Electrophones are typically not thought of as amplified instruments.

2.15 Musical ensembles

The majority of the time, musical instruments are played in groups, making it crucial to record these groups and specify which instruments are played with which others and for what purposes. Unfortunately, there aren't any current descriptions of this location, thus future study in Northeast India will need to fill that gap.

2.15.1 Shawm and drum ensembles

The shawm and drum ensemble is a form of group that is common to both mainland India and the Sinosphere

Fig. 2.84 Garo flute and zither ensemble

Typical Khasi drum and shawm ensemble may be seen in figure 2.85.

Fig. 2.85 Khasi shawm and drum ensemble

2.16 The Bodo tribes of North-east India's traditional musical instrument expertise

A race of Mongolians known as the Bodos or Boros is said to have originated in a nation located in Western China, north of the Himalayas. A broad group of people who speak the Tibeto Burman languages of the North and East Bengal, Assam, and Burma are included in the term "Bod," which refers to a homeland whose residents are known as Bodo phicha or Bodos. Bod, which signifies Tibet, is where the name "Bodo" originates (Whitehead, 2001). They were referred to as "Kiratas" during the Epic era that arrived in Assam about 2000 B.C., according to Dr. Suniti Kumar Chaterjee, a well-known historian, who believes they are the descendants of the son of Vishnu and Mother-Earth. This society has a long history and is known for its unique eating customs, mythical religions, and socio-magical rites. The Bodos' events have a strong connection to dance and music. They perform dance and song at practically all of their festivals since they are essential parts of their rituals. As a result, these tribes' musical instruments have a huge impact on how diverse the Bodo culture is. Using these conventional musical instruments, seasonal holidays like Domashi, Boisagu, Kangali bihu, and other religious festivals like Kherai and the Garja puja are celebrated with fanfare. These musical instruments are all widespread in the civilization but quite different from other Aryan musical instruments in terms of size and construction. The origins of the numerous Bodos musical instruments are the subject of several mythology. Although the origins of the various musical instruments used by the Bodos are not specifically described in the myths, they do provide information on how the instruments were initially employed by the Bodos during various festivals and festivities (Cheek and Smith., 1999). All of these instruments are constructed of bamboo or wood, with some of them additionally being made of brass metal. The culture of the Bodo people is extensive, varied, and unique. The Bodos' farming methods, eating habits, and philosophical beliefs are a synthesis of elements from both Aryan and Mongoloid cultures. Folk music is a type of traditional music that has no recognised creator and is passed down orally from generation to generation based on the values and traditions of the common people in this community. Eight musical instruments are played by the Assamese Bodos: "Kham," "Siphung," "Serja," "Jotha," "Jabkhring," "Gangona," "Bingi," and "Thorkha." All of these instruments are associated with distinct types of traditional music and folk dancing. The plants mostly used to make these folk musical instruments are Bambusa assamica Barooah & Borthakur (Poaceae), Bambusa tulda Roxb. (Poaceae), Bambusa pallid Munro (Poaceae), Alstonia scholaris L. (Apocynaceae), Sterculia villosa Roxb.

(Sterculiaceae), Sansevieria roxburghiana Schult.f (Agavaceae) and Artocarpus heterophyllus Lam. (Moraceae) (Haley, 2001). The following plants are utilised in the Bodos' traditional musical instruments:

a) "Siphung": This specific bamboo, known as Owajlaw (Bambusa pallida) and Owathare (Bambusa assamica), is used to make the long flute. It is about 27 and 29 inches long and has one hole for blowing and five holes for playing. At events like Kherai Puja, Garja Puja, Boisagu Festival, Domashi Festival, and wedding ceremonies, it is played. On the opening day of the Boisagu festival, it is ceremonially performed in accordance with this notion.

Fig. 2.86. Siphung

b) "Serja": It resembles a harp and has three strings composed of wood from Alstonia scholaris and Artocarpus heterophyllus. Hollow and partially wrapped in goat or maphou (iguana) skin, the lowest section of the body is hollow. It contains four threads composed of either sterculia vilosa bark or muga silk. Four puthis, or tuning knobs, one ghora, or bridge, and a bamboo bow with a string made of horse tail hair, Odal (Sterculia villosa) bark, or fibres from Sansevieria roxburghiana leaves make up the instrument's accessories. The Boisagu and Domashi festivals, as well as wedding ceremonies, all feature this instrument.

Fig. 2.87. Serja

c) “Bingi”: - It has only one string and is a single blowing instrument. Its body is composed of bamboo (Bambusa tulda) with a coconut shell affixed at the bottom and a wooden frame. The whole wooden or bamboo section of the instrument known as the trunk is lengthy at first, extending from the apex all the way to the coconut shell. The coconut shell is divided horizontally, and the best section is picked for attaching it to the base. This area is slightly larger than half. Goat leather has been applied to the whole surface of the shell in such a way that the shell is punctured by the goat's trunk. Below the string, there is a little bridge on the leather composed of tightly coiled Muga threads that resembles a single thread. The bridge is used to align the string correctly and provide comfort when playing. A bamboo piece bow is used to perform the performance.

d) “Thorkha”:- It is produced from Bambusa tulda. A piece of bamboo is split down the middle and used to create the bamboo clapper, which is played by holding it with both hands. The majority of the Bodo women utilise it during the Boisagu and Domashi festivals, and its length can range from 2-1/2 feet to 3 feet.

Fig. 2.88. Thorkha

e) “**Kham**”: It is a substantial drum with a diameter of approximately 2 1/2 to 3 inches and a length of about 3 1/2 to 4 inches. The stem of the Alstonia scholaris, Artocarpus heterophyllus, Magnifera indica, or Sterculia villosa trees is used to make it. While the bracing are made of buffalo leather, the two sides of the timber frame are covered in deer or goat skin. On ceremonial events like Kherai puja and Garja puja, this instrument is played.

f) “Jotha” (Cymbal):- In English, the zotha is known as a cymbal. It is a musical instrument that looks like a basin that is hammered in pairs. It is bought from the market and is the same size and form as those used by the players of real Indian music. When music is played at the Boisagu, Domashi, Kherai, or Garja festivals, it is utilised to keep time.

Fig. 2.89. Jotha

g) "**Jab-khring**":- Small, rounded pieces of metal sheet are placed into a wooden frame. Wood and metal pieces generate a clapping and jingling sound when two wooden frames are banged against one another. It is mostly utilised in wedding ceremonies, Boisagu festivities, and Domashi celebrations. It is produced primarily from Alstonia scholaris or Artocarpus heterophyllus wood.

Fig. 2.90. Jab-khring

h) "Gongona":- The Boros play gongana, commonly known as the Jew's harp, which is a kind of wind instrument. Bamboo (Bambusa assamica) is used to make it. It is flat with a single internode that ranges in length from 6 to 7 inches and breath size from 1/2 to 3 inches.

Fig. 2.91. Gongona

The inside side of the broader end includes a ridge hook to grasp the object in between the lips in a balanced position. An extremely strong thread is used to tighten the tapering opposite end. In the Boisagu and Domasi festivals, it is mostly played by ladies and young girls.

2.17 Mising Tribe's traditional musical instruments

Rich folk music is produced in the Mising community. There are certain characteristic types of traditional instruments played in Mising folk music, such as ejuk tapung, derki tapung, tumbo tapung, tutok tapung, dendun, and tulung, in addition to some common musical instruments like dumdum, lupi, marbang, le:nong, etc., used in the "Gumrag" dance performed by other locals. All of these musical instruments are employed in the folk songs performed by Mising adolescents during celebrations of festivals and rituals, as well as when they are working in the fields, forests, or somewhere else. Each has its own set of laws and is an essential component of the Mising soman (dance). All of these musical instruments are divided into numerous categories based on how they make sound, including:

Beat (Percussion) Instruments: The most popular musical instruments in Mising culture are the beat instruments known as "demna" or "di:la mannam." It is stated that before any form of musical instruments were created, people in the past would dance and sing while creating sound by striking the mud with their hands. Later, it switches to beating tiny pieces of bamboo and wood that gradually took on the shape of an instrument. Similar to how the Mising culture from the past to the present originally used these traditional beat instruments. Here are some of them:

A) **Dumpag:** It is constructed of bamboo and is about 18 inches long. It resembles a cylinder with one side open and the other closed to maintain the node or junction in the middle. The sound is then produced by playing beats with a stick on a tiny hole that has been gently peeled out of the centre of the node. The majority of the time, cowherds utilise this instrument in the fields and at celebrations.

B) **Dentulung:** Similar to a cylindrical tube, this instrument is likewise composed of bamboo, however in this case, both sides are left open. Dentulung is the name of the instrument because it creates the sound "dentulung dentulung" when struck with a stick. While assisting with fieldwork, it is typically performed by boys or young children.

C) **Dendun:** The most basic musical instrument is composed of bamboo in the shape of a cylinder with one end closed by a joint and the other end open. To make noise, you simply hit it with the stick.

D) **Dentug**: An instrument with bamboo strings is this. A bamboo stalk is sliced into a closed cylindrical tube while maintaining the joints or nodes on both sides to create this instrument. After that, two sticks are placed through a string-like cutout on opposite sides of the surface that has been neatly peeled. The player used a stick to strike the string created on the peeling surface in order to create sound.

E) **Le:nong:** This metal musical instrument features an ear-like structure over both of its metal surfaces and is shaped like a disc. In order to suspend and wrap the le:nong, which produces a loud vibrating sound when played, fabric ropes are fastened through the holes in this ear-like device. Le:nong used to be a specific song sung in the Mising culture to tell people of their passing. It is said that when a member learns of a death, they walk to the top of the home and play the le:nong aloud to call the mourners to the deceased person's home.

F) **Marbang:** The marbang is a similar metal instrument to the le:nong in that it is shaped like a disc and produces music by causing rope cloths to strike one another. Le:nong and marbang are both priceless instruments that are valued as heirloom possessions in the Mising culture. Both are performed during significant events, including religious rituals, kebang, gumraag dance, and other deserving examples.

G) **Lu:pi**: The Misings play a different type of percussion instrument called lu:pi. The weight of this instrument ranges from around 12 kg to an enormous 3 kg. It is constructed of metal in the shape of a disc, and when two of them collide, they make music. Due to its methodical rhythms and chirping sound, lu:pi is typically accompanied by dumdum during dance performances that support the young people in the Mising culture as they celebrate the festivals through music.

H) **Koktar Toka:** To create this instrument, a cylindrical bamboo with a cork at one end is sliced in half from the side with the opening, and the two halves are struck against one other to produce music. In the Mising culture, women do the soman (dance) by alternately clapping their hands and using the koktar toka to maintain time with the beat.

I) **Dumdum:** The usage of "dumdum" in Mising culture began far later than the adoption of any other musical instrument by the Mising tribe. It is thought that the Mising tribe did not previously employ the "dumdum" as a musical instrument; rather, its use began after the group moved into the Assamese plains. It is constructed from a wooden barrel that has been hollowed out from the inside, leaving the two ends exposed. Animal skin is then wrapped over the exposed ends to completely encase them. The tightening and relaxing of the skin completely determines the dumdum's sound frequency. Despite the fact that this instrument was created later, it is the one that is played the most frequently during rites, ceremonies, and festivals since it blends in so well with the other instruments.

Wind Instruments: From their earliest use in ceremonies through the creation of many sorts of them up until the present, the Mising community has long treasured wind instruments (mudla mannam) and has the most of them in comparison to the other musical instruments. Some wind instruments are frequently used in ceremonies, festivals, and hunts, and the sounds they make evoke strong magic in the ears of listeners. The Mising community also produces a variety of wind instruments from natural resources, including:

A) **Ejug Tapung**: Among all the wind instruments used in Mising music, the ejug tapung is the oldest. This instrument is created from a particular variety of wild round bottle gourd, or "ejug" in Mising. According to legend, the Mising tribe has historically packed rice, water, apong (rice wine), and other items in the casket of ejug (bottle gourd). A mature bottle gourd is first cut from the tree and let to dry on the kitchen's smoke shelf before being used to produce ejug tapung. The seeds are carefully extracted from the inside of the gourd after a few days, when it has completely dried up. Next, the stem part is formed into a hole. The bottle gourd is then fitted with a bamboo instrument resembling a flute. This item resembles the "pungi or bin," a wind instrument used by Indian snake charmers. The three different varieties of ejug tapung include:

B) **Tumbo Tapung, Pumsu Tapung and Li:sig Tapung:** Tumbo tapung is the name for an ejug tapung with one prong. This instrument is produced by attaching a single bamboo flute to a dried bottle gourd. Six specifically formed openings on the flute allow sound to be produced. The two-prong hole of the pumsu tapung, where flutes are fastened, is well-known. It contains four embouchures in total, two of which are on the bottom of each flute and create sound. As opposed to the li:sig tapung, which has three prong apertures and five embouchures to create music. To create this third instrument, two flutes with two holes each are first connected to the bottom of the dried gourd, and the third flute, which has just one hole, is then placed at a 45-degree angle to the top of the same gourd. In folk songs like kaban (songs of mourning), selloi nitom (songs of celebration), and lereli nitom (sheer songs performed while visiting old acquaintances), all three of these varieties of ejug tapung are employed.

C) **Derki Tapung:** Similar to a flute, derki tapung is a type of bamboo instrument. In order to create this instrument, a single piece of bamboo is typically carved into a tubular shape that is about 1.5 feet long. At the end of the tube, six specially shaped openings, or "embouchures," are made, through which the maker blows to create a vibrating column of air whose pulsations are heard as sound.

D) **Tu:tog Tapung**: Similar to the derki tapung, the tu:tog tapung is a significant musical instrument that is made out of a single piece of bamboo and measures 14 inches in length. It has blowholes lined with cork that, when played horizontally, make sound from the movement of air over them. They still use the derki tapung and tu:tog tapung in their traditional songs nowadays.

E) **Jegreng Tapung**: Similar to the "pepa," the jegreng is another wind instrument used in the Mising culture, notably during the Gumrag dance. It is made partially of bamboo and partly of buffalo horn. To manufacture it, buffalo horn must first be softened by being submerged in warm water or cow faeces. After a few days, the buffalo horn's tip is chopped off and attached to a 15 cm long bamboo cylinder in a cylindrical fashion. When the player blows while directing their lips towards the bamboo ends, the horn end of the instrument opens out like a cone and emits sounds. In addition to helping certain distinguished visitors, it serves to greet the bride and groom. Although this instrument has been a part of culture for a long time, it is currently less well-known.

F) **Tu:lung:** It is a single-blow instrument with a bamboo body shaped like a cylindrical tube and a bamboo frame body. It used to be constructed of buffalo and mithun horns as well. The loud sound of this instrument is said to awaken a person who has fallen asleep because of a long-term sickness in the Mising culture. Additionally, it was played before battles or to warn the villagers of an impending enemy onslaught. However, in the modern era, less people are familiar with this instrument.

G) **Dumpe**: The "dumpe," another native musical instrument of the Mising people, is frequently used by hunters to entice wild animals and birds when they are out in the woods. It is formed from a shrub's leaf known in Mising as "tokam agleng." One end of the leaf is maintained smaller throughout the specific rolling process so that it may be blown into the mouth. The instrument's blowing makes a particular sound that attracted the woodland hunters.

H) **Gunggang**: It is a bamboo instrument with a bifurcation on one end that features vibrating reeds. During the festivals, the ladies play this instrument while dancing, usually tucking it into a bun of their hair.

I) **Bu:bung:** During the Mising dances, the bu:bung is utilised with the drum, and it is said that if one plays this instrument, it will rain. This instrument is made by first peeling a bamboo stick that is 8 to 10 inches long into a narrower size, and then securely tying an eri silk thread to one end of the stick. The **instrument** is known as bu:bung in the Mising culture because of the "bu:bung" sound it creates when played.

J) **Pi:li:** The three varieties, which are both referred to as pi:li, make up the smallest musical blowing instrument. One kind is played exclusively by attaching it to another instrument known as jegreng tapung during festivals, and the other type is typically played by boys while tending to their cows in the field. Both types are created out of a tree branch that is approximately 2 inches long. The third sort of pi:li, which is mostly used by kids, is constructed from a rice plant stem that is about 1 cm long.

Other Instruments: The only way to play these "Gilugiyar" musical instruments is in combination with other instruments. These are often only used sometimes during rites or ceremonies, making them less well-known to Mising youth and more prone to be lost in the present. These instruments all differ from one another due to their various construction materials and sound-producing methods. like as

A) **Yoksa Sapereng:** A metal blade with a hardwood handle is what is known as a "yoksa sapereng." Only priests or shamans of the Mising tribe known as Mi'bu utilise the instrument, which is around 25 to 30 inches long with a sharp edge and metal feather-like ring plates connected. The priest sings the auspicious song (ahbangs) and dances while standing in the middle of the queue, surrounded by three or four other dancers who are chosen from among the spectators, according to tradition. The Mi'bu perform the ritual dance known as "Mibu dagnam" while holding the yoksa by the handle. When the plates strike each other to produce a chiming rhythm. The Mi'bu wears a loincloth, a short-sleeved coat, a metallic sword hung on the right side, a leather bag slung on the left side, a few bead (dogne) necklaces, and a few other items when performing the dance. This ceremonial dance, which is done with a 'yoksa sapereng' instrument, has been a part of Mising culture for a long time and is revered by the community despite the fact that there is no clear origin story for it. Consequently, the Mi'bu sword falls within the musical instrument category as well.

B) **Raiko:reg:** It is a Mising tribal native musical instrument that the younger generation scarcely knows about. From a betal nut tree, a smooth piece of wood was curled into this instrument. After that, a few tiny incisions are created in the smooth surface, and a wild pig or boar's teeth is rubbed against it to make vibrating noises.

C) **Deoghanta:** The deoghanta has long been a part of Mising tradition as a musical instrument used by the Mi'bu (priest) of the Mising tribe to sing for a family's well-being or to start an event. This instrument is also used in a ceremony in which the Mi'bu sings the auspicious "Yal" melodies to bring about relief while praying for the release of a victim from an evil spirit. For this reason, the deoghanta is regarded as another musical instrument used by the Mising people.

D) **Kekung**: A stringed instrument, that is. The base is formed from the coconut or bamboo shells, and the body is composed of bent wood to which a few pieces of cork are strategically fastened to keep the string taut and sustained. After that, a silk rope is fastened to the body, and when struck with a horseshoe chip, it vibrates and makes noises.

E) **Ramtaal:** The Mising priest typically uses this instrument, also known as a kortaal, in religious ceremonies. The sound is produced by striking two cylindrical bamboo blocks that have been cut in half against one another. In order to keep track of the beats and as an alternative to hand clapping, the ramtaal is typically played.

The Meghalaya people play a variety of musical instruments at their religious rites, festivals, marriages, and other celebrations. Musical instruments from Meghalaya are utilised in dance, singing, religious gatherings, and other public performances. Folk songs, indigenous instruments, and other elements set Meghalayan music apart (Pitts, 2007). In addition to having a large number of punk musicians, the entire nation of Meghalaya is talented in western music. The Northeast is known for its music and the organ, both of which are important. Numerous creative musical instruments may be found in the vicinity. The following are a few of them: Garos's music is traditional, with the exception of their use of modern musical instruments and melodies. Generally speaking, there are four types of Garo traditional musical instruments (Clift and Hancox, 2001).

A) **Idiophones:** Materials that resonate both naturally and artificially, such as rangkilding, nogri, rangbong, kakwa, nangilsi, guridomik, and kamaljakmora.

B) **Aero phone:** The sound produced when a wind instrument such as the Aadil, Singgaa, Shanai, Kal, Bolbijak, Illep or Illip, Olongna, Tarabengh, Imbanggi, Akok or Dakok, Bangsi rosii, Tilara or Taragaku, Bangsi mande, Otekra, Wa'ppe or Wa'pek, vibrates in a pipe.

C) **Chordophone:** Sarinda, Dotrongg, Chigringh, Dimchrang or Kimjim, Gongmima or Gonggnaa are examples of stringed instruments.

D) **Membranophone:** They are arranged in a frame covered with skins or membranes: Ambengdamaa, Chisakdamaa, Atong damaa, Gaaraganching dama, Ruga and Chibok dama, Dual-matchi dama, Nagraa, Kram etc.

2.18 An explanation of a few well-known musical instruments from the Garo community:

a) Kram

The drum is not as large as a Dama. It is constructed of wood with ends covered with leather. The Kram taper significantly thinner on one side and is larger on the other. They are only seen at serious events, such funerals and some yearly religious gatherings, when the Duma is still in use. The owner's house and the Kram are inseparable, save in dire circumstances or when the Garos is believed to bring bad luck.

Fig. 2.92. Kram Musical Instrument

b) Dama

It is a long, thick drum with shrimps on either end or the thickest part in the middle. It is made of wood and may reach a length of 4 to 5 metres. A hardwood drum, cylindrical and bifacial. Both faces are covered with flesh and have crimson belts around them. Red and golden hues, brightness. Both hands were playing while it was horizontally dangling from the neck. Tribes from the hilly parts of Meghalaya use this.

Fig. 2.93. Dama Musical Instrument

c) Nagra

It's an amazing pot of barrels filled with a cowhide drum. To invite people to a joyful or entertaining rally at Nokma's Home is simply to be defeated. Since the Nagra is a sacred object, only Nokmas may possess it; it cannot be taken out of the Nokma structure. The Garos say that if Nagra is removed from Nokma's home in any way, bad things will probably happen to the founders. The Nagra cannot be overthrown by anyone else; only the current owners or its partners may do it.

Fig. 2.94. Nagara Musical Instruments

d) Gongmina or Jew`s Harps

The Jew harp is made out of a thin, precisely cut piece of bamboo that is about 4 cm long and 1/2 inch high. It is cut so thinly that the centre of the brief, which has only one end, slides down a little tongue. A little handle is attached to one end of a small string that is fastened to the Jew's harp. The cord is secured with the sharp pull in the right handle, and it is positioned between the thumb and fingers of the left hand so that it reaches the tooth.

e) The Trumpets

There are two varieties of Garo trumpet used in the drum accompaniment.

1) **Adil-** It is a narrow trumpet with a bamboo mouth that has a buffalo horn mounted on top of it. It need around six inches.

2) **Singga-** Just two or three breaths are needed to produce the sound, which is really the buffalo's full horn.

f) The flutes

All Garo flutes are constructed entirely of bamboo. Neither are they registered or painted.

1) Otokra- This is a gigantic two-hole bamboo flute, measuring about 3 feet and 1 inch in diameter.

2) Illongma- It's a little bamboo flute with three steps.

3) Bangsi- Compared to other notes, the flute is somewhat smaller.

4) <u>Imbingi</u>- A other type of flute, with one end closed and the other open, is fashioned from a little piece of bamboo. The soft white portion beneath the rigid outer coat of the bamboo is pooled. Located at the top of the closed end, the mouthpiece has a square aperture measuring half an inch. By cutting the stripped bamboo at a depth of approximately 0.5 inches on each side, a little slip or tongue is created from the mouthpiece through the top surface.

5) <u>Dakok</u>- The Longest Flute Is This.

g) Rang or Gongs

Brass, brass, or basin coverings are used for the gongs and rangs. The Garos utilise them for many purposes. Festivals and dances are performed as musical instruments. When a person's social standing and level of riches are determined by how many ranks they wear, they are frequently viewed as a gold mine. A deceased Nokma is placed in the queue before to the cremation. In the event of legal problems, the coupable is required to pay the fine in Rangs. There is an age significance to these gongs.

h) Cymbals

There are two types of cymbals made by the Garos. These are the ones that follow.

1) Kakwa- The cymbal used by the Hindus on the plains is somewhat similar to this one.

2) Nenggilsi- Compared to the first cymbal, it is less. It appears to be two little brass cups. By beating against one another, these cymbals are utilised in unison with another instrument.

The Garos are not the only musicians who play many instruments. There are many drums available, including Kynphong, Naila, and Padiah. Though most of them are round, a few have an angle towards their heads, like a cucumber from the centre. After the wood frame has been sufficiently cured and oiled, chopped oak is used to hallow it, and the heads are left exposed before being covered in skin pads. The drums are suspended from the shoulder blades to the chest using wire in both scenarios, and the drummer uses his hand to strike his head. Similar to drums, harps have unique models, such as Singdiengphong, a basic eight-string harp made of soft bamboo from bamboo reeds and bark. Diengphong is performed to the accompaniment of a song or music.

1. ***Natik****: It’s a Small accompaniment drum*
2. ***Dimchang/Kimjim****: It’s a Flat instrument made of bamboo*
3. ***Chengchap****: Cymbals*
4. ***Chigring****: Stump from bamboo with strings.*
5. ***Serenda****: Violin type of instrument.*

2.19. An explanation of a few well-known musical instruments used by the Khasi and Jain communities:

Whatever Khasi music lacks in the formal polish of current schools and genres, it makes up for in its deft interpretation, which embodies simplicity, grace, and a certain amount of complexity. Every holiday and ritual, from birth to death, in Khasi culture is filled with music and dancing (Mukherjee 2005). One may hear the sounds of nature mixed throughout the songs, such as the trickling of a creek, the calls of birds, the buzzing of bees, and the cry of a wild animal. One of the fundamental forms of Khasi music is the "phawar," which is more akin to a "chant" than a song and is typically composed spontaneously on the spot to fit the mood. Other musical genres include lyrics from old ballads, the actions of legendary heroes, and laments from martyrs. Because they accompany the dancing and melody, Khasi musical instruments (Ksing Shynrang, Ksing Kynthei) are also intriguing. Various types of drums and flutes are used. The most common position is occupied by the ever-present Drum. Drums are utilised to 'welcome' participants/ peoples to the gathering in addition to having a festival beat. "Shaw Shaw" (cymbals); "Tangmuri" (a type of flageolet); "Nakra" (large drum) and "Ksing Padiah" (small drum); "Besli" (flute for "solo" recitals); and several other wind instruments, including "Sharati" and "Shyngwiang" (sad or joyful for various occasions); "Duitaraa" (a stringed musical instrument played with a wooden string); The "Spanish Guitar" has gained popularity in recent years and is frequently utilised for festive and everyday entertainment purposes. The traditional heritage of the Jain people is extensive. The Jaintia tribe's art, crafts, poetry, dances, and rituals are all represented in their culture. The tribe is renowned for their artistic bamboo, cane, and woodcarving as well as weaving. Additionally, this is the tribe's main commerce. In addition, they are well-known for weaving silk and carpets and for using pineapple fibres to make jewellery, musical instruments, and other items. The people that live in this district like music. The Pnar people used music to honour the land, hills, valleys, rivers, and other natural features. Traditional musical instruments include ramyNthei, duiitara, ksing / nakra, ramynken, shawiang, tangmurii, etc. Several Traditional Khasi and Jainti Musical Instruments:

1. *Beslie: Bamboo Flute.*
2. *Tangmuri: Clarinet*
3. *Duitara: It is a Guitar-like musical instrument with muga strings.*
4. *Ksing/Nakra: Drums applied on numerous occasions.*
5. *Dymphong: Bamboo instrument that is flat.*
6. *Maryngod*
7. *Marngthing*
8. *Padiah: Small drum with fine sticks to beat.*
9. *Singthap: Beat one side of the drum with a stick, and the other side with your hand.*
10. *Tanglod: Bamboo Flute*
11. *Ksing Kynthei: The drummer was only designated for female artists. Putting wax on only one hand*
12. *Shaw Shaw: Cymbals*
13. *Sharati: used a flute throughout the funeral.*

Fig. 2.95. Khasi Musical Instruments

A) **Duitara** - The duitara is a musical instrument resembling a two-stringed holy guitar. It is an instrument used in traditional music by the Khasis and Jaintias of Meghalaya. You are able to play Duitara with a wooden pick since it is made of robust hard wood. It is attached with four holes at the top using wooden pegs to keep the string in tune. Animal skins cover the whole body of the Duitara.

Fig. 2.96. Duitara

B) **Ksing Shynrang**: A wooden body with two cylinders that is tied together with paper and fastened to the body with leather straps. The drum tuning bracing are threaded with iron rings. Compared to your left cheek, the inside of our right cheek is larger. The larger left face performed with a fist, while the smaller face played with a stick. The Khasi culture of the Jaintia hills uses it in their holy dance festival, known as "Ka Shad Nong Krim."

C) **Ksing-Phong**: fifteen bamboo tubes that are tied together and stand approximately two feet tall. The bamboo sticks' skin is separated from their bodies and thrown away. Two bamboo sticks and two long sticks are positioned in the middle, between the skin and the sticks on both corners. kept a fist and rhythmically struck with the other fist while using a hammer. used in religious and celebration dances among the Khasi of the Jaintia hills and surrounding regions.

D) **Tangmuri**: The Meghalayan people of northeastern India play the double-edged conical-bored wind instrument known as the tangmuri. The musicians who play for folklore performances and other local rites, such cremations conducted in accordance with the traditional Niam Khasi faith, utilise the tangmuri. The tangmuri produces an extremely high-pitched sound when the artist plays it. A 20 cm long wooden chanter with a twisted conical bore and seven finger holes on the front makes up the instrument. A 15 cm long wooden bell with a flared twist is attached to the chanter by a push-fit connection. A thin metal tube with a conical bore and a length of approximately 3 cm is attached to the double-edged tube and is secured in the chanter by a thread weave.

Fig. 2.97. Tangmuri Musical Instrument

E) **Sharati**: This flute was utilised in the funeral rite. The sharati is a different flute that has around eight large holes. Her nose is turned up a little.

F) **Tanglod**: Here is a bamboo flute. The tangod flute is paired with a noisha and a reading.

G) **Beslie**: Here is a bamboo flute. Similar to an eight-hole chuwiang, a besli pipe is made from a slender bamboo split in half and has six or seven holes drilled into the outermost layer after the bark has been carefully scraped.

H) The Trumpets

Trombone is performed in two ways. Horns are the main instrument of the Ronsing and Turoi.

a) Ronsing is a buffalo's naturally bent horn; the inside is sacred, and there's a tiny aperture on either side.

b) The trumpet known as a turoi has a broad brass rim with additional prolonged bends upward.

Only a small number of cymbals have the Kynshaw, which is made up of a pair of smooth copper plates with various marks that are concentrated on the surface. Two pointed or curved surfaces make up the Majra's brass construction. Smashed together with percussion and flutes, they are performed at big dances.

I) **Bom**: Initially, a lone, sizable kettle drum was carved out of soft wood. The thick hide covering the wide mouth was fastened with the help of leather belts. Using two sticks and some padding to play. Usually seen in "Pyrta Shnong" public service announcements; also seen in Meghalaya dancing festivals.

J) **Mieng**: Jews constructed a bamboo harp. A tongue that vibrates is severed in the centre. Firmly clamped between the upper and lower lips and removed with one hand using fingers. The mouth is acting like a resonance organ. Meghalaya and the shepherds and cowherds around utilise it.

K) **Khasi tribe guitar**: It is performed sitar-style. Wood is used to make it. Compared to our Hindustani Slide guitar and Acoustic guitar, this instrument's construction is slightly larger. In Meghalaya, this guitar is performed in a number of orchestras.

Fig. 2.98. Khasi Tribe Guitar

L) **Khasi tribe violin**: This is one of Meghalaya's most renowned instruments. Wood is used to make it. Both hands are used to play it. Utilised by Meghalayan hill people. In Meghalaya, this violin is utilised in many orchestras, festivals, and pujas.

Fig. 2.99. Khasi Tribe Violin

M) **Serja**: This is the kind of musical instrument used by the Bodos; it has four strings and is typically played with a little bow made of strips of bamboo. The bow strings is composed of a little clump of horse tail hair. Serja is most famously made from the log of Sijou (Euphorbia spledens).

Fig. 2.100. Serja Musical Instrument

N) **Kum Dang Dong**: It's a musical instrument akin to Ektara. It is utilised by the Khasi population in the Jaintia Hills' many orchestras and religious dance festivals.

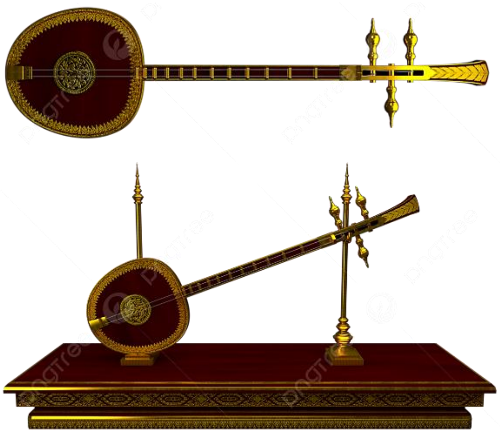


Fig. 2.101. Kum Dang Dong

0) **Marynthing**: A single-stringed instrument from ancient times is the Marynthing. For a drone, it serves as an instrument. There was also a demonstration of another five-stringed Marynthing. At the holy dance festival of Jaintia Hills, it is utilised by the Khasi culture.

P) **Saranga**: It's a musical instrument made of strings. Wood is used to make it. This instrument is played by members of the Tiwa Community. It is utilised at the Tiwa community's sacred dance celebration.

Fig. 102. Serja, Kum Dang Dong, Marynthing and Saranga

We have described above all the new musical instruments that we have found by surveying different places in the North-Eastern part of India. We will discuss the scientific study of those musical instruments in our next chapters.

Chapter 3

A Study of Sumui: A Folk Musical Instrument of North Eastern Part of India

Due to their close relationship with music and their social existence, the Tripuri people of Bangladesh and North-East India have a particular fondness for it. The Tripuri clans' music and instruments are claimed for their richness and profundity of imaginations related to the primary note's entrance. They usually try to maintain the timing and cadence while travelling by beating a drum. The folk music of Tripuri is referred to as Tipra Bharat. The folk songs are as old as the clan and have survived time and again as a custom. The Tripuri people's songs, like those of all other people from other zones, are typically shared with the broader public. These songs were written by people whose personalities are unrecognisable and disregarded in the beginning of their lives together. People's music is influenced by a variety of factors, including enduring traditions, beliefs, superstitions, sentiments, wishes, and the evolution of jhum. The theme of melody has persisted through the ages without change, and up to this day, people still sing society melodies enthusiastically and surprisingly, either in its original form or with minor modifications. People from Tripuri use a variety of traditional instruments. As a result, after a while, the new age population stops using a lot of these gadgets; they are gradually disappearing from the planet. These days, a large number of individuals in Tripuri are ignorant of the names of these instruments or their existence. Many people in their younger years are unable to recognise these instruments. Certain tools specifically aim to shift people's perspectives. We are now going to introduce the Sumui folk music instrument's structure, playing system, construction, technique for producing tune, and fingering chart.

3.1 Introduction

The indigenous Trible People of India's northeast region share similarities with the culture of Tripura. Like Assam, Manipur, Burma, and Southeast Asia, the culture of Tripura is characterised by standard Indian social impact, with Bengali culture ruling over indigenous ancestral customs that are uncommonly practised in those plain zones (Gromko and Poorman, 1998). Seldom does this Bengali culture reach out to the people who live on the slopes of Tripura, particularly the Tripuri culture. North East India contains the state of Tripura. Bengalis made up around 70% of the population in India according to the 2001 census, while 30% of people in Tripura were inborn. The term "indigenous populace" refers to a small number of distinct ethnic groups and clans with different languages and social structures (Bilhartz et al, 2000; Graziano et al., 1999; Orsmond and Miller, 1999; Rauscher and Zupan, 2000; Rauscher, 2002; Costa-Giomi, 1999). With 543,848 members as of the 2001 assessment, the Kokborok-speaking the clan of the Tripuri was the largest inborn group, accounting for 16.99% of the state's population and 54.7% of the total clan population. The remaining prominent clans, listed in decreasing order of population, were the Munda, Kuki clans, Debbarma (16.6% of the inherent population), Jamatia (7.5%), Chakma (6.5%), Halam (4.8%), Mog (3.1%), and Garo Hajong. Due to the large population of Bengali people in the state, Bengali is the language that is most commonly spoken. Many clans speak a language called Kokborok. The unique clan speaks a several different languages that belong to the Sino-Tibetan and Indo-European groups (Hetland, 2000). There are several diverse ethno-etymological groups in Tripura, which have contributed to the development of a hybrid culture. The major societies are the following: Mizo, Mogh, Munda, Oraon, Santhal, Uchoi, Murasingh, Chakma, Halam, Garro, Hajong, Kuki, Reang, Naitong, Koloi, and Jamatia. Tripuran people are fundamentally inherently musical and movement-oriented. India offers a vast variety of folk music that originates from Tripura. Around 1979, the Tripura National Volunteers, who were separatists, made great use of the vocalist Hemanta Jamatia (Bilhartz et al., 2000). He led music in a way. Afterwards, he gave up and returned to his regular life, working on Tripuri folk music. As a reward for his services to Tripuri-language folk and contemporary music, the Government of India granted him the Sangeet Natak Academy (Schlaug et al., 2005).

3.1.1 Culture of Tripura

The sumui, chongpreng, and sarinda are some of their native instruments. Weddings and other formal occasions are occasions when tunes are sung. Every ancestral network has a unique set of songs and dances. During the Goria puja, the Jamatia clan and the Tripuri clan execute goria moves. Other Tripuri motions include the jhum move (also known as the tangbiti move) during the reap season, the lebang move, the mamita move, and the mosak sulmani move (Schellenberg, 2004). The hojagiri manoeuvre, which is executed by young children adjusting on earthen pitchers, is a notable feature of the Reang people group, which is the second largest clan in the state. On the last day of the Chaitra period, the Bizhu celebration occurs when the Chakmas do the Bizhu manoeuvre. Some examples of ancestral movements are the wangala move of the Garo people, the hai-hak move of the Halam group of Kuki people, the sangrai and owa moves of the Mog clan, and so on. Apart from the music of their ancestors, the people of India are also taught old style Indian music.Five Bollywood film music has produced several famous songs composed by the royal family's Sachin Dev Burman, a master of the filmi genre of Indian music. An extensive variety of people's music has come from the Indian province of Tripura. From about 1979 onwards, the singer Hemanta Jamatia's status rose significantly as he became a musical representative of the rebel Tripura National Volunteers. Later, after giving up, he returned to his regular life and focused on working on the Tripuri people's social music. The Sangeet Natak Academy of the Government of India awarded him the highest honour in the music industry for his dedication to the people and the present Tripuri language music. Tripuram folk songs in Tipra Bharot. The custom of folk song has endured over the ages, dating back to the tribe's founding. Tripuri folk songs are as extensively dispersed across the entire population as are the songs of other people from other nations. In the early years of their collective life, these songs were composed by anonymous and impressionable individuals. The themes of the folk songs include historical farming practises, superstitions, emotions, wishes, love, and ancient beliefs. Folk music is still performed by people spontaneously and joyfully, either in its original form or with little variations, and the songs have withstood the test of time almost unchanged. Tripuri songs, whose names translate to "Rwchabmung," include melodies that evoke their own traditions while maintaining a rhythmic pulse. These days, a large number of Tripuris sing the songs from Kok Borok (Tirpuri), which mimic other modern songs, especially the Hindi ones. Since the inauguration of Kokborok at the The All India Radio station Centre in Agartala, this pattern of behaviour has been apparent. Furthermore, the present music director is composing new songs according to its artistic aptitude. Despite the current tendency of imitating songs from other cultures, the melodies and lyrics of Tripuri unique songs are highly renowned. Songs from Tripuri are still highly well-liked.Six, it is difficult to pinpoint the persons involved in the writing of these ancient folk tunes. Through these songs, one may experience the surrounds and survival of the old culture. Folk songs frequently reveal their aspirations, wealth, joy, sorrow, and flaws. Though it is hard to dispute that we frequently find greater enjoyment in older rhymes, new Tripuri compositions are composed using words and melodies from the present era. Like any other country, Tripura's folk songs capture a significant portion of the populace as well as the social, ceremonial, and religious framework of the nation (Catterall and Rauscher, 2008). Tripuri is a spoken language, or what is called a dialect, yet despite this, it has a very rich literary tradition. The folktales and melodies have beautiful rhymes and profound meanings. The Tripuri people are naturally gifted song writers, as evidenced by the songs that come to them on religious and social occasions. The clever villagers use songs and stories to convey their inventiveness, love, and grief, especially the innocent and endearing girls. Through their songs, the Tripuri moms impart knowledge to their daughters, attorneys, and lawyers. Children and young adults are taught moral lessons through storytelling. The pleasant, little Tripuri girls echo and concentrate on the grasslands, hills, and plains. The beautiful sumui-banshi bamboo flute plays along with the tunes. People in the area toil hard all day, but they especially take advantage of the youth to compose and perform music. Translations sometimes struggle to capture the precise meanings and rhythms of folk songs, but the two samples below should give you a sense of the Tripuri folk song's allure (Rauscher et al., 2007).

3.1.2 Bamboo Cultivation in Tripura:

One of Tripura's most valuable and important recurring assets is bamboo. The state is home to a large area covered in bamboo brakes and tropical moist deciduous woodlands with pockets of evergreen backwoods. The annual precipitation varies between 2,250 and 2,500 mm, and the environment is humid to moist. According to the Forest Department of Tripura, there are typically 19 different varieties of bamboo found in the state (Johnson and Memmott, 2006). In the state's forests, there are 3,246 km2 of bamboo-bearing land. Bamboos are commonly referred to as "green gold" and "poor man's timber" because of their ability to adapt to a broad range of climatic and edaphic situations. About 28% of the country's bamboo stock is found in the North Eastern state, and Tripura has 2397 square kilometres of bamboo forests that encircle almost 23% of the state's geographical area. Approximately eighty percent of the state's bamboo resources are muli bamboo, which is the most widely used single stand (non-bunch shaped) variety. In Tripura, there are 21 different kinds of bamboo. The majority of ordinary bamboos are (Trent, 1996 and Cararelli, 2003):

1. Muli (Melocanna baccifera is the scientific name)
2. Barak (Bambusa balcooa is the scientific name)
3. Bari (Bambusa polymorpha is the scientific name)
4. Rupai (Dendrocalamus longispathus is the scientific name)
5. Dolu (Neohuzeaua dullooa is the scientific name)
6. Makal (Bambusa pallida is the scientific name)
7. Pecha (Dendrocalamus hamiltonii is the scientific name)
8. Kanak kaich (Bambusa affinis is the scientific name)
9. Jai (Bambusa spp is the scientific name)
10. Mritinga (Bambusa tulda is the scientific name)
11. Paora (Bambusa teres is the scientific name)

Just as a flowering culm eventually dies, so too do seeds and the growth of bamboo through them are advised throughout the blooming season. Bamboo is used to make a wide variety of musical instruments in Tripura. Bamboo from Tripura was used to make Sumui instruments.

3.2 Etymology and Nomenclature

Since ancient times, people have used music as a very uplifting and relaxing medium. This is based on the astounding transforming power of music. A little music suddenly lifted the great majority of us from a state of mild disbelief to one of delight. Over the centuries, a vast array of instruments have been used to tune us into music and seemingly express through sound the emotions we experience on the inside. The fact that Sumui are the greatest traditional instrument in Tripura is not surprising, as twisting an object may produce sounds that are perhaps the least complicated. In actuality, Sumui existed before humans. For instance, there have been several trees where a bare limb has broken off, allowing the air to rush across the aperture and produce the Sumui sound. Because the entire thing is performed using breath, sumui have a unique and remarkable quality. As breathing is the body's most important source of energy, so too is the vibration of the Sumui a food for the soul. When a Sumui is played or heard, we are filled with an endless vibration. Life's essence is this. Bamboo has always been a dependable material for Sumui construction. Its typical hollow interior and strong resonance are the direct causes of this. Because each piece is unique are same, another reason for utilising it is that a Sumui made from bamboo is truly unique and has its own personality. The materials used to make Tripura's musical instruments are readily available locally. The inhabitants of Tripura value the extraordinary regular abilities and try to appease local divine entities and animistic spirits. These instruments are constructed from wood, skin, bamboo horns, and other species. It is believed that each of these gadgets can display material preferences. Tripura's instruments are an essential component of the traditional music played by the locals. The Sumui is arguably the timeliest instrument in the Sushira (wind) repertoire. One of the oldest and most often used instruments in Tripura's melodic tradition is the sumui. Out of all the instruments, the sumui is the best and least mechanical; Tripuran clans have great sentimental value for the sumui. Bamboo is used to make it. Sumui come in two distinct varieties: one with seven gaps and another with eight openings. Two predominant characteristics of manipulators that have been found are:

- The ones kept by the mouth
- The ones held by the mouth

Among the woodwind ensemble are the Sumui, a collection of instruments. An anaerophone or reedless breeze instrument, a sumui produces sound by the passage of air across an aperture, unlike woodwind instruments with reeds. A transverse Sumui constructed of bamboo that operates without a key is among the most well-known instruments in Tripura. For closing and opening the gaps, two hands' fingers are used. Accessible in several measures are the instruments. Those who play the Sumui are also highly esteemed, and it is a given that they will be happy to get the opportunity to play it as it is considered a blessing. Over-blowing and cross-fingered playing can help the Sumui produce two and a half octaves. Due to its regular two and a half octave sound propagation and monophonic nature, the Sumui is similar to the human voice in many ways. Another essential aspect of raga-based music performance is the ability to generate a variety of Gamakas by sliding the fingers on and off the openings. In Hindustani now, it is found in traditional style, filmic, and many various classes, although previously only being connected with social music.

3.3 Construction

For a very long time, indigenous communities have used bamboo to build tiki homes and watermills, among other things. Plant species are generally used for almost everything due to their quality and versatility. It also includes instruments. It is still used today for a variety of things, such as paper, texture, and even ground surface. Still, bamboo may also produce wonderful melody when chopped precisely. The artist himself breaks the bamboo to a suitable length and places it in a playing situation to determine the separations of the Sumui stops by simply placing his fingers in the locations designating the zones where the two fingers closest to a bamboo hub fall. The bare bamboo stem is used to make sumui. When the entire region is resolved, the distance between them becomes the standard length, and the designated locations are lit with a hot iron nail.At the last step, a specific imprint is carefully scratched at a range of one (1) finger-width for a rectangular score, inclining gradually according to stem width; the designated district is then cut with a blade in alignment with the stop opening near the upper edge. Sumui has been utilised extensively in various civilizations and is still utilised in many different contexts today. Here are a few easy steps that walk you through the process of making a Sumui.

- *A 2 (Two)-mm, 8 (Eight)-mm and 10 (ten)-mm assortment drill Ruler*
- *Hacksaw*
- *A Medium grain attachment rotary tool Wood clamps*
- *Bamboo*

NOTE: To produce a high-quality tones with at least one node, commonly referred to as a knot, make sure that the Sumui is smooth and devoid of holes.

- *A Bamboo of 3/4 to 7/8 inches in diameter*
- *A Sandpaper medium grit.*
- *Dowel rod - approximately 20 (Twenty) inches*

3.4 Different lengths provide different tones

Bamboo longevity will be a significant factor in defining the key that our popular musical instrument sumui will play. In the event that we need a sumui to play key A, cut it to 14 inches in length. Cut your bamboo to eighteen inches for a D note and F key tone, making sure it is twenty-one centimetres long.

- **Preparing the bamboo**

A. Examine the selected node for any holes, both interior and exterior. If it has issues, it could be advisable to use a separate area where the node's structure is in its whole. The sumui's tone is influenced by the holes in the node.

B. Remove them all, excluding the closest to the end node that still has strong (and non-hollow) nodes. It will assist us in settling the sumui and functions similarly to a cork. Without a cork, the sumui cannot be played correctly.

C. Wrap the dowel rod in sandpaper and fasten it with tape. Place it inside the bamboo and smooth the tube within.

Tip: Sand only travels one way: it keeps bamboo from breaking.

Next steps to making a Sumui

Once the bamboo is ready, measure the node's length by two centimetres and label it with a pencil. The mouthpiece is located at the end of our sumui.

A. Using a screwdriver, carefully cut the pencil line, then smooth it with sand.

B. Within the diameter of the cork, the lower part of the hip or body should measure one length. It must be eight centimetres from the cork, for instance, if the bamboo has a diameter of 8 cm.

The node measuring and marking the entire length of the inner bamboo with a pencil is located in the middle of the mouthpiece, also known as the blow hole.

C. Using a flute calculator, we can calculate the necessary distance between each sumui hole on the mouthpiece (Flutomat). Mark each hole for boiling with a pencil. (Verify the straightness of our line).

D. Ensure that the bamboo with the wood clamps is facing up. First, use a boiling bit of two millimetres to drill each hole, and then increase the size of the hole with a boiling bit of ten millimetres. We can prevent the bamboo from being split, cracked, or scratched by using this consistent ploughing technique.

E. Using a medium grain setting and a rotary tool, sand each hole to make it smooth. Dust off and tidy the drill holes.

3.5 Playing Technique

When playing Sumui, a player typically holds the object on a flat platform that slopes downward towards them. Spreading the exterior finger holes are the file, centre, and ring fingers of the proper hand, while the remaining finger holes are distributed by the corresponding fingers of the left hand. The thumb and little finger support the Sumui, while the airhole is placed near the lips, with air blasted over it intermittently to get the perfect octave. Pinky, or the little finger of the right hand, is usually used for the seven-gap Sumui. The Sumui's sound originates from the reverberation of the air section inside it, just like other air-reed wind instruments do. This section's length varies according to how many gaps are closed or left open. Playing little or level notes requires the use of half-holing. One obtains the 'Sa' note (corresponding to the size of an Indian sargam or the proportional 'do' on the octave) by separating the first three gaps from the blowing-opening. Octaves differ by managing the embouchure and focusing the blowing force. Sumui players partially or fully spread the tap apertures using their fingertips. We must locate the notes in order to play the diatonic scale on the Sumui. For instance, you may play sheet music by creating a finger documentation that corresponds to individual notes in a Sumui where the Sa or tonic is continuously performed by closing the first three spaces, which is comparable to C. A Sumui player may achieve complex Raga musical elements, such as glissando, ornamentation, and microtonal articulations, by dividing the breath, using deft fingerwork, and using mild, clarifying signals to close or open the gaps.

3.6 Notes/Information on Sumui

The following is how Sumui's seven (7) complete tone notes sound:

Sa Medium Octave remark about maintaining three closed openings from the side of the mouth gap and blowing air out of it. Re: Medium Octave remark on maintaining two gaps from the side of the mouth gap closed while blowing air out of it. Ga: Medium Octave remark about holding up one opening from the side of the mouth gap closed and blowing air out of the mouth. The middle Octave When Tivra Ma remark about maintaining all the holes open and allowing some air to enter the mouth while blowing. The Lower Octave Pa note is closed from the rear of the mouth, opening when air is exhaled and including six spaces. The Dha note in the lower Octave about holding up five openings from the side of the mouth gap and blowing air out of it is closed. Ni: Lower Octave note on air-blowing the mouth while maintaining four closed gaps from the side of the mouth. Sa's Upper Octave note is closed from the side of the mouth, opening with two times the force and maintaining three spaces. Using a similar method, the additional Upper Octave notes may be executed on twofold (2:1) power air passing up. Notes in Half Tone: (Komal Swara). There are four half-tone notes: Re, Ga, Dha, and Ni. Playing half-tone notes on the Sumui may be done in two ways:

1. Significantly closing the disparities.

2. By shifting the location of the notes.

According to the fundamental approach, if we leave the holes of the entire tone notes half open and the half tone note will emerge. For example, the half tone notes will emerge when the gaps No. 3 half - Re, No. 2 half - Ga, No. 6 half - Dha, and No. 5 half - Ni are opened. When playing Sa (Do), the first three fingers are used to plug the holes. Shuddh, which means the pure. All flattened notes (Komal Re (R), Komal Ga (G), Komal Dha (D), and Komal Ni (N)) except Ma (unraised 4th degree) are played by exposing the required area of the lower finger hole adjacent to it. One may finger Tivra Ma on a Sumui that has seven (7) finger holes in both the middle and upper octave, either with all of the holes closed or with all of the holes open. When utilising the all-holes-closed Tivra Ma in both the middle and higher octaves, the first finger hole is either partially or fully exposed to achieve the right intonation, or depending on the behaviour of the specific instrument.

3.7 Delivery strategy for Tune on Sumui: Essential details

Prior starting playing Tune on the Sumui, the following points should be kept in mind:

Given that air is blasted in the North Eastern Musical instrument of Sumui with a tongue stroke, as suggested by the song, it is apparent that the melodies' tunes should be carefully addressed. The sound produced by the Sumui will not be audible if the apertures are not carefully maintained closed. Playing half tones and sharp notes requires the fingertip to be lifted slightly from the gap. For closing the gap in the middle, this is the optimal strategy. Pneumatic force coming from the mouth should be gradually increased during ascent and decreased during descent. When performing on a diagonal sumui, the instrument should be held at a point around 300 (Three Hundred) from the chest, and when performing on a straight sumui, the edge should be virtually directly from the face.

3.8 Points for starters

Maintain proper posture for the Sumui and place all of your fingertip weight on the apertures so that the air may remain in a tight position. Make sure that when one finger comes out of the aperture, the overall weight of the other fingers does not decrease.

Pneumatic force explosion is used to assist in elevation and decrease in descent. In order to play every note in a single breath minute progressively, the tongue stroke and the pneumatic stress should remain up to date with each other at this point in the activity. When playing a single note twice, such as SS RR GG and so on, they should be executed with the tongue stroke. The tongue stroke should be applied according to musical pitch. Recalling the minute and tempo is always crucial. Every matra minute of practise, the foot stroke matters. Half-tone notes should be played with half-open gaps or with the note location changed. To improve your practise, rearrange the notes' initial position. Make sure the Sumui plug is in place and clean on the inside. A few players maintain the Sumui in perfect tune by smoothing the inside piece with oil. Practise for thirty (30) minutes each day and try to take advantage of the opportunity to play with experienced players as often as possible.

3.9 The Playing Positions on Sumui

1. Conveying on the ground.

2. Unarmed, perched on a chair.

3. Set in erect alignment.

3.10 Breathing Techniques

Summoners may use their breath in a variety of ways to force air through the device and make sound. Two methods that players might employ include diaphragmatic breathing and circular breathing. The musician can reduce the quantity of breath needed while playing and maximise air intake by using slide breathing. A musician can make a continuous sound from their instrument by using a method called circular breathing, which involves inhaling through their nose and exhaling through their mouth.

3.11 Treating the Sumui

The Sumui of Murali type is dealt with in a tilted situation. The necessary opening moves the lower lip. The top lip should be used to hurl the air into the aperture so that it enters the critical gap straight. The player should place the lips of the primary, second, and third fingers on the left side independently on the starting numbers 6-5 and 4, then all together on the digits 3-2 and 1. Thumbs of two hands should be held simply inversely, such as the bottom side of the Sumui. If a space exists on the back, use your left thumb. It is important to position the fingertips on the opening so that they completely cover it, allowing air to enter via the outlet where the second is to be created. Straight position handling is used for Sumui of the Bansuri kind. It is obvious that the player needs to adjust their thumb and fingers such that the out-of-the-air aperture stays in front of their lips. Similar to Bansuri type Sumui, the throwing and finger development are comparable.

3.12 Difference between Sumui and flute

While the flute is a woodwind instrument made of a metal, wood, or bamboo tube with a circular hole row and plays through a locking mechanism at one end or a narrow channel at one end against a sharp edge, covering most or all of the holes with an arch, the sumui is a transverse bamboo flute used for Hindustani classical Indian music.

3.13 How the Sumui Works

a) A Tube with Holes

Almost all instruments for music are made up of two basic parts: a resonator that modifies and intensifies the vibration to produce the instrument's sound, and a generator that initiates the vibration. The generator on the sumui is the mouthhole's edge, where the player directs their breath. The respiration will not divide into the two air streams as planned if it approaches the edge. Instead, the air stream changes dramatically as it enters and exits the hole. The tube rapidly vibrates as a result. The resonator, or, to be more exact, the air inside the resonator, is the remaining portion of the sumui tube. There is absolutely nothing to do with producing sound from the devices outside the sofa; they are only intended to open and close the aperture. Given that the mouth hole functions as though it were an open end, the tube seems to be open at both ends. The tube functions as a steep spring, isolated from the air surrounding it, since the walls force the air within. This air flow gets a quick series of little pushes and starts to vibrate as the air flow from the mouth hole varies in and out of the tube.Though not at the same rate, the mouth hole's vibration does not vibrate. Although it is strong enough to start the airflow, the push of vibration at the mouth hole is insufficient to control the rhythm of the airflow's vibrations. Instead, the energy from these pushes is captured by the air stream, causing it to vibrate at its own speed. This natural rhythm is set by the total length of the air spring. If the vibration is set up correctly, the passage of air in the tube produces a sequence of comparable contractions and extensions.Because it is limited, the air source retains some of its energy and is stronger as a result. The slight variations in the mouth hole will be swiftly overcome, and it will rapidly adapt its time to its rhythm. This means that each air spring contraction and the push of the muck hole fluctuations happen simultaneously. This reminds me of someone pushing a swing. By doing this, the vibration is increased to the point where a note is produced and the air around it can vibrate.The lip and respiration may be changed very little to modify this note; however, in order to completely alter the note, the air spring's length needs to be changed. To do this, a hole must be made on the tube side. This hole eliminates the air restriction, almost as though the tube were severed. As of right now, the air spring only reaches this exposed hole. When the second hole opens up closer to the mouth hole, the air spring will come to an end. The vibrating portion of the tube is always between the mouth hole and the first open hole, at least on the first octave. The natural beat is quicker and the note is higher when the air spring is shorter. In order to ascend the first octave of the Sumui, the supply pan opens one hole from the bottom. Each hole is then slightly opened, shortening the air spring. In a modern sumui, with all of its holes closed, the air spring compresses and expands 262 times every second; with all of its holes open, it contracts and extends slightly more than twice. This gives you an idea of the magnitude of what we're talking about. A note's full expansion or constriction is typically one-half of an inch, as seen in the illustrations, with just half of that distance extending in each direction.

3.14 Harmonics

In addition to moving in several harmonic vibrations, air flowing in the Sumui tube moves in the basic vibration described above. These are additional air source vibration patterns that occur naturally. For example, you may reseal the pants in the tube and observe the first harmonic. The aforementioned pattern of vibration is the result of the air spring acting as if it were split into two equal parts. In the primary vibration, the complete air spring simultaneously compresses and expands; while one expands, the other contracts in opposition to each other. Every component is half the length of the original air spring and twice as fast as the fundamental vibration. Until the sixth (6th) harmonic, and even higher for a certain fingering, the air in the tube vibrates in three parts as well as in a second harmonic. All of these types of vibration are displayed concurrently by the sumui tube. Additionally, vibrations will be heard in the tube from the mouth hole to the first open hole below it when the holes are opened. How are these vibrations able to occur simultaneously with one another? Understanding that these vibrations are caused by forces acting on the air as well as actual air movements may be helpful. In the event that two opposing vibrational forces exerted simultaneous pressure on a single air molecule within the tube, the molecule would gravitate towards the more powerful force; if they were equal, no movement would occur. The two forces would go further in the exact same direction if they were moving in the same direction. If any of us had ever played on one end of a long rope, we may have witnessed something similar. And just after that, we could send a vibration down the rope. Both of the vibrations will bounce back and pass through at the opposite end of the first vibration. Let us first return to harmonious. The prior discussion indicated that the two equal halves vibrated twice as fast as the fundamental portion. Clearly audible, the harmonic note is one (1) octave above the fundamental sound. Every additional harmonic vibration also produces a distinct harmonic note, all of which happen simultaneously with the fundamental vibration. All of these sounds are connected so well, though, that we experience them as a single note rather than as separate noises. But they drastically alter the tone. Any instrument can be used to calculate the harmonics' relative strength. All instrumental sounds have the same fundamental vibration; for example, if the note C is performed by a violin, a flute, a sumui, and a tuning fork, the fundamental vibrations will all be comparable, with the exception of loudness. The different noises are produced by the vibrations together. This is analogous to creating many unique recipes using different combinations and amounts of a given set of ingredients. The main cause of the sumui's distinctive tone is that its sound has a lower harmonic than that of almost any other instrument.

3.15 Conclusion

In India, there are different communities with distinct customs that are adhered to by distinct types of people. In Indian culture, we discover unity. Every Indian region has a distinct manner of life, customs, and attire. Due to India's amazing mentality and hospitable atmosphere, unique innate networks have flourished there. Every state has promoted its own music genre since earlier times. This essay includes comments on the Sumui instrument as well as construction, playing, and handling styles.

Chapter-4

New Learning Models and Applications of Tipara Flute: A Folk Musical Instrument from India's North Eastern Region

Due to its close relationship to their social existence, music is significant to the Tripuri people of Bangladesh and Northeastern India. The rich and profound imaginations associated with the fundamental note's entry are seen in the Tripuri clans' instruments and music. By striking a drum, they frequently attempt to maintain cadence and beat while moving. Tipra Bharat refers to the traditional music of Tripuri. The clan has always used their music as a convention; it is as old as the clan itself. Like all other people's melodies from various zones, Tripuri people tunes are frequently shared with the broader public. These songs were written by individuals whose identities were hidden and unnoticed in their early years. Folk music is influenced by a variety of factors, including beliefs, superstitions, old practises, thoughts, wishes, love, and the development of jhum, collecting, celebrations, and so forth. The overall musical concept hasn't altered over time, and people continue to surprise and excitely play popular songs in their original versions or with very little modifications. People from Tripuri perform several customary practises. As a result, many of these technologies are eventually being phased out of the world and are no longer used by the following generation. These instruments exist, although many people in Tripuri are still unaware of their names. The younger generation, for the most part, does not perceive these devices. Certain devices are made expressly to influence people's conduct to alter. We give an analytical research of Tipara Flute in this work.

4.1 Introduction

The Tipara Flute blows a rapid stream of air through the embouchure aperture. The pressure within the player's mouth is higher than the surrounding air (usually a few tens of kPa, which is sufficient to maintain a few tens of centimetres of differential in a water manometer's height) (Butzlaff et al., 2000). The effort required to accelerate the air in this jet provides the instrument's power input. In real terms, it is comparable to DC electrical power as the player continuously provides power. Conversely, sound requires oscillation (like AC electricity) or air movement (Piro and Ortiz, 2009). Together with the air resonances inside the instrument, the air jet in the Tipara Flute produces an oscillating component of the flow. A portion of the energy released when the Tipara Flute's air starts to vibrate is transferred as sound through the end and any exposed holes. Friction (or viscous loss) with the wall wastes a lot more energy (Movsesian, 1967). The player's energy takes its place in a sustained note. The Tipara Flute resonates at specific frequencies because its air column vibrates noticeably more readily at some frequencies than others (Atterbury, 1985). These resonances have a significant impact on the pitch and playing frequency; the musician chooses the right set of resonances by choosing the right key combination. Each of these effects will be examined separately in this article.

4.2 The jet of air trembles

The player creates an air jet with his lips as it passes over the aperture of the embouchure hole, striking its sharp outer edge. When this kind of jet is disrupted by a displacement that travels along it and deflects it like a wave, it might blow into or out of the embouchure hole. The player's oral air pressure determines the jet's normal speed, which is between 20 and 60 m/s. This displacement wave's velocity on the jet is about equal to the jet's airspeed. Air flows into and out of the embouchure hole as a result of the sound vibration in the Tipara Flute tube, which creates the jet disturbance. The Tipara Flute produces a sustained tone when the jet speed is precisely adjusted to the note being played. The jet will enter and exit the embouchure hole at the farther edge at precisely the right phase to intensify the sound. The wave travel time on the jet must be decreased to match the higher frequency in order to produce high notes. By drawing the lips forward to shorten the distance along the jet to the tip of the embouchure hole and by increasing blowing pressure, which speeds up the jet, this is accomplished. When playing the Tipara Flute, we eventually learn to adjust on our own. It is common instruction for flute players to close their lip aperture when playing high notes. In the image, the jet is sporadically directed upwards and downwards, out of and into the bore at the embouchure to the right of the Tipara Flute.

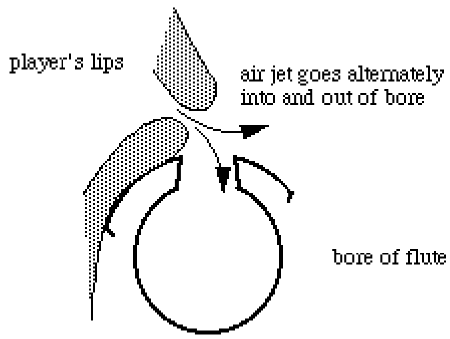
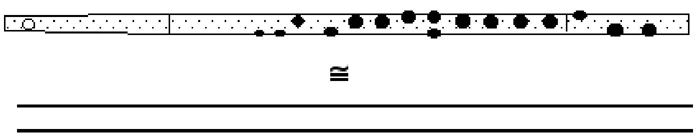
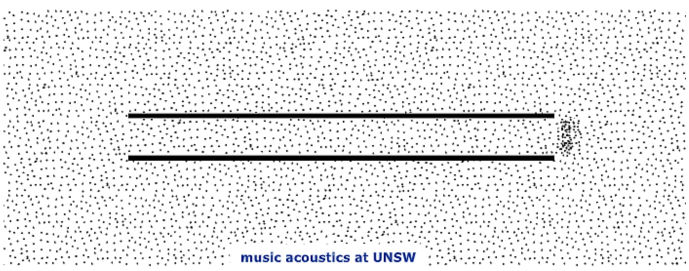


Fig. 4.1 The Tipara Flute is an open pipe

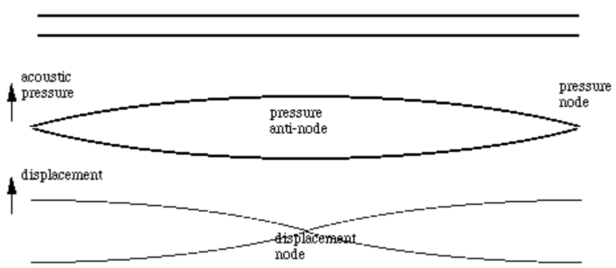
The Tipara Flute has holes on both ends. That the other end is open is evident. As can be seen in the accompanying figure, a Tipara Flute player keeps a significant portion of the embouchure hole visible to the surroundings, even if their lower lip conceals it to some extent. Let's start by thinking of a pipe that is less complicated than a Tipara Flute. Initially, we'll assume that it's a straightforward cylindrical pipe, which means making the assumptions that all of the holes are closed (at least partially) and that the head is cylindrical. Additionally, a hole at the end will take the place of the side-mounted embouchure hole. In actuality, it sounds less like a Tipara flute and more like a shakuhachi. It is a crude approximation, but it is easier to describe and preserves much of the fundamental mechanics.



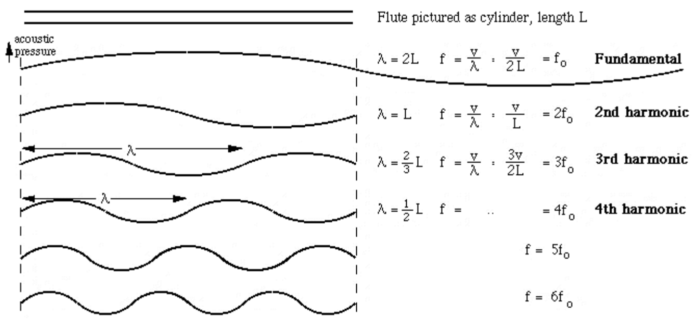
The animation that follows, from Tipara Flutes vs. Clarinets: Open vs. Closed Pipes, provides a more thorough explanation. It shows how a high pressure pulse is reflected in a pipe with air openings on both ends. Recall that the time it takes for the pulse to travel twice as far as the Tipara Flute (once in each direction) is equivalent to one full cycle of vibration. The cycle would repeat at a frequency of v/2L since the pulse travels at the speed of sound, or v, as we will learn later.



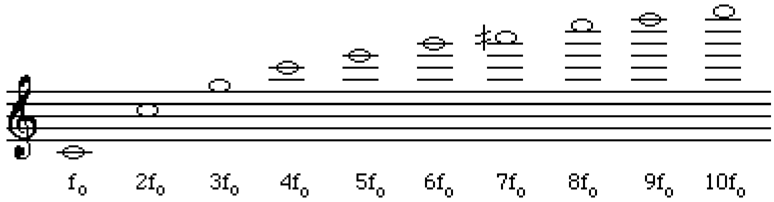
The Tipara Flute's air vibrates spontaneously due to resonances. The air pulse that appears in the animation illustrates the Tipara Flute's fundamental, or lowest resonance. More details regarding resonances may be found on the standing waves website. What standing waves or resonances may occur in an open cylindrical tube? Now, we will use sine waves and harmonics to find a solution to this question. Since the pipe's ends are open to the atmosphere, the overall pressure there must be somewhat near to atmospheric pressure. This means that the pressure fluctuation caused by sound waves, or acoustic pressure, is equal to zero. These areas, referred to as pressure nodes, actually extend somewhat beyond the end of the tube (about 0.6 times the radius, as indicated; this distance is known as the end correction). The pressure within the tube does not have to be atmospheric; in fact, the pressure anti-node, or core of the tube, has the most pressure variation during the early resonance. A sketch of a standing wave may be seen below. The bold line indicates the difference in pressure, while the fine line indicates the difference in air molecule displacement. Air molecules can easily enter and depart the anti-nodes at the ends of the latter curve. Note that a pressure node and an air motion node are not the same thing; in fact, anti-motion nodes for pressure might occasionally overlap with motion nodes and vice versa. Look into resonances and pipes. The distinctions between closed and open pipes are explained in Open vs. Closed Pipes (Tipara Flutes vs. Clarinets), which compares them using wave diagrams, air motion animations, frequency analysis, or other flow simulations.



The wave seen above is the longest standing wave that satisfies the requirement of having zero pressure on either end. Its wavelength is double that of the Tipara Flute, as seen in the image below. The longest wave on an instrument corresponds to the lowest note, or C4 on a C foot instrument, because frequency f is equal to wave speed v divided by wavelength l. (Note to Tipara Flutests: this page uses the names of standard notes, not the ones that Tipara Flutests occasionally use.) We may wish to measure the length L of our Tipara flute, compute the predicted frequency, and use the speed of sound in warm, humid air, v = 350 m/s. Next, look up the solution in the note table. (We'll discover that the solution is only roughly calculated due to end adjustments.) With this fingering, we can play C4 on the Tipara Flute; however, we can also play other notes by narrowing the lip aperture or by blowing more forcefully (either produces a quicker jet). These additional remarks relate to standing waves with shorter wavelengths that are feasible, provided that there is no sound pressure at either end. The graphic below displays the first several of them.



The pitches of the notes in the harmonic series, which includes notes with frequencies fo, 2fo, 3fo, and so on, are displayed below. We can play the first seven or eight notes of the series by shutting all the tone holes and blowing harder and harder (or by narrowing the lip aperture) since the first ten or so resonances of the Tipara Flute are about in this ratio when all the tone holes are closed. The seventh harmonic has a half sharp, which is located about halfway between A6 and A#6. Take note of this. We may find it interesting to contrast this with the sound files and comparable diagram for the clarinet, which only possesses the odd harmonics. A more thorough explanation of the harmonic series of both closed and open pipes is also included. Additionally, note the caution about the terms "fundamental" and "harmonic.



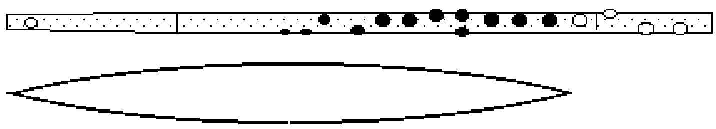
In the following drawing, every standing wave has a sine wave counterpart. When played gently, the Tipara Flute's sound resembles a sine wave, which is a highly pure vibration; but, when the volume is increased, the resemblance fades. You may combine sine waves from the harmonic series to create a periodic or repeating wave that isn't just a plain sine wave. Therefore, C4 on the Tipara Flute has some vibration at C4 (which we will refer to as its frequency fo), some at C5 (2fo), some at G5 (3fo), some at C6 (4fo), and so on. The spectrum refers to the "recipe" of a sound in terms of its constituent frequencies. To understand why, see the sound spectrum. The first harmonic (fundamental) and the frequency of the note C4 dominate at pianissimo, and as the note is played louder and the Tipara Flute develops a richer tone and sounds less and less like a sine wave, the higher harmonics become more significant. These are the real sound spectra for played C4 or Open a new window for C4. Loudness and timbre provides a thorough explanation.

4.3 How the pipe and air jet cooperate

In summary of the previous parts, the Tipara Flute's bore contains a number of resonances that roughly correspond to harmonic ratios, such as 1:2:3:4, etc., although they get increasingly more approximate as frequency increases. We'll discuss why this is the case below under frequency response. Depending on its length and speed, the air jet has a unique natural frequency. To put it a bit too simply, the Tipara Flute typically resonates at the strongest bore resonance, which is in close proximity to the jet's inherent frequency. As we'll see later, register holes are utilised to amplify one higher frequency while attenuating the lower resonance or resonances. The jet oscillates at a certain frequency when the Tipara Flute is played. However, it produces harmonics, particularly if the vibration is strong, as it does when playing loudly (see what a sound spectrum is?). Standing waves support the first several harmonics on low notes. Nevertheless, the Tipara Flute's resonances are no longer harmonic at high notes, thus the bore resonances only sustain a limited number of harmonics—just one in each of the third and fourth octaves. On the other hand, when a note is played loudly, its harmonics may be observed by examining its spectrum, which is visible for each given note.

4.4 Opening tone holes

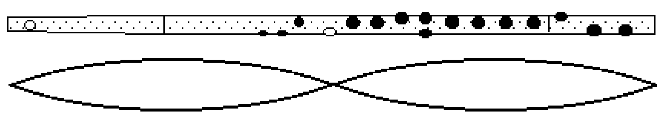
The pressure node moves closer to the top of the pipe if the tone holes are opened, beginning at the far end. This effect is similar to shortening the pipe. Every tone hole that is opened on the Boehm Tipara flute raises the pitch by one semitone. The fingering for E4 is displayed below once we have opened four holes on a C foot Tipara flute, as seen below. (To access E4, open a new window).



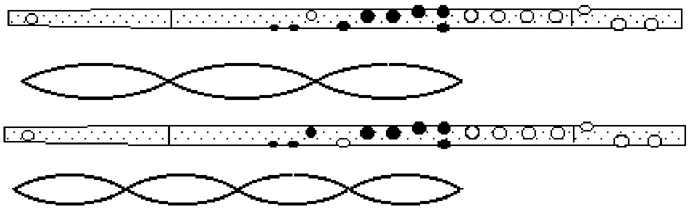
For the time being, we may say that an open tone hole functions something like a "short circuit" to the ambient air; hence, the initial open tone hole behaves roughly as if the Tipara Flute were "sawn off" close to the tone hole. When we talk about register holes and cross fingerings below, we will go back and clarify these presumptions. (To continue the electrical analogy for the technically inclined, we might argue that the open tone hole behaves more like a short circuit at low frequencies than at high ones since it is essentially more like a low value inductance. When we talk about cut-off frequencies below, we come back to this subject.)

4.5 Register holes

Register holes are another use for holes. To open a hole halfway down the instrument, for example, play C4 and then lift your left thumb. The even harmonics, which have a node there, are minimally affected by this, but the fundamental and odd harmonics become impossible. The Tipara Flute will so play C6, G6, and so on before "jumping up" to C5 (2f1). Because it is halfway along the Tipara Flute's working length and thus allows the second harmonic of the fundamental C4, the register hole in this instance raises the played note by at least one octave. A register hole that is half the length is used for typical fingerings for D5 and other keys; the sample seen is not a conventional fingering.



In the case of high notes, where the intended wavelength is short, a register hole can be opened at a different length fraction. To ease the third harmonic of G4, for instance, the fingering for D6 employs a register hole at around one-third of the length of work for G4, producing a note that is a twelfth higher than G4. The working length for G4 is likewise used in the fingering for G6, although the fourth harmonic is made easier by a register hole located around 25% of the way through.



Two register holes at one quarter and one half the wavelength are included in one of the alternate fingerings for D#6, which uses the working length for D#4. All Tipara Flutes' tones in the third octaves mostly rely on tone holes being used as register holes. The pages pertaining to these comments give specific examples. (Refer to Tipara Flute Acoustics and select a note that is above D#6)

4.6 Acoustic impedance of the Tipara Flute

We evaluate the impedance of sound at the embouchure hole because it determines how the jet goes into and out of the Tipara Flute (Lu, 1986; Montgomery, 1997; Bowles, 2003; Kemmerer, 2003). Sound pressure to oscillating air flow is the ratio that determines the acoustic impedance. For further information, see Acoustic impedance. An audible sound can be generated when there is a low impedance, as air can flow freely in and out. Resonances, or frequencies at which the impedance of the sound is extremely low, are really so significant that they 'catch' the behaviour of the air jet. For this reason, the Tipara Flute can only play at frequencies that are quite near to resonances. Under the Tipara Flute's frequency response, we talk about the acoustic impedance below. The definition of acoustic impedance and its significance are expounded upon and also a talk of C4's impedance.

4.7 Cross fingering

Subsequent semitones are performed on the contemporary or Boehm Tipara Flute by opening a tone hole specifically designated for that purpose. To move from, instance, D4 in the primary register to D5 in the subsequent register, one must first open twelve (12) keys in a chromatic scale since an octave has twelve semitones. (The fingerings only repeat between E4/5 and C#5/6, not exactly throughout a complete octave, due to the usage of registration holes for D#5 and D#5.) Twelve is more than the fingers on a conventional player, especially if you use your right thumb to hold the instrument. Clutches are used in Boehm's key system so that a single index finger may shut several holes. Keys for tripartite flutes were limited during the period known as baroque and early neoclassical eras. (See The Tipara Flute's Anatomy and Evolution.) Each hand featured three big fingers covering six open holes. Sequentially plugging these holes revealed the instrument's "natural" scale, located in D major. The fingering chart for such an instrument, with X representing a closed hole and O an open one, is roughly as follows:

D4 : XXX XXX
E4 : XXX XXO
F#4: XXX XOO
G4 : XXX OOO
A4 : XXO OOO
B4 : XOO OOO
C#5: OOO OOO
D5 : OXX XXX

Utilising the identical fingerings as E4 to B5, with E5 to B5. (Much more information about fingerings and their operation may be found on the website pages for classical and baroque Tipara flutes). Some of the interim notes on these instruments are produced by cross fingerings. Following the initial open hole in a cross fingering, other holes are sealed off downstream. For instance, the baroque Tipara Flute's fingering for F4/5 is:

F4/5 : XXX XOX

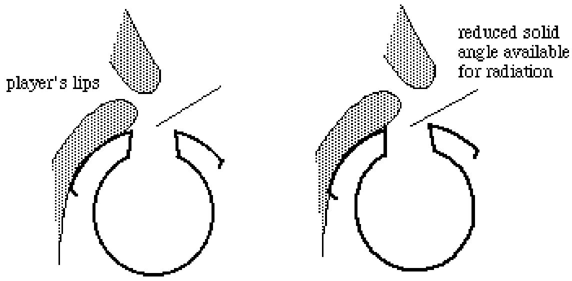
The pointing at for F#4/5 is XXX XOO; compare this to that. When the instrument is in F#, the standing wave continues past the first open hole and down the bore. In comparison to the current Tipara flute, the baroque or traditional instruments have a greater extended wave due to their smaller holes, which result in a lower impedance of sound between the bore and the external field. The open hole in the contemporary Tipara Flute behaves more like an auditory short circuit, giving the impression that the flute has been "sawn off" at a location not far below the initial opening. Therefore, the end adjustments on the new Tipara flute are rather minor.) By closing the downstream hole, the standing wave is further extended, increasing the instrument's effective length for that fingering and lowering the resonance frequencies and flattening the pitch.

Cross fingerings vary in their impact based on frequency. Particularly for tiny holes, the standing wave's reach beyond the open hole grows in proportion to frequency. The consequence of this is that the Tipara Flute's effective length grows as frequency increases. Higher frequencies hence often result in flatter impedance minima than strictly harmonic ratios. As a result, some cross fingerings are ineffective when used in both the first and second registers. For example, a cross fingering that is utilised for G# in the first register may be excessively flat in the second register or may not even produce a note close to G#. (Take a look at the baroque Tipara Flute's fingerings for G#4 and G#5).

The harmonics produced by playing a low note will also not "receive much help" from resonances resulting in the instrument as a result of the disrupted fundamental ratios of the smallest values in impedance. (Technically, at that frequency, the bore does not give impedance matching or feedback to the jet; as a result, the jet contains fewer high harmonics and radiates them less effectively as sound.) Because of this, the baroque Tipara Flute's sound spectrum exhibits weaker upper harmonics, making notes like F4 and G#4 less powerful and having a deeper or mellower tone than the ones on either side. As we mentioned before, the 'native' scale of these musical instruments is D major; they don't employ cross fingerings in D or B minor, therefore their timbre is brilliant. Their tone is darker and their playing is more subdued in Eb fundamental or C minor. The baroque bassoon and baroque oboes, as well as recorders from both the past and present, will also exhibit similar characteristics. That's probably part of the reason why various keys have varied qualities: keys with a few sharps are linked to bright, loud winds, while keys with a few flats have been linked to quiet, dark winds. Check out a scholarly research on the subject to learn more about the acoustical of cross fingerings.

4.8 Lipping' up and down

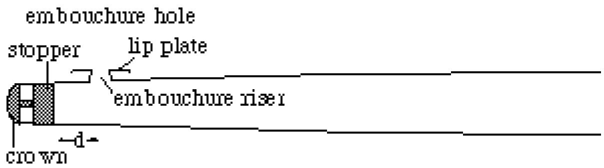
A Tipara flute's construction necessitates concessions, and the player must slightly alter the pitch of some notes. Refer to Tuning Woodwind Instruments. The major methods used by players to reduce the pitch are rolling the embouchure hole of the Tipara Flute towards or away from them, pulling the chin forward or back, and altering the jet shape. These actions accomplish several things: (i) they reduce the amount of the embouchure hole that is exposed to the lower lip, which reduces the dimension of the hole opening to the atmosphere; (ii) they reduce the solid angle into which the sound waves can radiate (or, to put it more colloquially, they 'obstruct' the radiation); and (iii) they shorten and alter the jet.



The Tipara Flute's effective length is increased by Effects (i) and (ii), which lowers the resonance frequencies and flatters the tone. Pitch can be raised by extending the lower part of the jaw or rolling away the embouchure, which have the opposite effects. From a technical standpoint, these movements function by altering the radiation impedance at the embouchure. Specifically, whenever a note is 'lipped down', the embouchure hole becomes 'less open', meaning that there is a greater resistance to radiation from the bore to the electromagnetic field due to the smaller hole and angle. The jet's own effects are more intricate. By putting our impedance measuring apparatus into a Tipara Flute head and evaluating the amount of impedance at the embouchure hole, we have directly quantified these effects. As seen from within the blowhole and somewhat obscured by the lower lip, this represents the radiation field's impedance. Moreover, the mouth and face of the flautist act as a baffle to lessen the radiation angle. Visit our research papers page to view the current conference paper that reports these results.) The specifics of the impedance spectrum and a few jet characteristics determine the lipped interval. Short tube lengths feature fewer and shallower harmonics minima in their impedance spectra than long tube fingerings, making note pitch adjustments easier. On the shakuhachi, the corresponding effects are far more pronounced and are explained on that page.

4.9 The cork and the 'upstream space

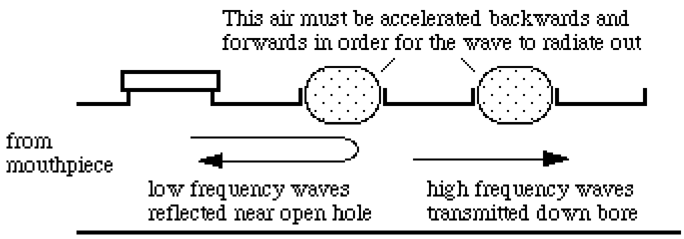
There is a tiny amount of air between the cork at the closed end of the musical instrument and the place where the embouchure risers joins the Tipara Flute's main bore. Generally speaking, the cork should be placed around 17 mm from the embouchure hole's centre (the precise amount differs from player to player - see pitching wind instruments). The Tipara Flute's internal tuning is adversely disturbed by any extremely large fluctuation. How then does this operate?



When we compress this "upstream air," the pressure increases like a spring. One might think of the air as a mass inside the embouchure riser tube. When combined, they can produce the same resonance as the mass bouncing on a spring, or a Helmholtz resonator.Although it is centred at around 5 kHz, its resonance spans a wide frequency range. At much lower frequencies, or throughout the Tipara Flute's playing range, it functions as an impedance in parallel with the bore's main portion, albeit one whose amplitude declines with frequency. The main benefit of this is that it keeps the registers in tune with one another by compensating for the frequency-dependent end impacts at the other end of the Tipara Flute when the cork is positioned appropriately. However, when the frequency gets closer to the Helmholtz resonance, it does lessen the change in impedance with frequency, which is one of the impacts that restricts the instrument's upper range. The instrument's octaves will be severely out of tune if we press a cork in, as Charanga style musicians do. However, this allows us to reach higher into the fourth octave. Downloading our technical paper will help us learn more about this effect. To reach the upper limits of the Tipara Flute's range, look for fingerings with "high playability" on the Tipara Flute virtual and in the F#7 and G7 report. But this is the key takeaway for Tipara Flutests. The Tipara Flutes are the orchestral wind with the easiest internal intonation adjustment system. If our octaves are little, consider slightly inflating the cork. Pull it out if they are broad. Naturally, we'll also need to shift the tuning slide. Also see wind instrument tuning.

4.10 Cut-off frequencies

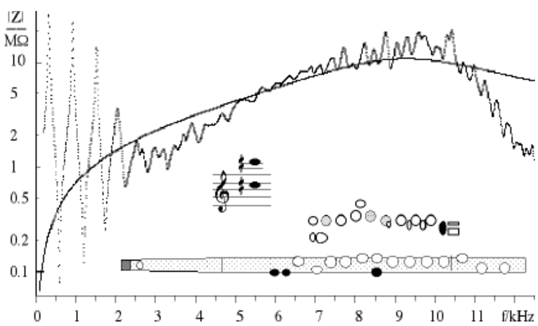
We originally said that tone holes reduced the effective length of the tube because they let outside air into the bore. At low frequencies, this is accurate because the hole forms a low impedance "short circuit" with the surrounding air, which makes the wave reflect around or close to this point. At high frequencies, though, it gets more difficult. Dense air surrounds and fills the tone hole. This mass must be accelerated by a sound wave in order to pass through the sound hole, and (all other things being equivalent), this acceleration increases with frequency squared, meaning that a high frequency wave has little time to begin moving after half a cycle.



Because it doesn't 'look so open' to high frequency waves as it does to low frequencies waves, the air in the tone hole functions as a barrier to them. While sufficiently large frequency waves move down the tube past the open holes, high frequency waves travel farther, perhaps allowing for the formation of cross-fingers. The first open sound hole reflects low frequency vibrations. Consequently, a set of exposed tone holes functions as a kind of high-pass filter, permitting the passage of high frequencies while rejecting lower ones. Approximately 2 kHz is the cut-off frequency of the Boehm Tipara Flute. On the acoustic response curve for A4, for example, the first four or five resonances gradually become weaker with frequency. This is because the energy losses resulting from "friction" (viscous loss) between the air and the wall are becoming increasingly significant. The waves at this frequencies move down the bore and progressively radiate from one tone hole after another, thus above 2 kHz, the resonances abruptly becomes significantly weaker. The remaining weak standing waves produce resonances with different frequency spacings, as we'll see in the next section. But before moving on, compare the A4 and B3 graphs. The latter has no open tone holes and no cut-off frequency because it is the lowest notes on the Tipara flute. Consequently, across the complete frequency range, the resonances gradually and steadily diminish with frequency. There is no cutoff frequency on the Tipara Flute since there isn't an array of open holes for a lower note or two. If higher-frequency harmonics were powerful enough, it would be expected that this would alter the timbre of these sounds. The oboe and clarinet are also used to prevent this from happening. One way to do this is to supply a bell that emits high frequencies but not low ones, with a cut-off frequency that is comparable to the tone hole array." Because the Tipara Flute has less radiated strength at higher frequencies than the oboe and clarinet, there is a considerably reduced need for a bell to "homogenise" the timbre. An apparatus that would magnify high frequency radiation for both long and short tube notes is called a pinschofon. (In this scientific study, crossfingering and cutoff frequencies in baroque, classical, and contemporary tippara flutes have been measured and examined. In addition, a more detailed explanation of cut-off frequencies and the resulting results may be found here.

4.11 Frequency response of the Tipara Flute

Now let's look at the acoustic impedance spectrum of a modern Tipara flute. We'll choose the fingering for C#5 and C#6, leaving nearly all of the tone holes free. It is seen in the graph below. This graph shows a wide variety of frequencies, but not a lot of fine detail. Refer to C#5 for further details.)



The curve below 2.5 kHz mimics that of a straightforward cylindrical pipe that is about half the length of the Tipara Flute since the tone holes are open in the bottom half of the flute. Given that the first three minimas all allow standing waves, we may use this fingering to play the notes C#5, C#6, and G#6. However, around 2.5 or 3 kHz, the resonances become much weaker. This can be attributed to the high pass filter discussed under cut off frequencies. At an even higher frequency, around 5 kHz, the Helmholtz resonator mentioned before beneath the cork and the "upstream gap" cause the resonances to almost completely disappear. The Helmholtz resonator no longer short circuits, allowing the resonances to reappear above this range. However, because of the air's "friction" with the walls (increased impact of viscothermal losses at higher frequencies), the resonances remain ineffective. Note, however, a crucial difference. At the low frequency end of the graph, the spacing between peaks and troughs is around 600 Hz (the frequency of C#5), which is equivalent to a standing wave in the half of the Tipara Flute without tone holes. At high frequencies, peaks or troughs often happen around every 260 Hz. The Tipara Flute's complete length has a standing wave at this frequency, which is C4. At these high frequencies, the wave in the Tipara Flute's bore "sees" straight through the open tone holes without "noticing" their presence because of the air's inertia, as is discussed under cut off frequencies. In order to excite a fundamental frequency in this range, a human player cannot blow air fast enough. A loud note in the usual range will have some high harmonics falling in this region. However, since the Tipara Flute is not needed as a resonator for these harmonics, the tuning of these extremely high resonances is mostly of theoretical interest. Lastly, notice the general shape of the curve, which peaks widely around about 9 or 10 kHz. This can be attributed to the relatively tiny air tube that exists between the embouchure riser and the main bore. The air in this tube, together with a little portion of the outside atmosphere at both ends (the end effects), is also a resonant tube because of the air's resonance, which happens over a wide range of frequencies because the tube's width is comparable to its length. The solid line on the graph indicates the estimated impedance of a truncated cone with an embouchure riser's shape and end effects. Our technical analysis goes into further detail on the ultimate effects on the Tipara Flute.

4.12 Conclusion

There are several ethnicities in India that have unique customs that specific individuals follow. Indian culture is all about unity. Every Indian state has its own unique traditions, customs, and distinctive fashion sense. India's exceptional thought process and suitable environment have allowed it to maintain its distinct innate networks. Every state has long fostered an own musical genre. The functioning of the Tipara Flute is described in this essay. A broad the air jet vibrates due to the interplay between the air jet and the pipe, the harmonics of an open pipe, and the Tipara Flute as a pipe. Tonal holes, register holes, sound impedance, the cork, "lip-syncing," "upstream space," crossing one's fingers, etc.

Chapter 5

The Physics of Electric Saroj Veena: A Folk Musical Instrument from India's North Eastern Region

The North Eastern region of India is well-known for its folk music and the Saroj Veena. The shape, size, structure, and internal workings of Saroj Veena will be discussed. Of these investigations, we examine the standing wave harmonic structure of Saroj Veena strings. The experiment data was collected using a digital oscilloscope equipped with a Fast Fourier transform and a magnetic pickup from a Saroj Veena. The measured signal's harmonic amplitudes fluctuate depending on where the string is plucked, creating a unique timbre for the sound. When the boundary and starting conditions coincided with the initial form of the string, the wave equation predicted the relative amplitudes of transverse standing waves in a string, which were derived from experimental data.

5.1 Introduction

Musical production is an act of accomplishment and dissemination of musical ideas to listeners or audiences. Concerted musical cognition, perception of the structure and context are expressed through the different genres, styles and types of music (North et al., 2000; Zillman and Gan, 1997). The principle of touch of Felds is also applicable to music. It's not a 'thing' or 'entity' but rather a 'socially articulate' and 'intersubjective' process. This involves the allocation of social knowledge, which is moved from a 'pre-given mentality' to a capacity. In shows, musical skills gained by performers are seen in their training, perception, assimilation, and experience. People ingested their familiarity with the language of art. Due to the complex variations of several musical elements, the impact-output is difficult to predict. These include: chosen musical material, added virtuosity, and subsequent effects at different stages of rendering. The experiences of artists and audiences are never identical. Consequently, what the artist does has no ability for the spectator to be heard (Zillman and Gan, 1997). In Folk Instrumental Music (FIM), improvisational elements remain available in a music recital. Performers undergo a profound learning process (talim), familiarize themselves with common words, learn about different aspects of ragas, and understand how to arrange different patterns of singing and playing. A raga transmits various color tones at different times and when it is performed by different individuals. In addition, the same musician will invoke different effects from certain raga at different times (North et al., 2000; Zillman and Gan, 1997).

The traditional development of FIM music inherently blends technical and descriptive components. These are the components of virtuosity and ingenuity. Virtuosity components are critical for the selection and melodic variation of materials, such as tempo, rhythmic complexity, difficult decoration, and dynamic tone. The actors also create expressive elements that challenge exceedingly virtuous executions. These performances have an effect on the aesthetic perception of the listeners and offer special significance to the performances. In addition to the structure of songs, ornamentation and other musical components, extra-musical influences often play a vital role in the accomplishment of a musical success (Goldstein, 1980). The architecture of the auditorium, which plays a crucial role in the transmitting of sound, the efficiency and adaptation of sound amplification systems, stage decoration, lighting arrangements, hosting of concerts and costumes of musicians, etc. These auxiliary actors participate and listen to the performers, and the Crowder plays a central role in the performance of the concert.

5.1.1 Related Work

During religious ceremonies, festivities, weddings and other events, the Tripuri people use different types of musical instruments (Goldstein, 1980). (1) Rosem is a bamboo and gourd flute-like musical instrument. This musical instrument stands 32 cm tall, 17 cm wide, 57.5 cm long, and weighs 125 grams. (2) Adhuri was constructed from Mithun or Misho horn and bamboo. This musical instrument measures 70 cm long, 7.5 cm in diameter, and weighs 800 grams. (3) The tripuri uakhrap is a traditional musical instrument. This is a hybrid of two musical foundations, strings and skin membranes. The semicircular form of the instrument's base (Tarrant et al., 2000). (4) The Wakhorok is an ancient traditional musical instrument. This instrument is built from bamboo. The length of the bamboo was hollowed out in the center to create a resonant chamber. The presence of frets suggests that it might be a string tool. This musical instrument is 18 cm long, 50 cm tall and 7.5 cm wide. (5) Wakhong is a widely used ancient musical instrument. This instrument is composed of bamboo. This musical instrument originated in Tripura (Resnisow et al., 2004). (6) A string musical instrument is the Sarinda Uakhrap. Its body is so severely squeezed that it seems to be in two sections. It also contains an oval-shaped hollow vibrating chamber of wood with thin skin covering it. The upper section of it is open. The waist is slim. This instrument stands 5 cm tall, 13 cm wide, and 69 cm long. It has an oval shape on the bottom. The center is huge, and the borders are broad. A section of the cave has been revealed. To secure the strings, three pegs are attached to the top section. Strings are metal, Muga thread, or animal intestine (Deli et al., 2006). (7) Tintrong is an ancient traditional musical instrument. This instrument is comprised of wood, bamboo, coconut, and wire. This musical instrument is made during the Lebang Bumani dance and is also used to accompany Vaishnav Bhakti's tribal melodies. The instrument may be as tall as 174 cm and as wide as 35 cm. (8) Twitreng is an ancient traditional musical instrument constructed of wood, wire, and leather. This musical instrument is 6.5 cm in height, 18 cm in width, and 80 cm in length. A simple string instrument with a resonator constructed of bamboo length. A big rope bird decorates the top (Schlaug et al., 2005). (9) Wood, wire, and leather are used to create the traditional musical instrument known as the regyoweing used by the Mog people. Water is passed via hollow bamboo containers that are passed by a single string, and this instrument is analogous to the jal tarang in that it has a rim-filled water reservoir. The instrument's leather pad at the front is struck to produce sounds in the pipes (Kreutz et al, 2004; Kuhn, 2002; Beck et al., 2000; 2006). This musical instrument weighs 3000 g and has dimensions of 4.3 cm in height, 25 cm in breadth, and 45.5 cm in length. (10) The kham is a traditional wood and leather musical instrument used in Tripuri music. Kham has a double diaphragm. The membranes are constructed from barrels that are identical in size and cut from the same tree trunks on both sides. Goat skin membranes are fastened at both ends to make it easier to cinch leather belts. This object is played with while being hung from the collar, bound to the hip, held on the ground, and hung from the collar. This musical instrument has a height of 28 cm, a width of 28 cm, and a length of 27 cm. (11) One of the most significant musical instruments used in Tripura is the little rod idiophone known as the Dangdoo, sometimes known as the mouth harp in English (Kreutz et al, 2004; Kuhn, 2002; Beck et al., 2000; 2006). The dangdoo is a special type of folk instrument because it combines wind and percussion. It has a single wire running between the arms and is constructed of iron in the little, tong-like shape, measuring 9 to 10 cm. With the lips open, one end of the dangdoo is gripped between the teeth. The player's inhalations and exhalations determine the twang and pitch as they pull the wire. (12) In the Tripura musical culture, the sumui (flute) is one of the oldest and most popular instruments. Of all the instruments used in music, the sumui is the most ideal and least mechanical. Bamboo is used to make them. There are two different varieties of sumui; one has seven (seven) holes, the other eight (eight). The two characteristics of the manipulator that are most frequently observed are: (a) those held above the mouth; and (b) those held along the mouth (Clift et al., 2008).

5.1.2 Saroj Veena

The Gomati District of Tripura is where this instrument originates from. This musical instrument's playing manner is somewhat similar of the Chittiki, a traditional instrument of Tripura. The Vichitra Veena, however, is more comparable in terms of shape, construction material, sound quality, and tone—most notably.

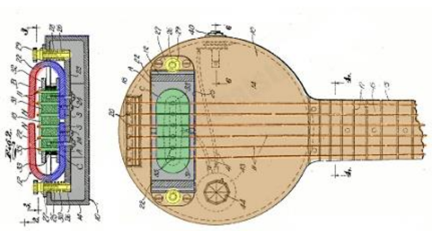


Fig.5.1. Saroj Veena

To play it, special plectrums are placed on the right-hand fingers together with a left-hand slide. Except for the fretboard, the Saroj Veena is entirely indianized. One solid piece of wood serves as the basis for the Instrument. It features a semi-flat sound chamber, like the Tambura and Veena. Four of the strings may be played, there are five chikaris (two in the front and three in the back), and there are also fourteen sympathetic strings. The sympathetic strings are placed above the playing strings at the bottom. Therefore, the lower sympathetic strings tremble in reaction when we stroke the playing strings. Ash and Mehagini wood are the primary building materials used to make Saroj Veena bodies.

They also differ in density. Ash weighs around 650-850 kg/m3, alder weighs roughly 420-500 kg/m3, and mehagini weighs approximately 500-850 kg/m3. Saroj veena is made of alder wood.

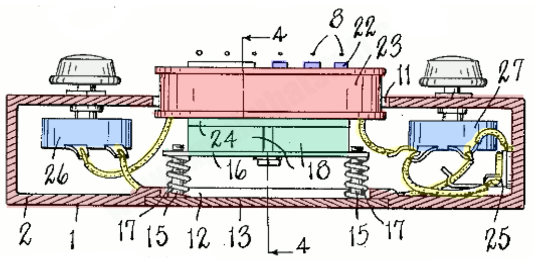


Fig. 5.2. Electro Mechanism of Saroj Veena

5.2 Experimental Setup

<u>Playing Strings</u>

1. d / SA - Steel 0.34 mm
2. a / low PA - Steel 0.51 mm
3. d / low SA - Bronze 0.54 mm
4. Ati lower Pa-Bronze

<u>Drone Strings (CHIKARI)</u>

1. c# / low shuddha Ni - Steel 0.26 mm
2. F# / low shuddha Ga - Steel 0.42 mm
3. A / low Pa - Steel 0.36 mm
4. d / SA - Steel 0.28 mm
5. d' / high SA - Steel 0.23 mm

<u>Sympathetic Strings (TARAF) - all Steel 0.23 mm</u>

1. d / SA
2. c# / low shuddha Ni
3. d / SA
4. e / shuddha Re
5. f# / shuddha Ga
6. f# / shuddha Ga
7. g / shuddha Ma
8. a / Pa
9. b / shuddha Dha
10. c# / shuddha Ni
11. d' / high Sa
12. e' / high shuddha Re
13. d' / high Sa
14. High pa

This tuning is based on the d-major scale. (Bilawal Thata). For different scales, the sympathetic strings, as well as occasionally the first and second drone strings, are altered properly. (Thata). This item has the following dimensions: 109 cm in length, 40 cm in width, 9 cm in depth, and 65 cm in circumference. It weighs around 2.8 kg. In the back of the neck, an improved Chrome-plated Brass Tumba is installed for increased sound endurance and resonance.

Fig. 5.3 Tumba

The hollow fretboard's border is elegantly curved to resemble the neck of a peacock. The instrument has a more veena-like tone that is incredibly well-balanced and silky. The wonderful sustained tone, similar to Vichitra Veena, encourages playing in the traditional (voice) gayaki style. It is easy to play since inlays are utilized to identify the positions of the notes. The strings of the Saroj Veena, which weigh more than 510 pounds, are under a tremendous amount of pressure. The tone tunes brilliantly as a result of the extreme strain, with the sympathetic ringing out and supporting each note played. This strong instrument was created to be audible with minimal amplification. An electrical device is connected to this musical instrument.

Fig. 5.4 Sound, pitch and Vibration control Switch

Pickups are mechanical devices that are inserted in the bodies of saroj veena. Pickups transform the string vibrations into an electric signal, which is then sent across a shielded wire to an amplifier. The amplifier plays the sound that was created from the electric signal. During this procedure, the sound's tone and loudness are also altered. In other words, a saroj veena needs an amplifier in order to be taken seriously as a musical instrument. A Saroj Veena string will vibrate on its own at a number of different frequencies. These intrinsic frequencies are what make up the harmonics of the Saroj Veena string. A string's natural frequency is affected by its tension, linear density, and length. This frequency is defined by these three factors. Each of these natural frequencies or harmonics has a connection to standing wave patterns. The image below depicts standing wave patterns for the lowest three harmonics or frequencies of a Saroj Veena string.

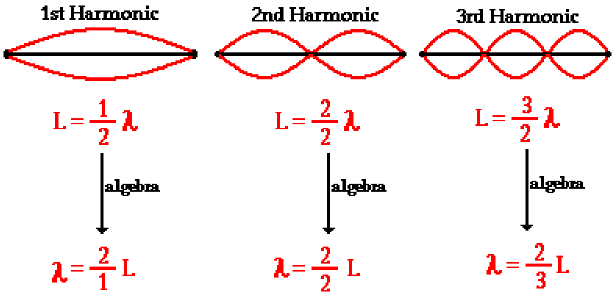


Fig. 5.5 Wave patterns

5.3 Construction of the Saroj Veena

Saroj Veenas contain a number of parts that allow them to generate the particular sounds needed for music in order to obtain the precise sounds. The headstock, which is connected to the Saroj Veena's neck, is the instrument's narrow end. Machine heads, sometimes referred to as tuning keys, are located on the headstock, around which the strings are strung. In the area where the headstock and neck of the Saroj Veena meet, known as the nut, there is a little piece of material (such as plastic, bone, etc.) with tiny grooves engraved into it to guide the strings up to the machine heads. The neck of the Saroj Veena is where the fretboard is placed; the neck runs the entire length of the instrument till it affixes to the body at the top bout. The frets are strategically placed along the neck's length to divide it mathematically. The sound hole, which is a cutout on top of the Saroj Veena's body, is a resonating chamber through which the body's vibrations are sent. The Saroj Veena's strings are attached at the bridge, which is a piece of hardware that is linked to the instrument's body and runs from the machine heads down the neck, over the nut, and into the sound hole.

5.4 Vibration

These Saroj Veena parts provide the instrument the ability to produce the precise tones needed to make music. Understanding sound mechanics is necessary before one can comprehend music and how Saroj Veenas create it. Sound is created when the vibration of material bodies builds up a wave motion in the atmosphere. Accordingly, when material bodies vibrate, vibrational energy is created and it travels across a medium as pressure waves. Saroj Veenas are a type of musical instrument known as a string instrument since the vibrations of a string are what cause them to sound. In order to create the sound waves that make up music, which is basically organized sound, all instruments vibrate. The string on the Saroj Veena that vibrates to produce the sound is tied at both ends, is elastic, and may thus vibrate. When strummed or plucked, the Saroj Veena string vibrates. These vibrations run down the string in both directions before being reflected back at each fixed end because they are waves. These waves will create a standing wave, which is a situation in which the wave's crests and troughs remain at fixed places in the medium as the wave as a whole rises and falls at the same time, rather than canceling each other out as they reflect back on themselves. The behavior of the Saroj Veena strings fulfills the equation $v = f\lambda$, which expresses the relationship between wavelength and frequency. You may rewrite this equation as $f = v/\lambda$ to show that a wave's frequency (f) is influenced by both its speed (v) and its length (λ).

Furthermore, the Saroj Veena string's tension (T) and linear mass density (μ) both have an impact on how quickly a wave moves up the string. In actuality, "the root frequency for a string is inversely proportional to its length, proportional to its linear mass density, and proportional to the square root of the tension." This means that as the tension of the string increases, so will the frequency, because waves move faster as tension increases ($f = v/\lambda$, where v is increasing). This means that waves will flow more slowly down a string with higher mass since v drops as mass increases. From the link between the speed, tension, and mass density, a new equation might be created,

$$v = \sqrt{T/\mu}$$

5.5 Construction

When a standing wave vibrates, a mix of reflection and interference occurs, causing the reflected waves to interfere constructively with the incident waves because the waves altered phase as they reflected off one of the fixed ends. When this occurs, it looks as though the medium is vibrating in sections rather than as a continuous wave. The wavelength that a Saroj Veena string may create when disturbed by being plucked or strummed is twice as long as the string since it acts like a standing wave because it has two fixed ends. The Saroj Veena's six strings all have the same length, so they all use the same range of wavelengths. However, because different amounts of air must be displaced at different frequencies in order to create the various sound waves required to create music, the Saroj Veena strings must be able to vibrate at a range of frequencies. One of the variables in the equation $f = v/\lambda$, the wave's speed or length, must be altered in order to produce different frequencies on the Saroj Veena. Due to the fact that the strings on the Saroj Veena are attached to the nut and bridge and have a set wavelength when played open, the only other element that can be altered to generate a variable frequency is the wave's velocity, or "v." Since the wave's speed is affected by the mass density and the tension on the string ($v = T/\mu$), changing either one of these elements is necessary to obtain a new frequency. The high strings, which require a higher frequency, would need to be wound tightly because the necessary tension would be quite high, whereas the lower strings, which need a lower frequency, would need much less tension and as a result, be very loose. This is because the tension is the only way to change the frequency of the Saroj Veena string's vibration. It would be extremely difficult to play a saroj veena with tight high strings and loose bottom strings, hence saroj veenas are constructed so that the tension of the strings should be equal. The construction of Saroj Veenas allows for simultaneous adjustment of the mass density and string tension, as the mass density is the only other factor that can be changed while playing all of the strings open. Saroj Veena strings are made to have less mass density the higher the frequency required of the open string since higher frequencies require a higher tension to be achieved. Less strain is needed to achieve that frequency the less mass they have. Due to the fact that higher tension results in lower frequencies and that higher tension is required when mass is added to the strings, the mass density increases as the required frequency of a string decreases. With the exception of the string between G and B, the strings of the Saroj Veena are all perfectly spaced apart by a fourth of a cycle in pitch (frequency), making it feasible to calculate how much additional mass density is needed to keep the strings under tension.

5.6 Frets and Intonation

Yet, music is a sophisticated kind of sound, and the right sound waves are needed to construct the music in order to manufacture it. This is an issue because, despite the Saroj Veena's six strings being set up to be playable, each one can only generate one frequency at this time. Furthermore, because the equation $f = v/\lambda$ remains same when an open string is played, there is insufficient variation to generate complicated music. Because of this, altering one component of the equation $f = v/\lambda$ when playing a Saroj Veena will result in a different frequency. Yet, because the two elements ($v = T/\mu$), the mass density and the tension of the string, do not vary sufficiently as a result of playing to alter the wave's speed sufficiently to change the frequency, the wave's speed cannot be altered. As a result, the Saroj Veena's neck has tiny metal strips called frets, whose purpose is to shorten the string's length and raise the frequency as a result. The resonant length of a string is reduced when it is pulled down close to a fret because it no longer extends from the bridge to the nut but rather from the bridge to the fret being held down. By shortening the medium (the string), this reduces the length of the wave (λ), increasing the frequency of the string in the process. In order to generate 24 different frequencies on each string, the Saroj Veena player can choose to shorten each string in about 24 different ways. The number of notes accessible is substantially boosted by the six strings and up to 24 frets that a Saroj Veena possesses on each string. The Saroj Veenaist now has a wide range of frequencies from which to choose while playing music on the instrument since many strings may be played simultaneously. The placements of notes and scales are fixed by the frets on the fingerboard, giving them equal temperament. As a result, the ratio between the widths of two subsequent frets is represented by the twelfth root of two, which has a numerical value of around 1.059. The string is divided into two precise halves at the twelfth fret, then at the 24th fret (if existent), it is divided once again. One octave is represented by every twelve frets. The positioning of the bridge saddles, on which the strings rest, determines the distance from the nut (at the top of the fingerboard). This distance serves as the basis for intonation and provides the harmonic node placements for the strings throughout the fretboard. When the actual frequency of a string at each fret matches what those frequencies should be according to music theory, the string is said to be in tune. Because of the physical limits of fretted instruments, intonation is at best approximate; as a result, the Saroj Veena's intonation is described as tempered. The first harmonic node (half the length of the string) occurs directly under the twelfth fret, or octave, and the ratio of the lengths between the frets on the tempered fretboard is roughly 1.06, as stated above.

5.7 Harmonics

Yet, if a Saroj Veena string just vibrated at one frequency, the instrument would sound fairly monotonous and would not sound all that different from other stringed instruments. Due to its distinctive overtones, or dominant harmonics, the Saroj Veena has a distinctive sound from other stringed instruments. When a Saroj Veena string is strummed or plucked, it starts to vibrate, and these vibrations resemble waves. However, the waves that are created by the string's vibrations progress and travel down it in both directions before being reflected off its immovable ends. When waves reflect, they change direction and travel through the medium in the opposite direction (the string). The waves interfere with other waves that are already traveling through the string and were set off by the vibration as they pass through it once more. When two waves travelling through the same medium interact at precisely the same moment, the result is a standing wave pattern in which the crests and troughs are set in place. Waves those are reflected and traveling in the opposite direction of the other waves cause standing waves to form on a Saroj Veena string. Standing wave patterns are produced by the competing vibrations on a Saroj Veena string, which results in some locations along the string which seem to be stationary. The string's nodes, or places of no movement, are those. Other locations that experience vibrations between a huge positive and large negative displacement are antinodes, which are the areas along the medium that experience the highest displacement during each vibrational cycle of the standing wave. A variety of standing wave patterns, each with a different number of nodes and antinodes, may be created using the Saroj Veena string. A variety of standing wave patterns with various nodes and antinodes may be produced by the string of the Saroj Veena by vibrating it at various frequencies.

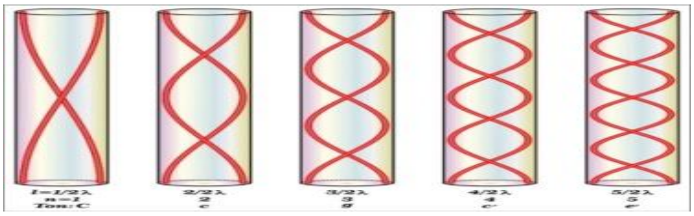


Fig. 5.6 Harmonics

But only when the Saroj Veena's string vibrates at specific frequencies can standing wave patterns be generated inside it. These are referred to as harmonics, and each frequency has a unique standing wave pattern associated with them. The first harmonic, also known as the basic harmonic, is the simplest standing wave pattern that may be created when the two nodes are at the fixed ends of the longest wavelength. There are many distinct frequencies on a Saroj Veena string because the waves continually reflecting off the fixed ends and interfering with one another. Yet, only specific sized waves can withstand any medium that is fixed at both ends. The term "tuned" is used to describe a medium like a Saroj Veena string since it suggests that only specific frequencies may reverberate on it. The Saroj Veena's strings are tuned in this way because the second pattern of the standing wave, or second harmonic, can only have half the wavelength and twice the frequency of the first harmonic. The Saroj Veena stands out from other instruments due to the numerous overtones that we can hear coming from its string. The first overtone is another name for the second harmonic. The third harmonic, also known as the second overtone and the third pattern option for the standing wave on a Saroj Veena, is analogous to the first harmonic. It has a wavelength that is one-third that of the first harmonic and a frequency that is three times as high. The nth harmonic, which has a wavelength of 1/n and a frequency of n, is all similar to the others in this pattern. The fundamental frequency, or first harmonic, is what causes us to hear a particular note, but the higher harmonics are what cause us to perceive a particular timbre. This suggests that while the sound of the musical note is generated by the more complex standing wave patterns, or the other harmonics, the musical note we hear is determined by the simplest standing wave pattern on the Saroj Veena string, which only has two nodes and two antinodes.

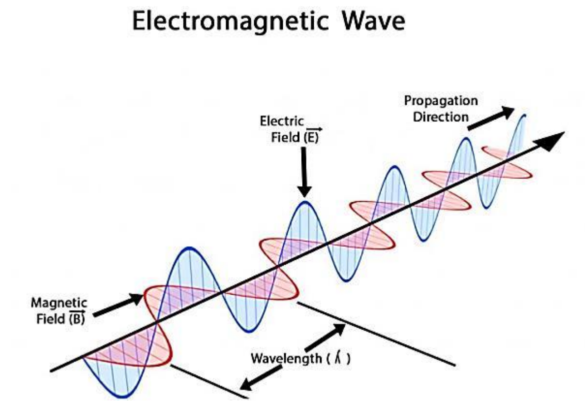


Fig. 5.7 Electromagnetic Wave

5.8 Acoustic Amplification

When physical vibrations alter the air pressure and generate pressure waves, sound is produced. The Saroj Veena's strings can't move enough air to make a sound loud enough for the human ear to easily hear because they are too thin. As a result, an acoustic Saroj Veena's body, which is made up of several pieces to make this possible, is used to amplify the sounds the strings produce. In essence, the body of the Saroj Veena is a larger hollow chamber created especially to amplify the sound of the strings. The top plate of the body, which is the wood component on the front of the Saroj Veena, is frequently made of thin, springy wood that is around 2.5 mm thick and is intended to vibrate up and down rather effortlessly. The top plate is held level by a number of supports located inside the actual body of the Saroj Veena despite string movement, which is likely to cause the bridge to move since it is attached to the top plate. The rear plate of the Saroj Veena, which is on the other side of the instrument and is pressed up against the player's body to prevent excessive vibration, does not contribute as much to sound amplification. The sides of the Saroj Veena likewise don't transmit much sound since they don't vibrate very much in a direction perpendicular to their surface. Plucking or strumming the strings causes them to vibrate, and these waves are then sent to the bridge of the Saroj Veena. Due of the bridge's connection to the top plate of the Saroj Veena, when the string vibrates, it also causes the top plate to vibrate. When a string vibrates at a high frequency, which causes the bridge to vibrate at a high frequency as well, the top plate vibrations, which make up the majority of the sound, produce the sound. Since the top plate has a substantially larger surface area than the string, when it vibrates as a result of the string's oscillations, the top plate displaces a significantly larger volume of air than the string. In turn, this will result in larger pressure waves and louder sound from the top plate. Lower frequency vibrations of the strings are transferred by the bridge to the top plate, where they are subsequently reflected through the sound hole to increase the volume of pressure waves created. This process is repeated for higher frequency vibrations. While listening to a Saroj Veena, what we actually hear is the vibration of the instrument's body amplifying the sound of the string, not the Saroj Veena strings itself.

5.9 Strings and Waves

For a string, the square root of the tension, mass per unit length, and length are all negatively correlated with the root frequency. Additionally, it is proportional to the length's square root. These ten generate different Saroj Veena string pitches by taking into account the variable masses and tensions of strings of the same length. By applying pressure beneath a fret, one may shorten the string and so produce individual pitches on it. This fresh string's size is L $[1 - 1/(2^{1/12})]$ where L represents how long the string is at the last fret or L/17.817. The connection between two of the twelve notes that make up a chromatic scale, or the semitone interval, is used to calculate this number, is 2^{12} (Evans 85). By doing this to itself 12 times in a row, the string's length is cut in half, producing an octave with a frequency of twice the hertz.

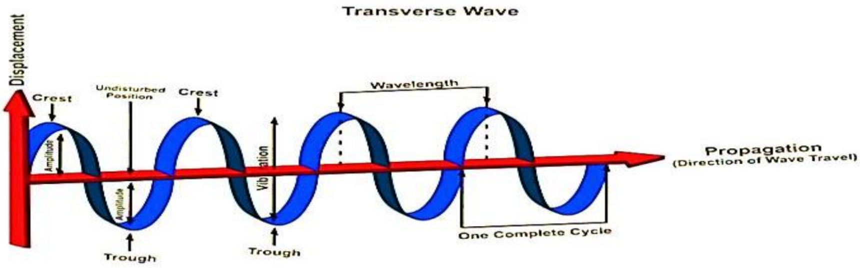


Fig. 5.8 Transverse Wave

Find out how the string echoes with a straightforward pluck. A comparatively high transverse to longitudinal force ratio along the string causes the face plate and bridge to resonate more, whereas a higher longitudinal force ratio causes the back and cavity to reverberate more. These forces can be measured as $F_T = (T_0 + dT) \sin ø$, and $F_L = T_0 + EA/L_0\, dL$ where T is tension, ø is the angle between the string and the neck, E stands for the string's electric modulus, A for its cross-sectional area, and L for its overall length. The sound generated will also vary depending on how the string is plucked. To enumerate all the forces that interact with one another in intricate ways would be impossible. A Saroj Veena may be thought of as a simple harmonic motion of a string at its most basic, but the sound that represents that sine wave is very different from that of the Saroj Veena. The Saroj Veena sounds the way it does because of all its infinite and distinctive features.

5.10 Internal Air

Particularly for the instrument's low range, the air inside the body is crucial. If you blow over the top, it can shake a bit like a bottle of air. If we sing a note between F#2 and A2 (depending on the Saroj Veena) while keeping our ear close to the sound hole, we can really hear the air in the body reverberating. This phenomenon is referred to as the Helmholtz resonance. We may hear the effect of this resonance by playing the open A string while sliding a piece of cardboard or paper back and forth across the soundhole. After the hole is sealed up, we will notice a loss of bass response since the resonance has been stopped (or has been moved to a lower frequency). A strong coupling exists between the air within and the top plate's lowest resonance. Combined, they produce a powerful resonance at a pitch roughly an octave higher than the primary air resonance. The motion of the top and rear plates is also somewhat coupled by the air. A Saroj Veena's Helmholtz resonance is caused by the air at the soundhole vibrating as a result of the air's springiness inside the body. Everyone has probably liked the unusually low-pitched tone produced by blowing over a bottle's top. Similar to that is the lowest Saroj Veena resonance. Because air is elastic, its pressure rises when we compress it. Think of an air "lump" near the soundhole. This compresses the internal air if it travels a short distance inside the body. The "lump" of air is now forced out by this pressure, but when it returns to its former location, its momentum propels it a short distance beyond the body. This dries up the air in the body, which forces the air "lump" back inside. Hence, it is capable of vibrating like a mass on a spring. In actuality, the increased pressure is produced by both the body's own distension and the compression of the air within the body. Helmholtz resonance is used to quantitatively analyse this.

5.11 How does the incredible twangy sound that we hear come from an electric Saroj Veena, which is made of moving strings?

1. A magnetic field is created everywhere around the bar magnet (grey) in the pickup.

2. Above the pickup, a magnetic field (seen as grey curving lines) rises invisibly through the metal guitar strings. (It also penetrates the instrument downward, but that is unimportant in this instance.)

3. The magnetic field causes a brown guitar string close to the magnet to get magnetised. It creates a shifting magnetic field of its own as it vibrates.

4. This magnetic field is detected (or "picked up") by a coil of thin wire (yellow) coiled around the pickup. In the coil, the field induces (generates) a very small electric current.

5. A loudspeaker may be driven by an amplifier by increasing the electric current, which is amplified.

6. Electric current is converted into sound via loudspeakers.

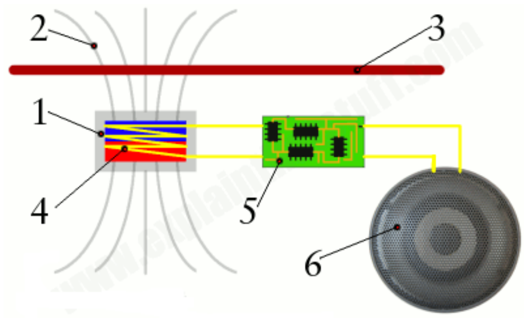


Fig. 5.9 Variation of Sound

5.12 Conclusion

This chapter concludes when plucking close to the middle of the string of Saroj veena, the amplitude of the fundamental tone is dominant. When plucking at the regular playing area, we get a melodious, clean and sine-like tone. When plucking closer to the edge of the string, more of the potential energy released goes into higher-pitch harmonic tones, producing a sharper sound. Students have the chance to learn through this lab experiment how the manner in which the strings are played significantly affects the harmonic structure of standing waves in the Saroj Veena strings. Many students had this misconception before the lab: they believed that playing a certain note on any instrument would cause oscillations at precisely this frequency. By visually seeing that other harmonics are also present and comparing this observation with how the note sounds when the string is plucked at different locations, students may link the sound waves produced by the complicated mechanical vibrations of the string.

Chapter 6

Mathematical Examination of Saroj Veena

In order to prescribe the activities of Saroj Veena's idealised vibratory line, a statistical model will be constructed in this work. In the case of a statistical model, the size and position of the pluck for each harmonic may be used to determine the principal amplifications. We report on a study on how a Saroj Veena string affects the energy distribution between fundamental nuances and overtones in this article. Saroj Veena recorded the sound samples, which were then mathematically processed by the computer. At last, it is reported that additional overtones were produced when a string was plucked near the Saroj Veena's edge. Being a physics research, the topic was examined empirically, and few or no statistical interpretations of the results were provided.

6.1. Introduction

The synthesis based on physical models has advanced significantly in the last few years. Studying acoustics and material science is a good place to start for the display in these endeavours (Clift and Hancox, 2001). Any disconnections may be used to improve the models so they can run continuously on a PC and make them computer-friendly. Even if the instruments' material sciences serve as the foundation for updated physical versions, they combine incredibly useful instrumental tones. In any case, the research needs to be done to the performer's operations to determine how to link to a PC model, regardless of whether it is advisable to utilise a physical model operating on a PC (Clift et al, 2008; Stacey et al., 2002). Equations for the manufacturing line's amalgamation are created and continually refined, specifically in the case of the guitar. A research was conducted for the purpose of the research partner to elucidate the relationships between timbre nuances and templates, as well as the mental, psychoacoustic, and physical factors (Coffman and Adamek, 1999; Vanderark et al, 1983; Wise et al., 1992; Kahn, 1998). Among the factors that can be eliminated, the timbre subtlety is significantly influenced by the placement of the culling point on the string. There is a pressing need to address the finger left. Singing along to music or playing finger harmony are actually two different ways. One may select a specific fingering because it sounds elegant and precise or because it is flawless, strong, and portable. On a guitar, any sound may be produced using up to five distinct string/fret combinations. In this sense, since a transcript is the only information provided, the fingering employed by a particular comedian may not always be obvious or visible. Among the instrumental motion characteristics that affect the guitar sound timbre, the location of the snoring point along the string's surface has a notable impact. A brighter, sharper tone is produced by culling a string around the scaffold. Richer sounding segments are those with high repetition (Bygren, Konlaan & Johnansson, 1996; Konlaan, Bygren and Johansson, 2000; Johansson, Konlaan and Bygren, 2001; Hyyppa and Maki, 2001). This is the result of playing the sulponticello guitar. Achieving sultasto, or playing close to the string's centre across the fingerboard, is another amazing feat. The sound is louder, mellower, and less rich in high recurrences in every way. The neutral right-hand position is behind the sound opening. Lower strings often travel farther than upper strings due to the position of the fingers on the right hand.

6.1.1 Motivation

The attempt to use numerical technique to explain the revelations served as one of the main sources of motivation. The exploration centre attempts to infer a numerical model that suggests using a vibrating line. There should be a connection between such simplifying assumptions and the scientific model's rationality. Towards the end of the show, a few explanations of the model are provided.

6.1.2 Related work

In the founding of O. S. Caroline Traube 2000, a recurrence space method for figuring out the culling point on an instrument's string from an acoustically recorded sign was developed. It further applies a single approach to define the fingering point for capturing point data. A methodical computation of the fundamental parameters of the spectral envelope was proposed by the inventor in order to produce the exciting point field on a musical instrument's string (Hurwitz et al., 1975). An overall process for assessing the culling zone in two stages is suggested by the paper's author: Starting with an initial raw contention known as the autocorrelation of the sign, a weighted minor square estimate is utilised to optimise the resulting value of a FIR brush-channel deferral to fit the intentional ghostly envelope.

Key sub-problem for the necessary model-based sonic union is the proposed model parameter adaptation in the maker (Rauscher et al., 1997). This paper presents modifications to an existing guitar display's adjustment procedure and broadens the parameter extraction technique to gather information on implementation features like damping management, slug replenishment, vibration characteristics, and different kinds of fearlessness and element variations.

6.2 Mathematical Model

The overall structure of the one-dimensional wave mathematical claim, where the fixed endpoints are to be (Rauscher et al., 1997):

$$y(x,t) = \sum_i X_i(x)T_i(t) = \sum_{k=1}^{\infty} \sin\left(\frac{k\pi}{L}x\right)\left(\alpha_k \cos\left(\frac{ck\pi}{L}t\right) + \beta_k \sin\left(\frac{ck\pi}{L}t\right)\right) \quad \ldots\ldots\ldots (1)$$

Where,

c= $\sqrt{T/\mu}$

The natural frequencies are $\frac{ck\pi}{L}$

6.3 Imposing initial conditions

The string is taken out of its equilibrium condition at location d by a distance h when it is plucked. A function f(x) is defined by the form of the string at the instant it is plucked (Hirt-Mannheimer, 1995; Wolf, 1992; Humpal and Wolf, 2003).

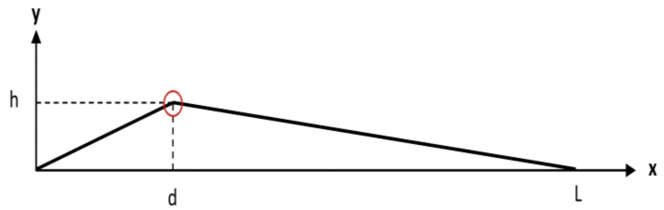


Fig. 6.1 Initial conditions of the plucked string.

Since we are assuming that the string is motionless when released (no speed), the initial conditions are:

$$y(x,0) = f(x) \qquad \text{for all } 0 < x < L \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\frac{\partial}{\partial t} y(x,0) = 0 \qquad \text{for all } 0 < x < L \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Using (1) gives:

$$f(x) = y(x,0) = \sum_{k=1}^{\infty} \sin\left(\frac{k\pi}{L}x\right)\left(\alpha_k \cos\left(\frac{ck\pi}{L} \times 0\right) + \beta_k \sin\left(\frac{ck\pi}{L} \times 0\right)\right) \quad \ldots\ldots\ (4)$$

$$= \sum_{k=1}^{\infty} \alpha_k \sin\left(\frac{k\pi}{L}x\right)$$

And

$$\frac{\partial}{\partial t} y(x,0) = \frac{\partial}{\partial t} \sum_{k=1} \sin\left(\frac{k\pi}{L}x\right)\left(\alpha_k \cos\left(\frac{ck\pi}{L}t\right) + \beta_k \sin\left(\frac{ck\pi}{L}t\right)\right)$$

$$= \sum_{k=1}^{\infty} \sin\left(\frac{k\pi}{L}x\right)\left(\alpha_k \frac{\partial}{\partial t} \cos\left(\frac{ck\pi}{L}t\right) + \beta_k \frac{\partial}{\partial t} \sin\left(\frac{ck\pi}{L}t\right)\right)$$

Applying derivatives to the chain rule:

$$\frac{\partial}{\partial t} \cos\left(\frac{ck\pi}{L}t\right) = -\left(\frac{ck\pi}{L}\right) \sin\left(\frac{ck\pi}{L}t\right)$$

$$\frac{\partial}{\partial t} \sin\left(\frac{ck\pi}{L}t\right) = \left(\frac{ck\pi}{L}\right) \cos\left(\frac{ck\pi}{L}t\right)$$

At t=0:

$$\frac{\partial}{\partial t} \cos\left(\frac{ck\pi}{L}t\right)\Big|_{t=0} = -\left(\frac{ck\pi}{L}\right) \sin\left(\frac{ck\pi}{L} \times 0\right) = 0$$

$$\frac{\partial}{\partial t} \sin\left(\frac{ck\pi}{L}t\right)\Big|_{t=0} = \left(\frac{ck\pi}{L}\right) \cos\left(\frac{ck\pi}{L} \times 0\right) = \left(\frac{ck\pi}{L}\right)$$

Giving:

From (3):

$$\frac{\partial}{\partial t} y(x,0) = 0$$

$$\sum_{k=1}^{\infty} \beta_k \frac{ck\pi}{L} \sin\left(\frac{k\pi}{L}x\right) = 0$$

$$\frac{\partial}{\partial t} y(x,0) = \sum_{k=1}^{\infty} \sin\left(\frac{k\pi}{L}x\right)\left(\alpha_k \times 0 + \beta_k \frac{ck\pi}{L}\ 1\right) = \sum_{k=1}^{\infty} \beta_k \frac{ck\pi}{L} \sin\left(\frac{k\pi}{L}x\right)$$

β(k=0) is implied for all k. This enables us to reduce (1) to:

$$y(x,t) = \sum_{k=1}^{\infty} \alpha_k \sin\left(\frac{k\pi}{L}x\right) \cos\left(\frac{ck\pi}{L}t\right) \quad \ldots\ldots\ldots\ldots\ldots\ (5)$$

6.4 Fourier series

There is a single representation for every smooth function f(x).

$$f(x) = \sum_{k=1}^{\infty} A_k \sin\left(\frac{k\pi}{L}x\right)$$

If the coefficients are calculated using

$$A_k = \frac{2}{L}\int_0^L f(x)\sin\left(\frac{k\pi x}{L}\right)dx \qquad \text{…………….. (6)}$$

In order to locate the coefficients α_k in (5) Fourier series shall be employed.

This means that a function f(x) can specify the form of the string at the exact instant it is plucked.

$$f(x) = \begin{cases} \dfrac{hx}{d}, & 0 \le x \le d \\ \dfrac{h(L-x)}{L-d}, & d < x \le L \end{cases}$$

The form of equation (4) is identical to a Fourier series. (6) is used to get the coefficients by separating the integral from d to L and from 0 to d. The integral by parts method is used to solve the integral.

Integration by parts (Wikipedia) (encyclopedia n.d.):

$$\int_a^b u\,dv = [uv]_a^b - \int_a^b v\,du$$

Coefficients in (4):

$$A_k = \frac{2}{L}\int_0^L f(x)\sin\left(\frac{k\pi x}{L}\right)dx = \frac{2}{L}\left[\underbrace{\int_0^d \frac{hx}{d}\sin\left(\frac{k\pi x}{L}\right)dx}_{\text{Part 1}} + \underbrace{\int_d^L \frac{h(L-x)}{L-d}\sin\left(\frac{k\pi x}{L}\right)dx}_{\text{Part 2}}\right]$$

Part: 1

Setting $u = \frac{hx}{d}$ and $dv = \sin\left(\frac{k\pi x}{L}\right) dx$

$$\int_0^d \frac{hx}{d} \sin\left(\frac{k\pi x}{L}\right) dx = \left[\frac{hx}{d}\left(\frac{-L}{k\pi}\right) cos\left(\frac{k\pi x}{L}\right)\right]_0^d - \int_0^d \left(\frac{-L}{k\pi}\right) \cos\left(\frac{k\pi x}{L}\right) \frac{h}{d}\, dx$$

$$= \left[\frac{-hLx}{k\pi d} cos\left(\frac{k\pi x}{L}\right)\right]_0^d - \int_0^d \frac{-hL}{k\pi d} \cos\left(\frac{k\pi x}{L}\right) dx$$

$$= \left[\frac{-hLx}{k\pi d} cos\left(\frac{k\pi x}{L}\right)\right]_0^d - \left(\frac{-hL}{k\pi d}\right)\left[\frac{L}{k\pi} \sin\left(\frac{k\pi x}{L}\right)\right]_0^d$$

$$= \frac{-hLd}{k\pi d} cos\left(\frac{k\pi d}{L}\right) - \left(\frac{-hL \times 0}{k\pi d}\right) cos\left(\frac{k\pi \times 0}{L}\right)$$

$$+ \frac{hL}{k\pi d}\, \frac{L}{k\pi}\left(\sin\left(\frac{k\pi d}{L}\right) - \sin\left(\frac{k\pi \times 0}{L}\right)\right)$$

$$= \frac{-hL}{k\pi} cos\left(\frac{k\pi d}{L}\right) + \frac{hL^2}{k^2\pi^2 d} \sin\left(\frac{k\pi d}{L}\right)$$

Part: 2

Setting $u = \frac{h(L-x)}{L-d}$ and $dv = \sin\left(\frac{k\pi x}{L}\right) dx$

$$\int_d^L \frac{h(L-x)}{L-d} \sin\left(\frac{k\pi x}{L}\right) dx = \left[\frac{h(L-x)}{L-d}\left(\frac{-L}{k\pi}\right) cos\left(\frac{k\pi x}{L}\right)\right]_d^L - \int_d^L \left(\frac{-L}{k\pi}\right) \cos\left(\frac{k\pi x}{L}\right) \frac{-h}{L-d}\, dx$$

$$= \left[\frac{-h(L-x)L}{(L-d)k\pi} cos\left(\frac{k\pi x}{L}\right)\right]_d^L - \int_d^L \frac{hL}{(L-d)k\pi} \cos\left(\frac{k\pi x}{L}\right) dx$$

$$= \left[\frac{-h(L-x)L}{(L-d)k\pi} cos\left(\frac{k\pi x}{L}\right)\right]_d^L - \frac{hL}{(L-d)k\pi}\left[\frac{L}{k\pi} \sin\left(\frac{k\pi x}{L}\right)\right]_d^L$$

$$= \frac{-h(L-L)L}{(L-d)k\pi} cos\left(\frac{k\pi L}{L}\right) - \frac{h(L-d)L}{(L-d)k\pi} cos\left(\frac{k\pi d}{L}\right)$$

$$- \frac{hL}{(L-d)k\pi}\, \frac{L}{k\pi}\left(\sin\left(\frac{k\pi L}{L}\right) - \sin\left(\frac{k\pi d}{L}\right)\right)$$

$$= \frac{hL}{k\pi} cos\left(\frac{k\pi d}{L}\right) + \frac{hL^2}{(L-d)k^2\pi^2} \sin\left(\frac{k\pi d}{L}\right)$$

Thus

$$A_k = \frac{2}{L}\left[\frac{-hL}{k\pi}cos\left(\frac{k\pi d}{L}\right) + \frac{hL^2}{k^2\pi^2 d}\sin\left(\frac{k\pi d}{L}\right) + \frac{hL}{k\pi}cos\left(\frac{k\pi d}{L}\right) + \frac{hL^2}{(L-d)k^2\pi^2}\sin\left(\frac{k\pi d}{L}\right)\right]$$

$$= \frac{2}{L}\left[\frac{hL^2}{k^2\pi^2 d}\sin\left(\frac{k\pi d}{L}\right) + \frac{hL^2}{(L-d)k^2\pi^2}\sin\left(\frac{k\pi d}{L}\right)\right]$$

$$= \frac{2}{L}\left(\frac{hL^2}{k^2\pi^2 d}\frac{\times (L-d)}{\times (L-d)} + \frac{hL^2}{(L-d)k^2\pi^2}\frac{\times d}{\times d}\right)\sin\left(\frac{k\pi d}{L}\right)$$

$$= \frac{2}{L}\left(\frac{hL^3 - hL^2 d + hL^2 d}{(L-d)k^2\pi^2 d}\right)\sin\left(\frac{k\pi d}{L}\right)$$

$$= \frac{2hL^2}{(L-d)k^2\pi^2 d}\sin\left(\frac{k\pi d}{L}\right)$$

Now, The solution:

$$A_k = \frac{2}{L}\int_0^L f(x)\sin\left(\frac{k\pi x}{L}\right)dx = \frac{2hL^2}{\pi^2 k^2 d(L-d)}\sin\left(\frac{k\pi d}{L}\right) \qquad \text{.................. (7)}$$

After that, the displacement function is as follows:

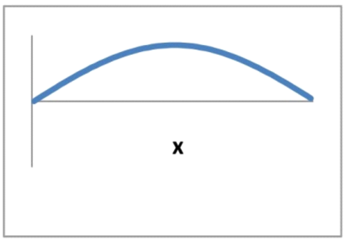
$$y(x,t) = \sum_{k=1}^{\infty}\frac{2hL^2}{\pi^2 k^2 d(L-d)}\sin\left(\frac{k\pi d}{L}\right)\sin\left(\frac{k\pi}{L}x\right)\cos\left(\frac{ck\pi}{L}t\right) \qquad \text{.................. (8)}$$

6.5 Harmonics

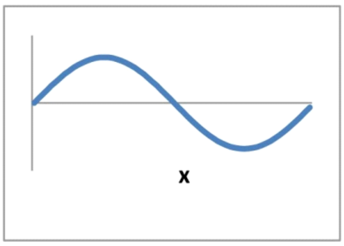
The displacement function, according to equation (8), is the sum of components known as modes or harmonics. Every mode denotes a distinct harmonic motion wavelength. For a predetermined period of timet_1:

$$y(x,t_1) = \sum_{k=1}^{\infty}\frac{2hL^2}{\pi^2 k^2 d(L-d)}\sin\left(\frac{k\pi d}{L}\right)\cos\left(\frac{ck\pi}{L}t_1\right) \times \sin\left(\frac{k\pi}{L}x\right)$$

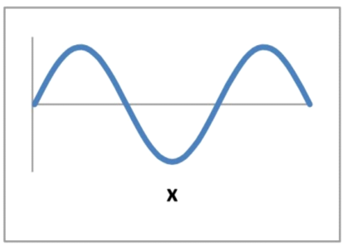
Implying that every mode has a fixed duration $\sin(k\pi x/L)$. As x runs from 0 to L, the argument of $\sin(k\pi x/L)$ runs from 0 to kπ , which is k half- periods of sin.



Amplitude for k=1



Amplitude for k=2



Amplitude for k=3

In a similar vein, for any fixed position x1:

$$y(x_1,t)=\sum_{k=1}^{\infty}\frac{2hL^2}{\pi^2k^2d(L-d)}\sin\left(\frac{k\pi d}{L}\right)\sin\left(\frac{k\pi}{L}x_1\right)\quad\times\cos\left(\frac{ck\pi}{L}t\right)$$

Implying that every mode is a timing constant$\cos(ck\pi t/L)$. As *t* increases from 0 to 1 s, the argument of $\cos(ck\pi t/L)$increases by $\frac{ck\pi}{L}$, which is $\frac{ck}{2L}$ cycles. For mode k=1 (the fundamental tone), the frequency is $\frac{c}{2L}$ cycles per second. For mode k = 2 (the second harmonic), the frequency is $2\frac{c}{2L}$ cycles per second. For mode k = 3 (the third harmonic), the frequency is $3\frac{c}{2L}$ cycles per second etc.

Since c=$\sqrt{T/\mu}$ a string's oscillation frequency decreases with density and increases with tension or string shortening.

6.6 Coefficients

The coefficients in (7) found by Fourier transformation gives the amplitude of each harmonic, i.e. computed by inserting k=1, k=2, k=3, etc. By superposition lemma the total displacement is formed by the sum of the harmonics. To illustrate the principle, we consider the following example: L = 0.64, h = 0.005 and d = 0.16, giving the following amplitudes according to (7):

k	A_k
1	3.821E-03
2	1.351E-03
3	4.246E-04
4	4.138E-20
5	-1.528E-04

We compute the graphs using Excel for *t* = 0 as an example. The first harmonic:

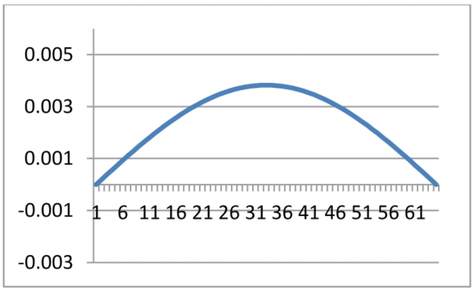
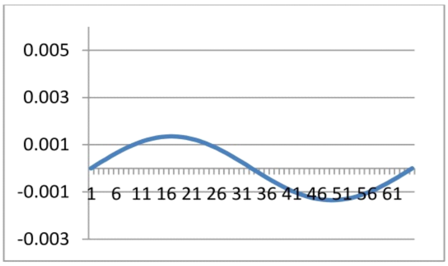


Fig. 6.2 First harmonic at t=0

The second harmonic and the sum of the first two harmonics:



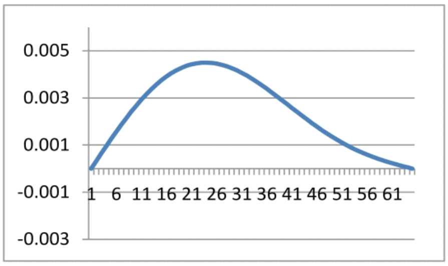
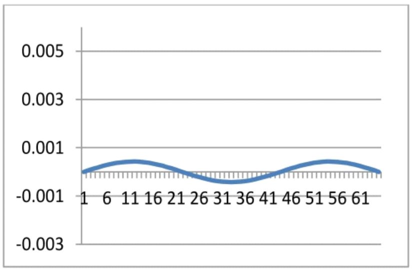


Fig. 6.3 Second harmonic at t=0 **Fig. 6.4 Sum of the two first harmonics at t=0**

The third harmonic and the sum of the first three harmonics:



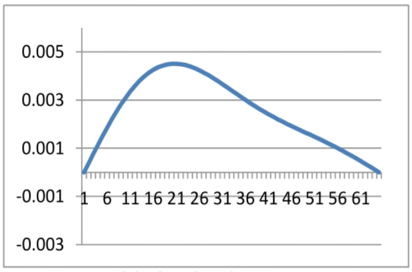


Fig. 6.5 Third harmonic at t=0 **Fig. 6.6 Sum of the first three harmonics at t=0**

As more harmonics are added, the total displacement function as the accumulated sum of harmonics becomes more and more similar to the initial displacement function *f(x)*

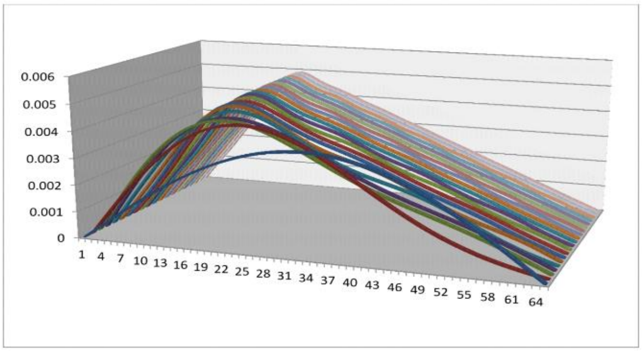


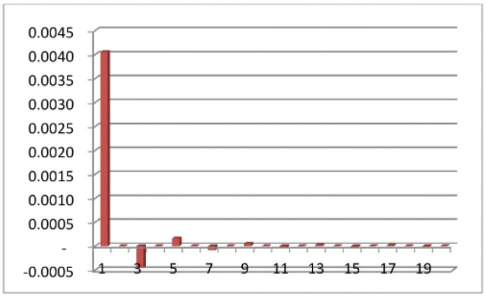
Fig. 6.7 Accumulated sum of the first 20 harmonics for d = 0.16

6.7 Amplitude distribution depending on position of plucking

We compute amplitudes in accordance with (7) for a few sample values of d in order to determine the impact of the distribution of amplitudes for the harmonics dependent on the position of plucking. With L = 0.64 and h = 0.005, L & h are fixed.

***d* = 0.32**

The following amplitude distribution should result from plucking near the middle of the string (d = 0.32);

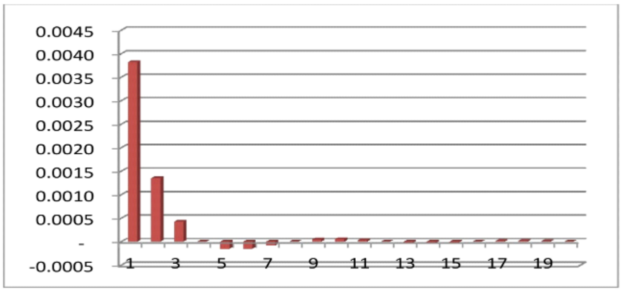


Amplitudes for d = 0.32

In this instance, the dominant fundamental harmonic creates an overtone with modest amplitudes that sounds "pure." There are no even-numbered harmonics at all (k = 2, k = 4, etc.).

***d* = 0.16**

Playing the Saroj Veena at its standard playing area (cad = 0.16), results in a somewhat altered distribution of amplitude.

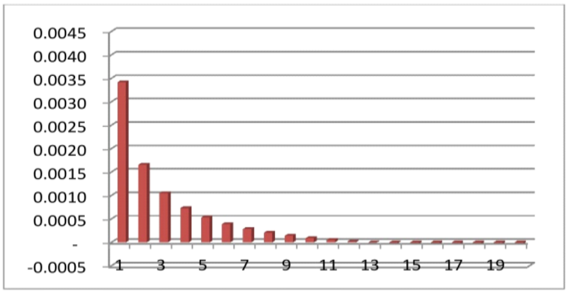


Amplitudes for d = 0.16

Even if the five initial overtones still have a lot of weight, the overall tone is affected.

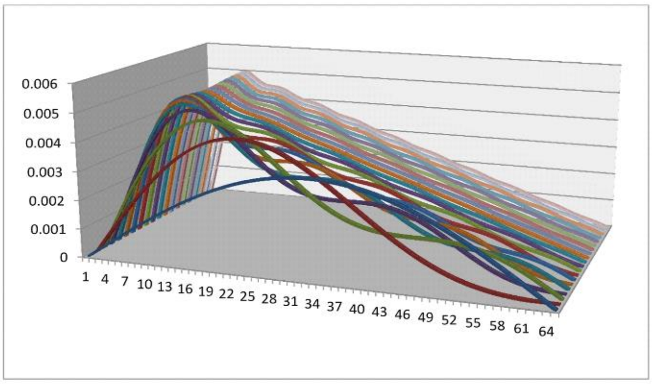
d = 0.05

The amplitude distribution that results from plucking the Saroj Veena near the nut or bridge is as follows.



Amplitudes for d = 0.05

The overtones will be noticeably more apparent in this scenario, even up to the 10^{th} overtone. A "bright" tone quality would result from this.



Accumulated sum of the first 20 harmonics for d = 0.05

6.8 Experiment setup

The following software tools were installed on a PC that had a microphone attached to it:

- Audacity for using a microphone to record.
- Spectra Scope, which generates frequency amplitudes by analysing the sound files.
- Full control over the start and finish times of the recording was made possible by recoding to a file and utilising MS Excel to examine and analyse the output frequency tables utilising Audacity. This prevented distortion from fading and transients at the beginning of the recording. 1.04 second samples were employed. Spectra Scope creates a frequency map of the amplitudes stated in dB by implementing a Fast Fourier Transform (FFT). As a result, we were able to determine the relative strengths of the overtones and basic tone. Frequency table export was supported by Spectra Scope. After importing and analysing the frequency tables produced by Spectra Scope, Excel was utilised. The dBv values were summarised from approximately ten Hz below to about Ten Hz above the real frequency in order to minimise causes of inaccuracy. There were always eight values in each group. Accurate measurements and tagging of the plucking location on the Saroj Veena were necessary to provide repeatable and consistent results. Additionally stated was the 0.5 cm sideways offset.

6.9 Saroj Veena

The Gomati District of Tripura is where this instrument first appeared. This instrument's playing technique is a little similar to that of the Indian classical guitar (slide guitar). In contrast, the Vichitra Veena is more similar in terms of design, structure, materials used in manufacture, and—above all—

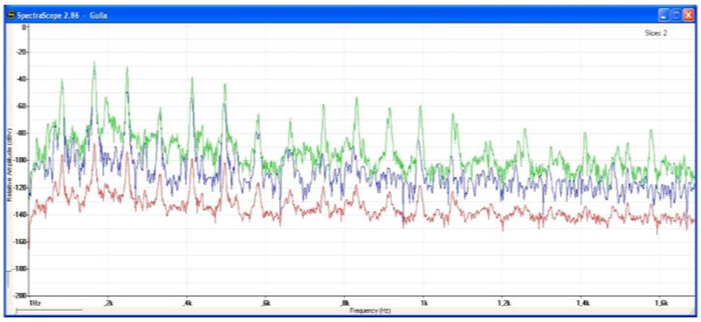
sound output quality and tone. It is played with a left-hand slide and special plectrums held in the fingers of the right hand. A slide guitar is entirely indianized, with the exception of the conventional fretboard. The instrument is constructed out of a single, solid wood piece. It has a semi-flat sound chamber, just as the Veena and Tambura. Four strings, three chikaris, and thirteen sympathetic strings can all be used to play it. One way to obtain more sustainability and sound resonance is to fasten a chrome-plated brass tuba to the back of the neck. The border of the fretboard or hollow neck is elegantly curled to resemble a peacock's neck. The tone of the instrument is smoother and more harmoniously balanced, similar to a veena's. Like Vichitra Veena, it is easier to perform in the traditional gayaki (singing) style thanks to the beautiful sustained tone. To make playing easier, inlays are used to show where the notes are located. In all, the Saroj Veena exerts tremendous strain on more than 500 pounds of strings. This strong tension is what allows the tone tune to work so well, with sympathetic tones reverberating and amplifying every note played. This is a loud instrument meant to be heard even when amplification is turned down. Today, the Saroj Veena is Tripura's most popular musical instrument. This instrument is utilised in a variety of orchestras, festivals, and pujas. This instrument may be found in both Hindustani classical and folk music.

Fig. 6.8 Saroj Veena

6.10 Measurements

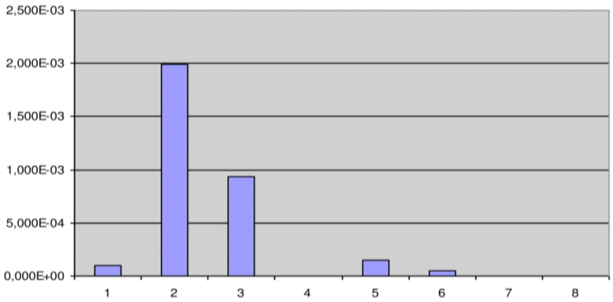
6.10.1 Acoustic Saroj Veena, 82 Hz, d=0.16, played with a plastic plectrum

A 1.04 second recording was made by employing a high-quality microphone linked to a laptop. SpectraScope's amplitude-to-frequency diagram is illustrated below.

\ 

For additional processing, the dBv values for various frequencies were imported into Excel.

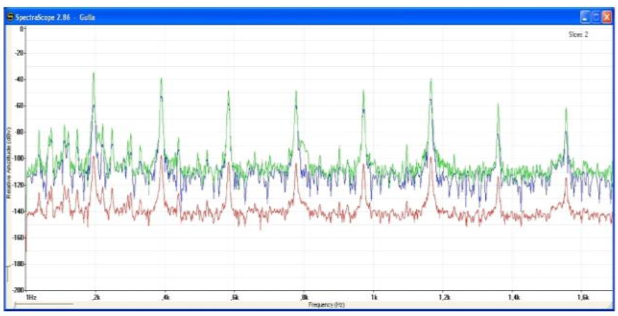
Tone	Ideal frequency (Hz)	Actual frequency (Hz) for max amplitude	Amplitude (dBv) from SpectraScope	Amplitude
Fundamental	82	82	-39.9	1.023E-04
Overtone 1	164	164	-27.0	1.995E-03
Overtone 2	246	247	-30.3	9.333E-04
Overtone 3	328	332	-60.3	9.333E-07
Overtone 4	410	413	-38.3	1.479E-04
Overtone 5	492	496	-43.2	4.786E-05
Overtone 6	574	581	-64.7	3.388E-07
Overtone 7	656	662	-68.2	1.514E-07



As seen in the graphic above, the amplitude of the fundamental tone at 82Hz is relatively low. The sound of an acoustic guitar is created mostly by the instrument body, rather than the strings themselves. It's possible that the body couldn't replicate such low tones.

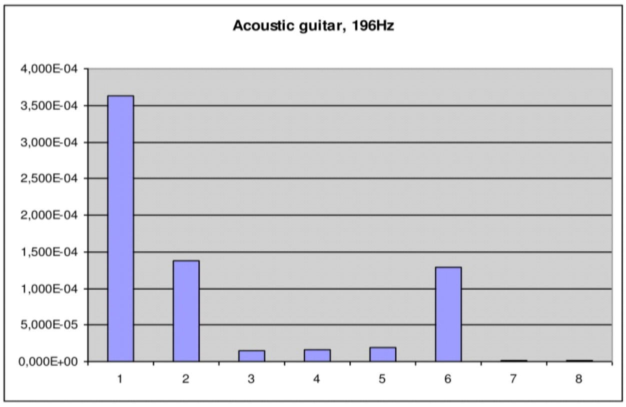
6.10.2 Acoustic Saroj Veena at 196 Hz, d=0.16; plectrum made of plastic

The experiment was performed using the G string at around 196 Hz instead of the low E string.



For additional processing, the dBv values for various frequencies were imported into Excel.

Tone	Ideal frequency (Hz)	Actual frequency (Hz) for max amplitude	Amplitude (dBv) from SpectraScope	Amplitude
Fundamental	196	193	-34.4	3.631E-04
Overtone 1	392	388	-38.6	1.380E-04
Overtone 2	588	582	-48.2	1.514E-05
Overtone 3	784	776	-48.0	1.585E-05
Overtone 4	980	971	-47.1	1.950E-05
Overtone 5	1176	1165	-38.9	1.288E-04
Overtone 6	1372	1359	-58.0	1.585E-06
Overtone 7	1568	1555	-61.1	7.762E-07

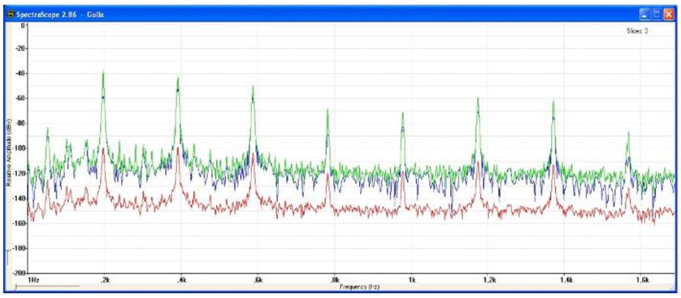


This graph far more closely resembles the distribution that the mathematical model predicts.

6.10.3 196 Hz, d=0.16 electric Saroj Veena, plucking with a plastic plectrum

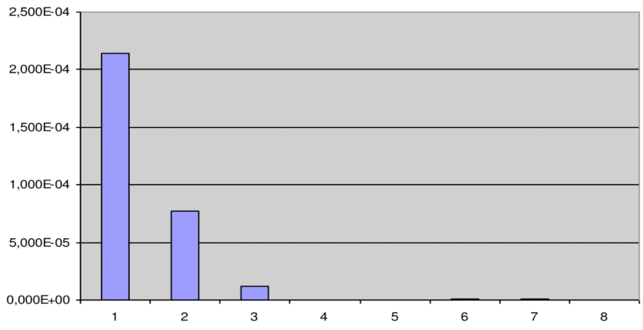
An electronic guitar was utilised in order to totally remove the acoustic guitar body's resonance impact.

The electric guitar's signal was amplified using an external digital sound.

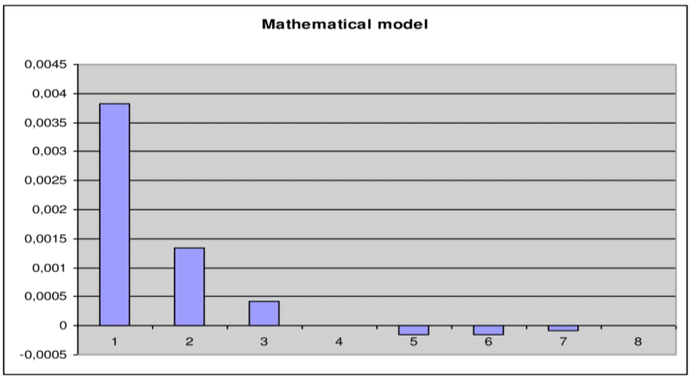


For additional processing, the dBv values for various frequencies were imported into Excel.

Tone	Ideal frequency (Hz)	Actual frequency (Hz) for max amplitude	Amplitude (dBv) from SpectraScope	Amplitude
Fundamental	196	195	-36.7	2.138E-04
Overtone 1	392	390	-41.1	7.762E-05
Overtone 2	588	586	-49.3	1.175E-05
Overtone 3	784	781	-68.2	1.514E-07
Overtone 4	980	978	-71.0	7.943E-08
Overtone 5	1176	1174	-59.1	1.230E-06
Overtone 6	1372	1372	-61.2	7.586E-07
Overtone 7	1568	1567	-86.8	2.089E-09



The comparable amplitudes calculated using formula (7) are displayed below for comparison.



The distribution anticipated by the mathematical formula is remarkably similar to the relative distribution of amplitudes for the various harmonics on a real electrical guitar, as can be witnessed.

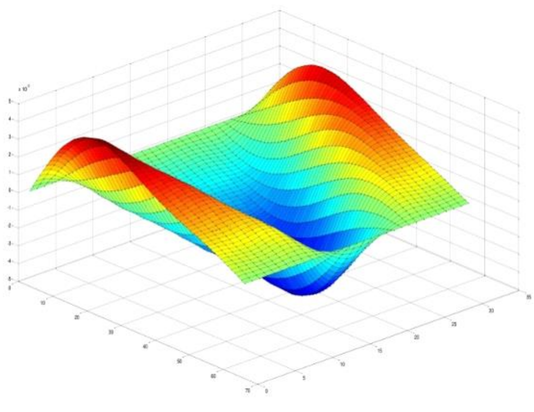


Fig. 6.9 Displacement functions of time and position for the three first harmonics

6.11 Conclusion

For each segment of the string (represented by location x) at any time (represented by t), equation (8) specifies the displacement from equilibrium. Owing to the formula's structure, it is easier to comprehend the complex function as a superposition of modes or harmonics. Every harmonic describes a tone that, depending on the string tension and density, corresponds to the potential standing waves indicated by the string length. Each harmonic's amplitude (7) matches the coefficients that were obtained through the use of the Fourier series. We may calculate the hypothetical amplitudes for the fundamental tone and the overtones based on this mathematical model, which is dependent on the location (d) and the extent (h) of the string plucking. A clear, sine-like tone is produced when plucking around the centre of the string because the basic tone's amplitude is dominating. A sharper sound is produced by plucking closer to the string's edge because greater amounts of the potential energy released is converted into higher-pitch harmonic tones. This aligns with findings made with an actual Saroj Veena.

Chapter 7

An Empirical Examination of Folk Musical Instruments of the Rural Area of Tripura

Music recommendation algorithms may significantly improve the listening and search experiences inside a music collection or music application. The market is overloaded with music, making it impossible for a consumer to effectively sift through tens of millions of tracks. The main driving force behind the creation of the rating-based recommendation system was the extraction of pertinent data from user evaluations of instrumental music. As time goes on, the majority of instruments are no longer in use by the younger generation, which causes these instruments to disappear from the planet. The primary characteristics of folk instrumental music performances are covered in the research (FIM). It covers several aspects of the FIM performed in public concert circumstances (Tripura). Additionally, the study looks into the elements that FIM performers have traditionally advised include raga mood, tranquilly, scalability, and astonishments, as well as the effects that music has on performances.

7.1 Introduction

An algorithm for making recommendations is called collaborative filtering. This algorithm is predicated on the idea that people share similar opinions and interests, have strong preferences, and are able to make decisions based on prior preferences (Davidson and Good, 2002; Young and Colman, 1979). Collaborative filtering bases its recommendations on a number of factors, including past user behaviour, user purchases, and user reviews of purchased items. In order to determine the degree of user similarity when creating restaurant recommendation systems based on ratings provided by previous customers or visitors, this study will conduct experiments involving the application of collaborative filtering algorithms and use the Pearson correlation function as a method. The act of developing and disseminating musical concepts to listeners or audiences is known as musical production. Concerted musical cognition, perception of the structure and context are expressed through the different genres, styles and types of music. Felds' touch principle can be used in music as well. It is a ‘socially articulated' and 'intersubjective' process, rather than a 'thing' or 'entity.' This involves the allocation of social knowledge, which is moved from a 'pre-given mentality' to a capacity. In shows, musical skills gained by performers are seen in their training, perception, assimilation, and experience (Young and Colman, 1979; Murningham and Conlon, 1991). People ingested their familiarity with the language of art. Due to the complex variations of several musical elements, the impact-output is difficult to predict. These contain selected musical content, virtuosity, and subsequent effects at various phases of rendering. Artists' and audiences' experiences are seldom exactly the same. Consequently, what the artist does has no ability for the spectator to be heard. In Folk Instrumental Music (FIM) improvisational elements remain available in a music recital. Performers undergo a profound learning process (tAlim), familiarize themselves with common words, learn about different aspects of ragas, and understand how to arrange different patterns of singing and playing (Hodges and Haack, 1996). A raga transmits various color tones at different times and when it is carried out by a variety of people. In addition, at various times, the same performer will invoke diverse impacts from different ragas. The traditional development of FIM music inherently blends technical and descriptive components. These are the components of virtuosity and ingenuity. Virtuosity components are critical for the selection and melodic variation of materials, such as tempo, rhythmic complexity, difficult decoration, and dynamic tone. The actors also create expressive elements that challenge exceedingly virtuous executions. The aesthetic impression of the audience is influenced by these performances, which have a specific meaning aside from the song's structure, other musical elements and embellishments, extra Musical influences often play a vital role in the accomplishment of a musical success. The auditorium's architecture, which plays a critical role in sound transmission, the efficiency and adaptation of sound amplification systems, stage decoration, lighting arrangements, hosting of concerts and costumes of musicians, etc (North et al., 2000). These auxiliary actors participate and listen to the performers, and The Crowder is an important part of the concert's performance.

7.2 Folk musical instruments of Tripura

The Tripuri people utilize many types of musical instruments during religious ceremonies, festivities, weddings, and other occasions, as indicated in Figure 3.1, and thorough descriptions of various musical instruments are covered in the following sections.

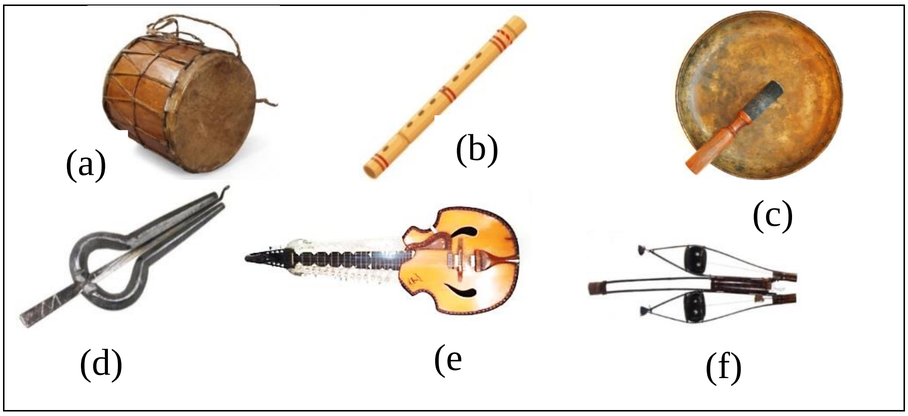


Fig. 7.1 Overview of Folk Musical Instruments, (a) Kham, (b) Murari Sumui, (c) Rang-Thali, (d) Dangdoo, (e) Saroj Veena, (f) Tintrong

7.2.1. Rosem:

Rosem is a flute-like Musical instrument made from bamboo and Gourd. The other names of Rosem are Rasem, Rawchhem. Similar to the western bagpipe; it has seven bamboo flutes, one of which is missing. There's only one person alive today who can play this instrument.

Characteristics:

The instrument is played as an accompaniment to jhum dance and marriage; it is now a typical but rare instrument. The Height of this musical instrument is 32 cm, the breadth of this item is 17 centimetres, 57.5 centimeter in length, and the weight is 125 gram. The origin of this Music instrument is Jampui hills, North Tripura. The Tribe of this Instrument is Kuki (Darlong) and Lushai. This Music instrument was created by Thanga Darlong. Shri Thanga Darlong was originally educated in music in the folk by his father Shri Hakvunga Darlong. Sri Thanga Darlong was born on July 20, 1920 in Tripura. Shri Thanga Darlong has been performing at his community's traditional festivals since childhood. He is recognized as one of the Rosem's most experienced musicians. He has trained a large number of young people in his community. Shri Thanga Darlong's dedicated work to the preservation and promotion of the traditional Rosem Musical instrument has been recognized by the people of the region and by various institutions in North-Eastern India. He was awarded Padma Shri (2019), India's fourth highest civil award. He is also the recipient of the 2014 Sangeet Natak Akademi Award, the highest Indian award for practicing artists. He is also the recipient of the Academic Fellowship Award (2015), Vayoshresta Samman (2016) and the Centenarian Award.

7.2.2. Adhuri

Previously, the Adhuri was made of Mithun horn or Misho horn and Bamboo, but now it is made of buffalo horn and bamboo and on occasions of joy it is played. .

Characteristics:

The Length of this musical instrument is 70 cm, 7.5 cm in diameter and 800 gram in weight. The origin of this Music instrument is Tripura. The Tribe of this Instrument is Garo.

7.2.3. Uakhrap

The Tripuri Uakhrap is a conventional musical instrument. Its origins can be traced back to antiquity. This is a hybrid of two musical foundations: strings and skin membranes as well.

Characteristics:

The base of the instrument is shaped like a semicircle and is built mostly of the trunks of gamai, koroi, or garjan trees; these trunks are often harvested prior to the cultivation of jhum. The hollow bamboo pipes are attached to the outer hemisphere of the semi-circular hardwood base with 4–5 cm long bamboo pieces. They have a total of nine holes. Metal strings link a bamboo pole or a pipe from one end to the other. The inner hemisphere is attached to the base of the leather (animal skin), which is where the bamboo sticks are hammered. The sticks are generally 4-5 in number and are attached to a pole that is secured from one end of the hardwood foundation to the other on the last end of the semi-circular disc. A rhythmic sound is generated when the bamboo sticks are hammered on the tanned skin linked to it. To keep up with or keep up with the rhythm to regulate the music alongside the bamboo stick beats on the skin layer, the hand palm is expected to cover the bamboo holes.

7.2.4. Wakhorok

The Wakhorok is an ancient traditional musical instrument. The Tribe of this Instrument is Tripuri.

Characteristics:

This instrument is bamboo-made. In the middle, the length of the bamboo was hollowed out to produce a resonating cavity. The appearance of frets means that it could be a string tool. The Length of this musical instrument is 18 cm, 50 cm in Height, 7.5 cm in width. The origin of this Music instrument is Tripura.

7.2.5. Wakhong

In Tripura, this is a well-known musical instrument. This instrument is from North-Tripura. This musical instrument is used by the Mog, Chakma, Halam, Reang, and other communities during their various festivals.

Characteristics:

Wakhong is a common ancient musical instrument. This instrument is bamboo-made. Tripura was the origin of this musical instrument. At different festivals, this instrument is played by the tribal people.

7.2.6. Chongpreng

It is said that in playing this musical instrument the forefather of this dofa survived as they suffered from 'gungri' sickness, as he is an ancient traditional musical instrument in Tripura.

Characteristics:

The Chongpreng, a type of chordophonic style lute is made of wood, leather and metal. It has a wooden block hollowed down; a parchment conceals the vibrator. A wooden bridge is accessible in the lower portion. The strings are attached to the lute's pins. A string tool equivalent to a rudimentary instrument or violin that can be played with a bow. Tripuri and Reang are the tribes of this musical instrument. The Height of this musical instrument is 7.5 cm, 13.5 cm in width and 70 cm in length. Chongpreng is also played to the accompaniment of dance recital.

7.2.7. Sarinda Uakhrap

Sarinda Uakhrap is a string musical instrument that is used by most of the tribes. The Tribe of this musical instrument is Tripuri and Reang.

Characteristics:

It looks like a peacock, and to some extent it looks like a mandolin. Its body is so deeply pinched that it looks like it has two parts. It also has an oval-shaped hollow vibrating chamber of wood covered with thin skin. Its larger top portion is open. The waist is narrow in shape. The height of this instrument is 5 cm, 13 cm in width and 69 cm in length. The lower portion of it is oval. The centre is rather enormous, and the edges are quite wide. The part of the cave is uncovered. To secure the strings, three pegs are affixed to the top section. Strings are made of metal, Muga thread, or animal intestine. It's a primitive "bow" fashioned of horse hair. Tightening or relaxing the strings is used to tune them.

7.2.8. Tintrong

Tintrong is an old traditional musical instrument. This instrument is made of wood, Bamboo, coconut and wire. The tribe of this musical instrument is Tripuri.

Characteristics:

The origin of this Music instrument is West Tripura. This musical instrument is prepared during the Lebang Bumani dance and is also used to accompany Vaishnav Bhakti's tribal songs. The bamboo center instruments are called 'wakro,' and the rest have been supplemented by the manufacturer. The instrument can be as high as 174 cm and as large as 35 cm.

7.2.9. Twitreng

Twitreng is an old traditional musical instrument made from wood, wire and leather. The tribe of this musical instrument is Tripuri.

Characteristics:

The height of this musical instrument is 6.5 cm, 18 cm in width, 80 cm in length. A rudimentary string instrument made of bamboo length as a resonator. The top is decorated by a large bird made of rope.

7.2.10. Reegyoweing

Reegyoweing is a Traditional Musical Instrument of Mog community made from wood, wire and leather.

Characteristics:

The origin of this musical instrument is West Tripura. This instrument is identical to the jal tarang, water is filled around the rim in the hollow bamboo containers, and each of these containers is passed via a single string. To generate notes in these pipes the leather pad in the front of the instrument is struck. This is a special musical instrument invented by Debbarman, and experimental. The height of this musical instrument is 4.3 cm, 25 centimeter in width, 45.5 cm in length and 3000 grm in weight.

7.2.11. Kram

The origin of this instrument is South Tripura. The Tribe of this musical instrument is Garo.

Characteristics:

This is an accompanying act for the Wangla Dance during the harvesting festivals and consists of a certain type of tree that has to be venerated before it is carved into an instrument. The length of this musical instrument is 89 cm, 22.5 and 18.5 in diameter, 5000 gm in weight.

7.2.12. Kham

Kham is an ancient instrument of tripuri music made of wood and leather.

Characteristics:

Kham's got a two-fold diaphragm. Both sides of the membranes are made of barrels, which are carved out from the same size tree trunks. Both ends of the goat skin membranes are fixed to assist the tightening of crisscrossed leather belts. This tool is hanged from the collar, bound to the hip, held on the floor and played with your hands. The height of this musical instrument is 28 cm, 28 cm in width and 27 cm in length.

7.2.13. Tipara flute

This Musical instrument was created from the state of Tripura that’s why the name of this instrument is Tipara Flute.

Characteristics:

It is made by Bamboo. The expert artists of tipara flute were Ustad Alauddin Khan and Sachin Debbarman.

7.2.14. Reang type of Sumui

In Tripura's musical legacy, the sumui (flute) is one among the earliest and the most prevalent performed instruments. Sumui is the most flawless and mechanically sounding of all musical instruments. They're created out of bamboo. Bamboo is used to make them.

Characteristics:

Sumui are classified into two types: one with seven (7) holes and one with eight (8) holes. The manipulator's two most common characteristics are:

A) The ones were holding along the mouth.

B) Those held over the mouth.

Sumui is created from a bamboo stem that has been hollowed down. The flute stops are easily determined by positioning his or her fingers in the location where the two fingers closest to a bamboo node fall down. The instrumentalist cuts the bamboo to a sufficient length and sets it in a play position with his lips to calculate the distances of the flute stops. When the overall position is determined, the space between them becomes the standard length, and the designated regions are scorched with a hot iron nail. In the last stage, a separate impression is scratched carefully, a fair ways off of one finger-width for a rectangular score, inclining continually according to stem thickness, with the stop-opening close to the upper edge. A knife is used to cut the indicated region.

7.2.15. Murari sumui

A tribal flute of bamboo, seven blowing hole and seven finger holes, both sides opened. Both hands held and a hole in the mouth blossomed. Used dance and music in west Tripura.

7.2.16. Rang-thali (idiophone)

This well-known Tripura instrument resembles an idiophone. In South Tripura, this is a well-known musical instrument.

Characteristics:

The edge was raised in a shallow bronze tub. Signs by hammer on the body. Kept in one hand and struck in the middle by a wooden handle. Used in tribal dancing and songs.

7.2.17. Dangdoo

The Dangdoo is a little rod idiophone with great musical value, sometimes known as the jaw harp in English, and is one of the most significant instruments in Tripura.

Characteristics:

The dangdoo is a one-of-a-kind folk musical instrument that combines percussion with wind. It has a single wire running between the arms and is constructed of iron in the shape of tongs measuring 9–10 cm. With the lips open, one of the dangdoo's ends is gripped between the teeth. The twang and pitch are controlled by inhaling and exhaling when the wire is plucked.

7.2.18. Dama (Membranophone)

This popular Tripura instrument is similar to a Membranophone. This is a well-known musical instrument in North Tripura.

Characteristics:

A broad cylindrical hardwood drum with a rightward taper. A long skin with leather bracing is fastened to both sides. It was effective to wrap both hands around the neck. This musical instrument is used by members of the Mog, Chakma, Garo, Halam, Debbarma, and other communities.

7.2.19. Tok-Du-Treng (Chordophone)

This well-known Tripura instrument resembles a Chordophone. In West Tripura, this is a well-known musical instrument.

Characteristics:

Tok-Du_treng is a Tribal Instrument for West Tripura. A rhythmic drone cum support. An instrument that reached bamboo. A cocoa with a mouth slashed loose down. Together they extended two strings perforated by the coconut, and at last attached to the upper tip. Hit with a long, thick wood slice.

7.2.20. Lebang-Lebangti

Lebang Boomani is an unusual musical instrument discovered in Tripura, and it is a very distinctive instrument.

Characteristics:

It's a strange mix of bamboo clappers with little tuntunes attached that are played with the "Lebangti," a regular bamboo clapper with strange claps and twangs. One of the most popular accompanying membranophonic instruments is the rasp, which is essentially cacophonic but successfully rhythmized between idiophonic stridulates drumming beat intervals and rasps.

7.2.21. Saroj Veena

The origin of this instrument is Tripura, Gomati District. This Musical Instrument's playing technique has some similarities to Hindustani classical guitar (slide guitar). But the structure, shape, construction material and, above all, the sound production quality and tone are more similar to the Vichitra Veena.

Characteristics:

It is played using a left-hand slide and special plectrums on right-hand fingers. Outside a slide guitar's regular fretboard, everything in this instrument is indianised. The Instrument consists of one piece of solid wood. It has a semi flat chamber of sound, like the Tambura and Veena. It has four strings to play, three chikaris and 13 sympathetic strings to play. For improved sound sustainability and resonance a Chrome-plated Brass Tumba is screwed into the back of the neck. The edge of the hollow neck or fretboard is well curved to resemble a Peacock's neck. The Instrument's sound is more like the veena, very smooth and well balanced. Like Vichitra Veena, the beautiful sustained tone helps an artist play in the true (vocal) style of gayaki. The notes' position is marked with inlays to allow easy play. The Saroj Veena is under tremendous tension; it pulls the total strings to be over 500 pounds. The tone tunes incredible with the sympathetic ringing out and strengthening each note played is due to this high tension. This is a loud instrument made for small amplification to cut through.

7.3 Performance Structure of Instrumental Music

For instrumental music, various performance structures are available, like saroj veena, rosem, sumui and additional musical instruments. An average technique for embed a melodic raga in an execution from Bandish typically comprises of a sluggish act of spontaneity without musicality support. This sluggish improvisation, known as aLAp, is usually followed by a slow structure and then a medium pace. The dRUm-pair like kHAm, dAmA, kRaM typically offers musical help with the renderings of sytheses. There are still significant variations in the way tata vadya, Ghana vadya, vadya sushir and vadya renderings are elaborated. Most instrumental schools opt at the beginning for a brief raga production known as 'AocARvi.' The itemized raga vistar with dAmA or kRam or kHaM backup is done in bArAkhayAl or the sluggish arrangement part in the bandish style of instruments delivering. The ragas are elaborated in this section at a later stage with short passages called tAnaix. Quick composition or chotA-khayAl is followed by the slow composition section. More tana passages are depicted by the faster-paced chotA-khAyAl renderings and less sluggish vistAr. Instrumental music delivery patterns are frequently based on vocal frameworks such as khAyAl and dhrupad. The sequence of the first part of the rendering is largely based on the style of Dhrupad, i.e., the alAp part. Instruments such as saroj veena, rosem, sumui and other string instruments typically adopt the NUm-TUm alAp dhrupad design, which is alluded to as aLLAp, jOd, and jhAlLA. Instead of a comprehensive alap, blowing instruments such as flute recitals typically offer a short aocAr. There are times, however, where the musicians opt for various openings to make wanted melodic effects. Saroj veena payers likewise play AoCcar in the saroj veena as and when appropriate. After AlAp, Slow compositions or Vilambit GAAt, accompanied by rapid compositions or drut gAat, are often played. Depending on the length of renditions and the choices of the performers, the silsila or presentation series will be distinct. A short result, followed by a striking quick composition, could take a brief AocAr. A performance can also be organised as one long AlAp-jod-jhAlA on one raga, followed by a centre rhythm piece and quick arrangement in another raga or another grouping of outcomes in another raga.

7.4 Performance and Appreciations

The performance of instrumental music is much more than just a course of action. It is the semiosis produced by feelings or sentiments and enhanced by fashionable interactions. It is non-conceptual and allows the senses to. In each stage of rendition, the said structure interpreted by the artist to the audience's perception adds multiple interpretations and distinct connotations. Following the framework, the genuine success interpretation begins with "how it goes" before "what it means," as

Paul Thom put it. There are two main players in an instrumental music concert: the artists as well as the audience. The FIM show is improvised to a large extent. The consequence of the rAGa performance is (a) talim [training] of the musicianS, (b) the examination as well as talim assimilation obtained, (C) musical knowledge that has been internalised, and lastly (d) the manifestations of musical thoughts that are the result of the preceding phases. Extra-instrumental musical variables [EIMV] are the other essential part. EIMV was not considered in this report. Extra Instrumental Music Considerations may include many areas in the concert scenario, such as the music delivery process, the actors' physical preparation so that they may perform in front of an audience, the technique for setting up the crowd to decipher the music appropriately, along with others. Audiences are largely prepared by means of previous knowledge, promotions and anchors. The music goes out to the fans from the crowd.

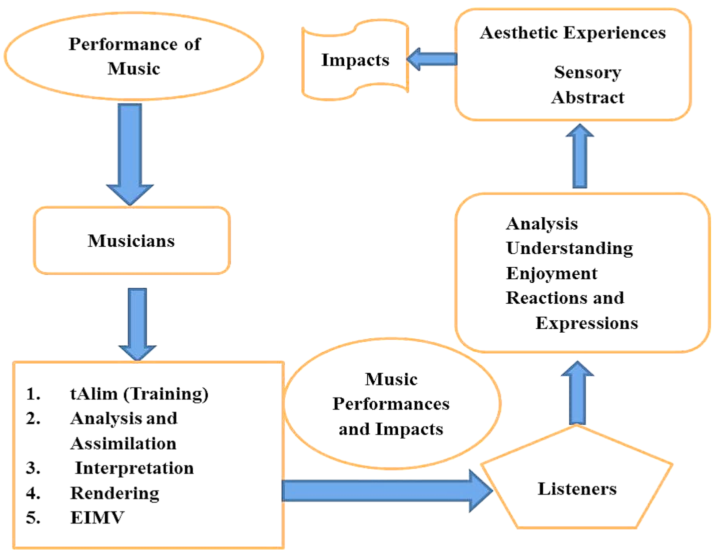


Fig.7.2 Performance of Music

The audience evaluates the music they hear in terms of understanding and taste, eventually, the audition reactions will lead to contentment [or dissatisfaction].The hearers may have a sensory and abstract aesthetic experience. The results of the music portrayed may be accepted as these perceptions.

7.4.1 RAaga moods

There are some folk music instruments that can also play Hindustani classical raga. Raga is a modality that goes considerably beyond the combination of those notes (many characterise raga as). Raga is more than just a modality. Each raga is likened to a sound character. Only the notes mentioned are insufficient to accurately identify a raga. Only the skeleton of a raga is there in the notes; through imaginative variations of conventional contents they add life and flesh. The musicians call them bAbat (inhalt) and tarIkA (way of presentation). The same will happen if separate tarIkA is involved. The modes of presentation shift as actors of various styles and comprehension rage; this will also depend upon the physiological and psychological circumstances of the musician during the performance. A raga's audio identity is special and varies in meaning simultaneously. We are convinced of this since we have seen multiple displays of a single raga by the same or different artists in different eras. Obviously, raga is defined in theories for the usual criteria of aroh (ascending), avroh (descent), aLpatvaA (note with fewer occurrences), bAhutvAa (a large number of instances of a note), nyAAsa (endnote of phrases), and/or time connection. There have been theories. Both these things are known as raAga-lakshAna. RaAga lakhshAna are the elements that occur if the mood of the raga is decided or raga with a particular audio personality. Special examples can be found in a variety of gharana exercises, but they have no bearing on the raga fundamental state of mind or life.

7.4.2 Singularity

While structural and intrinsic in elegance, the performer's distinctive qualities are central to introducing the styles of a rAaga. Musicians mostly take some well-known musicians to the road. Listeners may notice a certain originality in some recitals that aids in the rendering of raga but isn't present extensively in the regular delivering techniques of this particular rAaga. The professionals' distinctive knowledge, accomplishments, and abilities identify demonstrations that look to be intriguing and astounding to the audience.

7.4.3 Scalability

In general terms, scalability should be known. The audience in FIM is mostly animated when the musician commands the musical media. The musical media are playful. In this case, the optimised use of virtuosity in art makes the music vivid or vibrant.[21] Pitts writes that the distinctive character of an Indian Folk concert is the live contact between the artist and the audience. In these concerts, audiences are not merely "rightful applauders," as Juan Prieto-Rodriguez and Victor stated in the sense of Folk Music Bowwen and Baumoul (1966), Witers and Throwsby (1977), Garin and Aebbe-Diecarrx (1992). The trained listeners listen objectively at FIM concerts and often enjoy the verbal phrases 'Aah,' 'kyAbAthAy', or 'sAdhu' at presentations at the same time.[22] These principles revitalise the recitals and motivate the performers to get further into music.

7.4.4 Astonishments

The aspect of surprise produces something which is as unpredictable and raises music in a raga-rendering process. In a good way, surprise here is. It is a product of the skill and expertise of the artist alone. In this scenario the performer inserts the conventional systems. These astonishing influences enrich the production aesthetically and affect the audience's understanding with new adequate implications. The combination of oral conveyance and cunning extemporizations matching learning materials produce specific shocks. For musicians these aren't just movies, they are inventions that add new life to their music. Interestingly, this exceptional expressive ability makes an actor better than others.

7.4.5 Tranquility

Quietness again, as in common life experiences it is known. The representation of feelings is folk music. The development and lack of serenity of experiences such as the movement, conflicts, character of mankind, identity, beauty, religious faith and social circumstances. Musicians need strong leadership in the meaningful use of silence, extending performances and successful slow steps in music depictions to create musical calmness.

7.4.6 Accompaniment

FIM focused on free movement is constrained by rhythm cycles. Accompaniment to dAmA, or Kham and kRam in tata vadya and sushir vadya, is little more than that, because both the tabla player and singer's music is improvised, and the TAla is not a "prefabricated pattern" (1998). The structural and metaphysical levels of the harmony of melodies and rhythms are also effective. The rhythm and instrumental actors work well together, creating a buzz among the audience and performers.

7.5 Methodology

Digital ethnography is the core technique for data collection in the overall architecture of the research report. The premises of the study topic were used to create a semi-structured questionnaire, which was disseminated via a website. In this research, random sampling was performed. Seventy six Tripura listeners who were Folk Instrumental players, FIM fans, or long-time listeners took part in these interviews. A typical encounter among these people was paying attention to 200 hours or a greater amount of society music. After hearing successful performances, these audience members provided feedback. The duration of the recitals ranged between 50 and 90 minutes. Finally, the report drew 69 participants. The audience was enthusiastic and gave high ratings to the concerts. The components that are being assessed include (1) a variety of performance characteristics and (2) performance-related impacts. Each component was given a score from 1 to 5 on a 5-point scale, with 5 being considered exceptional. The participant audiences are made up of people of all ages, as well as people with varying degrees of awareness and prejudices of the total participants, 55.26 percent (N is equal to 42) assessed their attended Folk instrumental music performances, while 44.73 percent (N is equal to 34) rated Folk (Vocal) music events. A table pivot was used to examine the data. The investigation was conducted out between January 2019 and December 2020, during the concert season for popular music festivals in Tripura. The ratings for different participants are given in Table 3, Table 4 and Table 5 respectively.

Participants	**AlAp-joR without dAmA,Kram, and kHam etc**				
	Ratings				
	Weak (1)	**Modest (2)**	**Average (3)**	**Good (4)**	**Excellent (5)**
27 Nos Participants					●
25 Nos Participants				●	
17 Nos Participants			●		

Table 3. Overview of Ratings for different participants

Participants	Slow Composition Part				
	Ratings				
	Weak (1)	Modest (2)	Average (3)	Good (4)	Excellent (5)
29 Nos Participants					●
21 Nos Participants				●	
19 Nos Participants			●		

Table 4. Overview of Ratings for different participants

Participants	Middle or Fast Composition Part				
	Ratings				
	Weak (1)	Modest (2)	Average (3)	Good (4)	Excellent (5)
27 Nos Participants					●
29 Nos Participants				●	
13 Nos Participants			●		

Table 5. Overview of Ratings for different participants

7.6 Results and Discussion

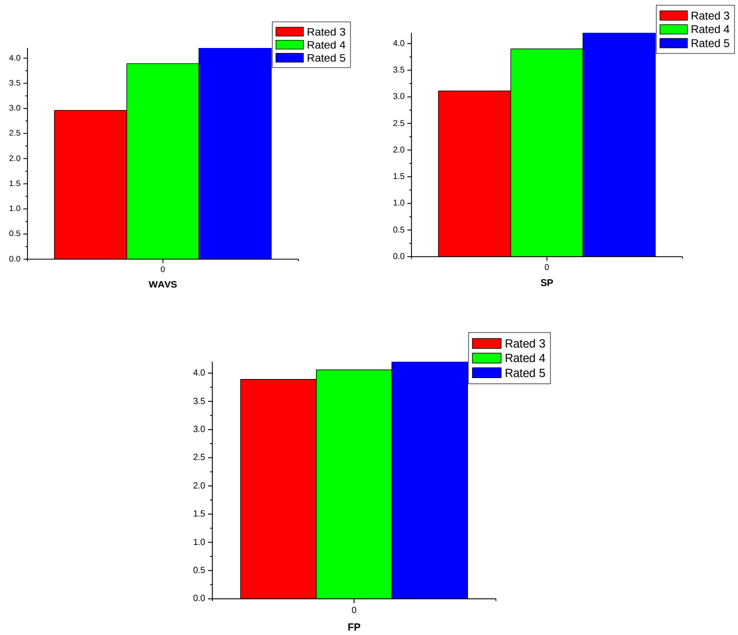
Roles of various sections of folk instruments in concert formation impacts at various levels. The sample size for this study was N is equal to 69, i.e. 69 cases were investigated. The paper focused on understanding the relative implications of various sections of the Hindustani Folk Instrumental Music recitals. The numerous renderings are the first alap-jala part played without support from Abanadhya Vadya; the slow section was performed with assistance from Abanadhya Vadya [SP], while the last rapid part was completed with assistance from Abanadhya Vadya [FP]. The data acquired demonstrates the relative influence rate of WAVS, SP, and FP on concert scores by listeners of these three recital works. The figure shows the average effect or ranking values in three separate FIM recital levels.

Recital-Rating (RR)	AlLAp-joOR without the assistance of dAmA,Kram, and kHam (mean)	Compositional elements that are slow (mean)	A section in a rapid or middle composition (mean)
RR^3	2.96	3.11	3.89
RR^4	3.89	3.90	4.06

RR5	4.41	4.17	4.53

Table 6. For concert ratings, 3 is average, 4 equals' good and 5 equals excellent

In this analysis the means ranking for areas without assistance from dAmA,Kram, kHam (WAVS), Slow [SP] and Quick [FP] as seen by an average rating [here graded as 3] 2.96, 3.11 and 3.89. The analysis reveals that FP is most affected in this region (3.89) while SP is the next (3.11), and WAVS was the least successful (2.96).

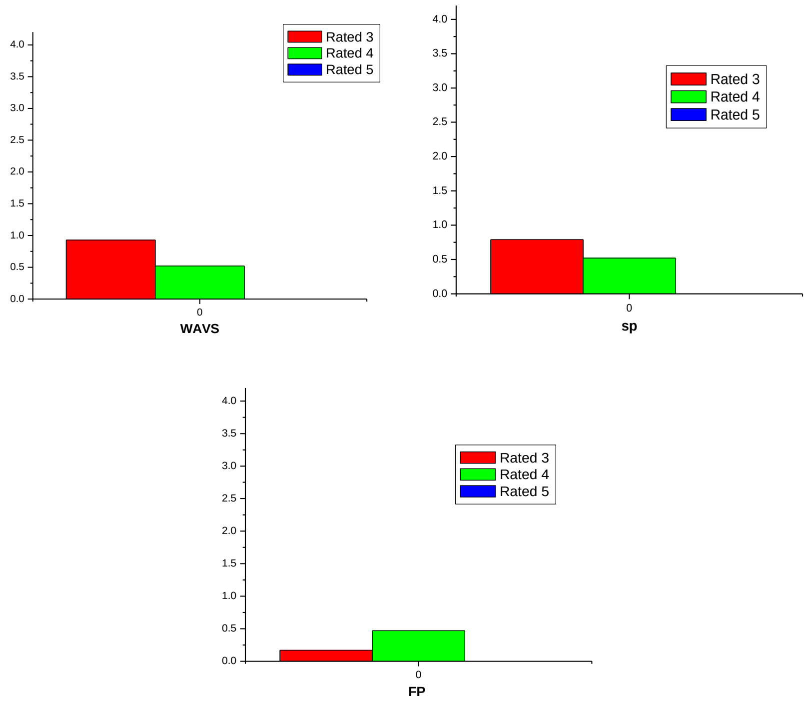


RR3= Average, RR4= Good RR5 = Excellent

There are similar developments in the strong recitals, which have a 5-point ranking of 4. Interestingly, there is a different theme in the highest or outstanding recitals. The WAVS=4.41, SP=4.17, and the FP=4.53 are shown here. In areas without dAmA, Kram, kHam [WAVS], which have a higher effect than the Slow dAma, Kram, kHam sections [SP] in consideration five, fast performance has always been the leading influence factor in any recitals [rating 3, 4 and 5]. In any of the fields of medium to high recital scores, we are seeing a consistently higher ranking in the three different areas of the FIM recitals. In other words, for recitals 3, 4, and 5 respectively, WAVS has 2.96, 3.89, and 4.41. For concerts ranked 3, 4, and 5, respectively, the SP or sluggish portion shows 3.11, 3.90 and 4.17. The mean rates are 3.89, 4.06 and 4.53, respectively, in the case of FP or faster pieces. The medium modifications are shown in Table 7.

Recital Rating (RR) change	WAVS	SP	FP
RR^{3-4}	+00.93	+00.79	+00.17
RR^{4-5}	+00.52	+00.27	+00.47

Table 7. RR Changes with respect to WAVS, SP, FP



RR^{3-4}=Average - Good, RR^{4-5} = Good- Excellent

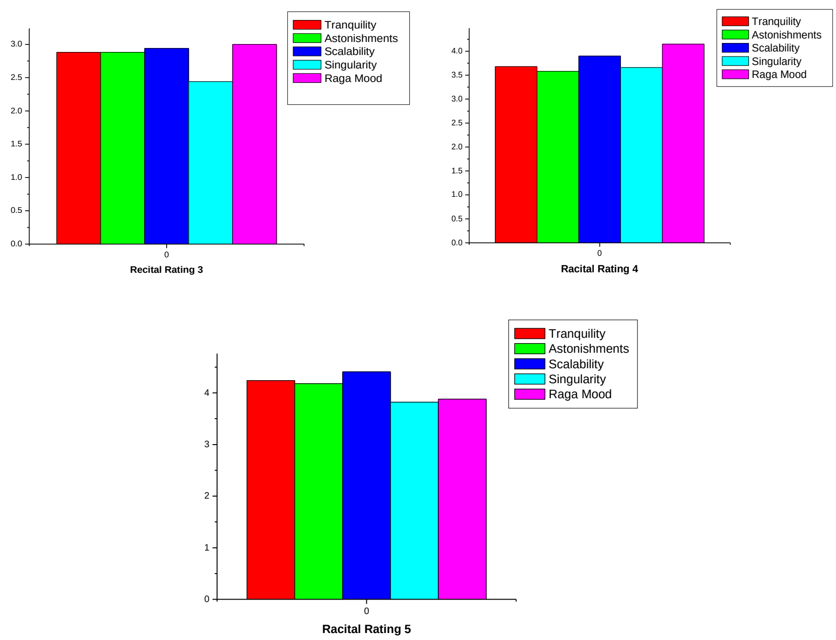
WAVS and SP played the most critical positions on this list with +0.93 and +0.79 respectively. With medium improvements of +0.93 and +0.79, WAVS and SP have played important contributions to raising the concert's rating from average to Good. The WAVS and the FP played important positions with average rises of +0.52 and +0.47 in the rising of the concert from Good to Excellence. In comparison, we can observe that the FP played a big influence in boosting the Decent to Outstanding rates, whilst the two other factors WAVS and SP played an important role in upgrading the concert from ordinary to good stages. The study illustrates the relative roles of WAVS, SP, and FP in developing a recital's wishes.

7.6.1 Effects of recital appraisal elements

Given the recital rating of 3, we can see that the effect levels of various findings may be arranged in the following order: (1) raga mood 3.00, (2) scalability 2.94, (3) astonishments and tranquilly both have the same mean score of 2.88, and (4) singularity has the lowest mean score of 2.44. Let us now look at the effect levels of the various components of the influence on the development of the recital that was agreed upon at level 4. The results of falling median ratings are (1) rAaga mood is Four point One Five, (2) scalability is Three Point Nine, (3) tranquility is Three Point Six Eight (4) singularity is Three Point Six Six, and (5) astonishments is Three Point Five Eight. The ranking of recitals as 5 has the following effect distributions: (1) scalability is Four Point Four One, (2) tranquility is Four Point Two Eight, (3) astonishments is Four Point One Eight, (4) rAaga mood is Three Point Eight Eight, and (5) singularity is Three Point Eight Two. The Results of falling median ratings are shown in Table 8.

Recital Rating (RR)	Tranquility [mean]	Astonishments [mean]	Scalability [mean]	Singularity [mean]	rAaga mood [mean]
RR^3	02.88	02.88	02.94	02.44	03.00
RR^4	03.68	03.58	03.90	03.66	04.15
RR^5	04.24	04.18	04.41	03.82	03.88

Table 8. Results of falling median ratings

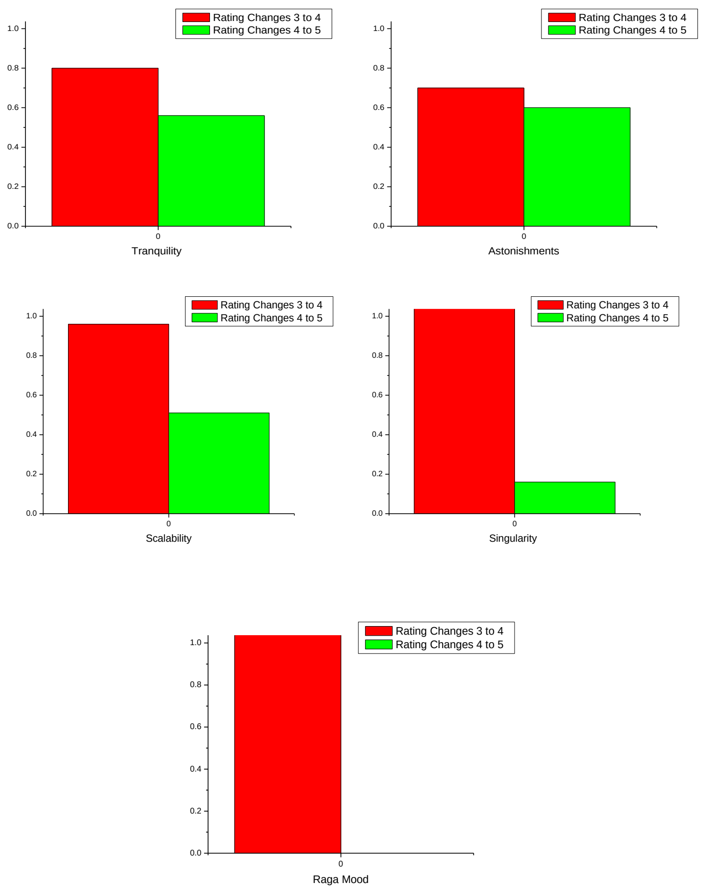


Series 1: RR^3, Series 2: RR^4 and Series 3: RR^5

When we look at recital or performance scores 3, 4, 5, we can see that, with the exception of the raga mood, all of the impact components show an orderly growing influence of the ways of affect. RR^3 and raga mood 3.00, RR^4 and rAaga mood 4.15 and rAaga mood mean 3.88 are seen in rAaga mood elements, and in RR^5, the rAaga mood mean is 3.88. Recitals with 5 scores therefore have lower rAaga mood ratings than Rating 4. The picture reveals that when a concert is assessed as outstanding, the listeners assign the raga mood less priority than other elements, such as scalability or tranquilly. In contrast of the various impact elements, when tranquilly has earned lower priorities for Recitals 3 and 4 it has been given higher priority for Recitals 5. For recitals of 3 and 4, the most noticeable influence is 'raga mood,' while the mean values are 3.00 and 4.15, the highest scores of the five display liveliness with a mean score of 4.41 and tranquilly as 4.24 as the most significant component of effects.

Recital rating changes	**Tranquility [mean]**	**Astonishments [mean]**	**Scalability [mean]**	**Singularity [mean]**	**rAaga mood [mean]**
RR^{3-4}	+00.80	+00.70	+00.96	+01.22	+01.15
RR^{4-5}	+00.56	+00.60	+00.51	+00.16	-00.28

Table 9. RR Changes with respect to Tranquility, Astonishments, Scalability, Singularity and rAaga mood



By analyzing the mean variations in the recital grade shifts, we can see that the most significant variables are singularity (+1.22) and raga mood (+1.15) for grade 3 to 4. Interestingly, though, we see the most influential favorable improvements for rating recital changes from 4 to 5 as the astonishments (+0.60) and tranquility (+0.56) when RAaga mood showed a pessimistic pattern (-0.28). It suggests that the listeners no longer place adequate emphasis on raga moods at the stage when rAaga mood reached an average of 3.88 (as in recitals graded as 5), and feel the modifications on other effects. When it comes to producing excellent results, it is vital to establish one's individuality while being committed to the rAaga mood until it reaches a satisfactory level. However, with outstanding performances after hitting such heights in all fields of effect, listeners are more likely to encounter variations in astonishments and tranquility.

7.7 Conclusion

The research concentrated specifically on the limited listening of Folk Instrumental Music output where the number of listeners and experienced individuals was not too high for obvious reasons. In view of this micro situation, the analysis tried to demarcate the performance-making variables. An optimized combination of technological, artistic, and extra-musical aspects is part of a traditional good Folk Instrumental Music performance. Both issues were scientifically addressed separately in this report. The Slow section is also enticing as the entertaining Short section. In a recital, the section of Abanadhya vadya can be as fun as it can be in artistic terms. The artist's selected musical applications, knowledge and accomplishments form the performance of the raga, and decide the success of a concert. The findings also offer insight into the success of music professionals and aspiring musicians. Finally, the trends are wider in music research and advanced training.

Chapter 8

Folk Music Recommendation Using NSGA-II Optimization Algorithm

The listening and search capabilities of a music library or music application can be greatly enhanced by using music recommendation algorithms. A user cannot efficiently explore tens of millions of songs on the market due to the sheer volume of music available. Music recommendation systems (MRS) is a fast growing field due to the huge need for high-quality music suggestions. Extraction of pertinent data from user evaluations of instrumental music served as the primary driving force behind the creation of the rating-based recommendation system. In this research, we propose an NSGA-II based system for music selection that takes into account user interest, instrument popularity, and overall cost. Our goal is to reduce expenses while optimising customer interest and popularity. Additionally, we evaluated our method against the baseline algorithm and found that it performs better. In order to evaluate our method against the baseline methodologies, we employed real-world measures like as F1-score, recall, and precession.

8.1 Introduction

Based on what customers find most interesting, a software programme and algorithm called the recommender system makes product recommendations for them (Douglas and Willatts, 1994). A proposal is associated with several types of real-world uses, such what goods are bought, what music is listened to, or what news is read recently. However, there has been a change in the recorded music business when Apple purchased Beats Music in 2014 (Gardiner et al., 1996). Subscriptions and streaming have become the main sources of revenue for the music business in recent years, replacing commodity sales as the primary source of income. Thanks to the new economic model in the music industry, digital music is now more accessible than it was a few years ago (Anvari et al., 2002). It is impossible to overestimate the significance of the music recommender system for music providers as a result. Its capacity to predict user preferences and then suggest the appropriate songs to their customers may increase user satisfaction and lead to the music service providers selling a wider variety of music. The challenge of effectively locating songs of interest in the vast and intricate sea of music in the current era of abundant music resources is one that a personalised music recommendation system is proposed to address (Barwick et al., 1989). Music recommendation algorithms predict and encourage user behavioural preferences based on information about the user's behaviour and the characteristics of the music. The way the algorithm for music suggestions has evolved has also altered, moving from a technological route suggested by users based only on their own preferences to one where users recommend songs to one another.

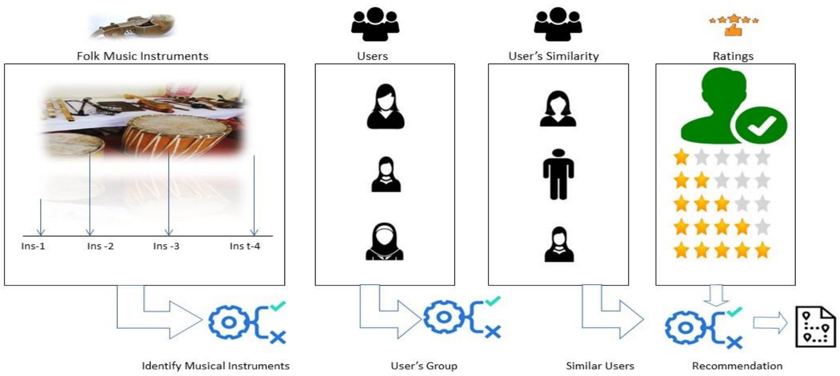


Fig.8.1. Overview of the system framework

The current emphasis has been on discovering prospective preferences. The technology behind music recommendation systems is generally improving. The cultural legacy of India's north-eastern region

North Eastern Region of India has a wide range of folk Instrumental Music. These musical accompaniments give the local music of this area extra vigour. Numerous wind, string, and percussion instrument types, as well as other musical instruments, may be found in North Eastern India. Another sign of the North Easterners' musical prowess is their inventiveness in producing unique and imaginative musical instruments, such as drums, taBla, flutes, mouth organs, clarinets, harmoniums, Slide guitars, trumpets, fiddles, Jews-harps, and leaf instruments (Chamberlain, 2003). A closer look at these instruments reveals another aspect of the people's connection to the natural world. These instruments' basic materials come from nature, which also acts as an inspiration. As can be seen in Fig. 1, the majority of their instruments are their own unique designs. The user ratings of other instruments may now be used to propose a certain instrument to a user. Finding comparable users across several locations requires an assessment of the user similarity (Lu, 1986; Montgomery, 1997;

Bowles, 2003; Kemmerer, 2003). Based on user assessments of different instruments, a user may now be recommended a certain instrument. To locate comparable people across many places, the user similarity has to be examined. The following are this work's primary contributions:

1. A number of research on music suggestion have been conducted. To the best of our knowledge, the suggested approach is unique in that it suggests folk musical instruments based on factors such as cost, popularity, and interest.

2. The suggested approach considers the popularity and area of interest of the user.

3. The recommended approach minimises expenses while maximising user interest and popularity.

4. The price gathered from a list of instruments that can be utilised is used to determine the cost.

5. The NSGA-II optimisation approach is utilised in the suggested strategy.

8.1.1 Related Work

Digital multimedia technology development has accelerated due to recent developments in mobile network technology. According to Shapiro et al. (2017), the primary target market is currently believed to be young people, especially students, and digital music is one of their preferred forms of media. Personalised music recommendations might be a better choice for users who don't have a specific request in mind or who simply want the music system playing whatever sounds good to them. Users can quickly find a specific piece of music by typing in the title or artist. The new content-based recommendation technique based on Gauss mixture model proposed by Dai et al. (2019) aims to improve the sensitivity and accuracy of probabilistic recommendation problems. In (Waddell et al., 2019), a content-based recommendation system was supported by convolution neural networks. A rating predicting approach was established by the creators of (Sarkar et al., 2020) in order to overcome the cold start issue. This method gives the system the ability to predict user evaluations for spontaneous musical creations, resulting in helpful recommendations. Currently, consumers' interests and preferences are seldom taken into consideration concurrently by recommendation algorithms. Improvisational elements are still accessible in a music recital for folk instrumental music (FIM). Performers go through a rigorous training process called tAlim, during which they become acquainted with common vocabulary, study the many ragas, and learn how to put together various singing and playing patterns. When performed by different persons and at different periods, ragas convey a range of colour tones. Furthermore, the same performer will evoke distinct affects from different ragas at different times. Technical and descriptive elements are naturally combined in the historic evolution of FIM music (Sarkar et al., 2021). These are the elements of creativity and virtuosity. Components of virtuosity, such as pace, rhythmic complexity, challenging embellishment, and dynamic tone, are essential for the selection and melodic variety of materials. A successful musical career is frequently greatly influenced by other music. According to Ramasamy et al. (2016), the design of the auditorium is important for a number of reasons, including sound transmission, the effectiveness and adaptability of sound amplification equipment, stage decorating, lighting arrangements, hosting performances, and musician costumes.

8.2 Background and Problem Formulation

Let I = $\{i_1, i_2, i_3, ...i_n\}$ be the folk musical instruments. Each instruments $i_x \in I$ ($1 \leq x \leq n$) consists of a set of behavioural pattern B = $\{b_1, b_2, b_3, ...b_k\}$. In this work, each recommended instruments can play a number of Ragas R = $\{r_1, r_2, r_3, ...r_k\}$. based on the user interest, the popularity of the instruments and the cost.

- Characteristics of a user U_i

A user U_i wishes to listen to various Ragas R_k from a suggested instrument. It should also be noted that if a user is belongs to a city C_y, prior histories may be unavailable due to the unreliability of such instruments.

- Average Instrumental Score

Considering the user's listening behaviour, the average instrumental score *S(I)* for a particular Raga R_k is calculated using Eqn. 1:

$$S(R)= \frac{\sum_{u=1}^{k}\left(T_j^{end} - T_j^{start}\right)\beta(r_j = r)}{D_z\, \beta(r_j = r)} \quad (1)$$

Where, T_j^{start} and T_j^{end} denotes the starting and ending time for listening $R_{k.}$ D_z denotes the total number of time a user listen to a specific instrument.

Here, $\beta(r_j) = \begin{cases} 1, if\ r_j = r \\ 0, Otherwiswe \end{cases}$.

- User interest for a specific instrument

Considering the user's listening behaviour, the user interest *I(Int)* for a particular instrument I_n is calculated using Eqn. 2:

$$I(Int)=\sum_{j=1}^{l} \frac{\left(T_j^{end} - T_j^{start}\right)\beta(I_{R_j} = I)}{S(R_j)} \quad (2)$$

Where, $\beta(I_{R_j}) = \begin{cases} 1, if\ I_{R_j} = I \\ 0, Otherwiswe \end{cases}$. The fact that a user spent more time listening to Ragas for a particular instrument indicates the user's greatest interest.

- Popularity and Cost

Popularity may be determined by totaling the amount of times every user have listened to a particular instrument; this is demonstrated in Eqn. 3.

$$U(I)=\sum_{u=1}^{l} \sum_{r=1}^{k} \left(T_j^{end} - T_j^{start}\right)\beta(I_j = I) \quad (3)$$

The cost may be ascertained by adding up the prices of a number of instruments.

- User's Similarity

Equation 4 provides the user's similarity, which is determined using the cosine similarity test.

$$Cos(U_x,U_y)=\frac{I(Int)\ U_x . I(Int)\ U_y}{\left|\left|I(Int)_{U_x}\right|\right| . \left|\left|I(Int)_{U_x}\right|\right|} \quad (4)$$

Here, U_x and U_y are the two different users.

- Problem Definition

The main objectives of this work is to recommend a list of instruments within a specific budget B_t. Our goal is to maximize interest and popularity and minimizes the cost and is given in Eqn.

$$\frac{Max(\pi U_{Int} + (1-\pi) U_{pop})}{Cost(I)} \quad (5)$$

Where, π is the weight parameter which is used for balancing the interest and popularity. $Cost(I)$ function is denoted to calculate the cost.

s.t

$I(1,x) = I(x,1) \leq 1;\ x=2,.....(m-1)$ (6)

$Cost(I) \leq B_t$ (7)

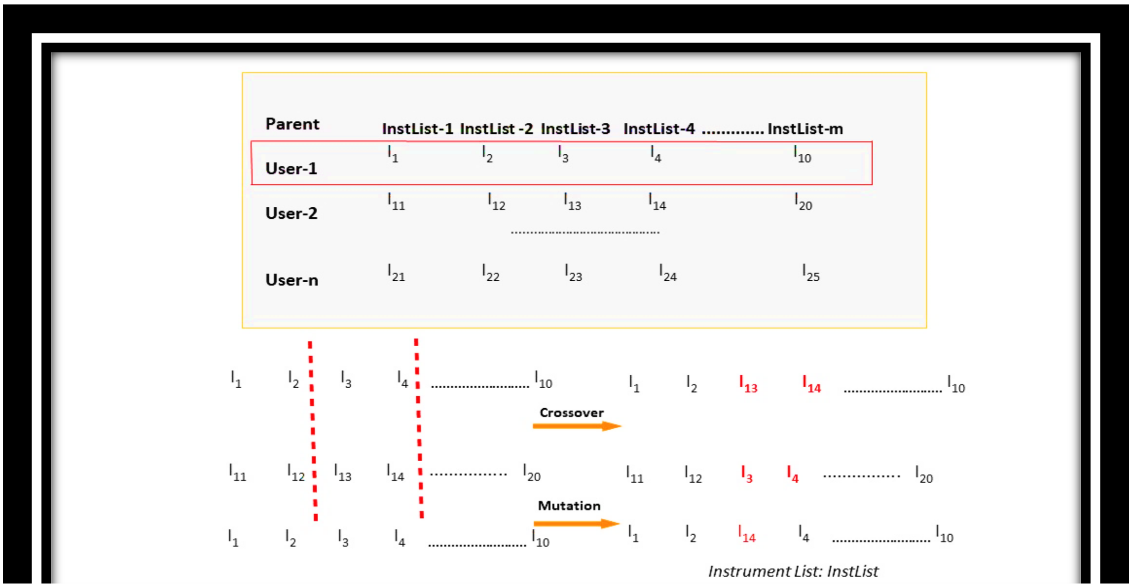


Fig.8.2 Crossover and Mutation Process

Objective problem and is discussed in section 5.

8.3 NSGA-II based optimization algorithm

In this study, we endeavour to provide an instrument list that minimises expense while optimising interest and appeal. Goal may therefore also be expressed as:

$Maximize(I(Int)_{U_x})$ (8)

$Maximize(I(Pop)_{U_x})$ (9)

$Minimize(Cost(I))$ (10)

s.t

$I(1,x) = I(x,1) \leq 1;\ x=2,.....(m-1)$ (11)

$Cost(I) \leq B_t$ (12)

When the specified quantity of generations is achieved, the NSGA-II algorithm terminates. Put differently, each solution's optimal top-N recommendations are taken into account. However, the proposed itinerary's overall travel expenses have to be within the allocated spending limit (Miranda et al., 2018). Fig. 2 depicts the NSGA-II algorithm's crossover and mutation phase. As stated in Eqns. 13 and 14, NSGA-II makes use of two fitness functions.

$$Fitness\text{-}1 = Max(\pi U_{Int} + (1-\pi)U_{pop}) \quad (13)$$

$$Fitness\text{-}2 = Minimize(Cost(I)) \quad (14)$$

8.4 Experimental Methodology

- **Dataset Description**

Three different kinds of datasets—Dataset (A), Dataset (B), and Dataset (C)—are categorised in this section. Sumui, Saroj Veena, and Rosem make up Dataset (A) in this study; Adhuri, Twitreng, and Wakhorok make up Dataset (B); and Tipara flute, Chongpreng, and Tintrong make up Dataset (C). Three distinct Raga kinds were played on each instrument. Table 12 provides a thorough explanation of the dataset. Also provided are the various user ratings in Tables 13 and 14.

Baseline Algorithms

For our findings analysis, we used the following benchmark approaches. There are no benchmarks

North Eastern Regions	*# of User*	*# of Folk Instruments*	*# of Ragas*
Tripura	35	18	5
Meghalaya	21	15	4
Arunachal Pradesh	08	3	3
Assam	40	11	4

Table 10. Dataset Description with respect to North Eastern Regions, Users, Folk Instruments and Ragas methods in the field of folk musical instrument recommendation that we are aware of.

- **Greedy Most Popular (G-POP):**

By choosing the top three instruments according to how long listeners have been enjoying them.

- **Greedy Random (G-RAND)**

Through the process of selecting instruments at random from a catalogue.

- **Greedy Near (G-NEAR)**

By determining the closest instrument based on the user's position. For example, for a north eastern, the sensors coming from the northeast should be given the highest priority.

8.5. Real-life Evaluation

- We decide to assess our response to several benchmarks using the following matrices. Based on the visitors' past history, a variety of real-world sequences are picked for our experiments.
- **Instrument Recall (InsRec(I)):**

Let R_{rec} be the list of ragas available in the recommended instruments. R_{real} be the collection of ragas that are listen in a real-life by users. The InsRec(I) is presented with Eqn. 15.

$$InsRec(I)=\frac{||R_{rec} \cap R_{real}||}{||R_{real}||} \qquad (15)$$

- **Instrument Precession (*InsPre(I)*):**

The tour Precession is showing in Eqn. 16

$$InsPre(I)=\frac{||R_{rec} \cap R_{real}||}{||R_{rec}||} \qquad (16)$$

- **Instrument F1-Score (*F1-score(I)*):**

Tour F1- Score can be calculated using Eqn. 17.

$$\textbf{\textit{F1-score(I)}}=\frac{2 \times InsPre(I) \times InsPre(I)}{InsPre(I)+InsPre(I)} \qquad (17)$$

8.6 Results and analysis

The efficiency of our technique is maximal when compared to benchmark approaches such as G-POP, G-RAND, and G-NEAR. The values of F1-Score, Precision, and Recall for our method and other benchmark techniques are displayed in Figs. 8.3, 8.4, and 8.5. The outcomes demonstrate that the suggested method performs better when compared to benchmark alternatives. When compared to other benchmark methodologies, the recall scores are greater. The Recall value depends on values $||R_{real}||$ and $||R_{rec} \cap R_{real}||$. In case of our algorithm, the value of $||R_{rec} \cap R_{real}||$is higher than the various benchmark approaches. Recall values rise as a result of this. Our technique has the highest efficiency when compared to benchmark approaches such as G-POP, G-RAND, and G-NEAR. When measured against other benchmark methodologies, the Precession ratings are greater.

Participants	Slow Composition Part				
	Ratings				
	Weak (1)	Modest (2)	Average (3)	Good (4)	Excellent (5)
33 Nos Participants					●
27 Nos Participants				●	
21 Nos Participants			●		

Table 11. User ratings: slow comparison

Participants	Middle or Fast Composition Part				
	Ratings				
	Weak (1)	Modest (2)	Average (3)	Good (4)	Excellent (5)
23 Nos Participants					●
17 Nos Participants				●	
14 Nos Participants			●		

Table 12. User ratings: middle/first comparison

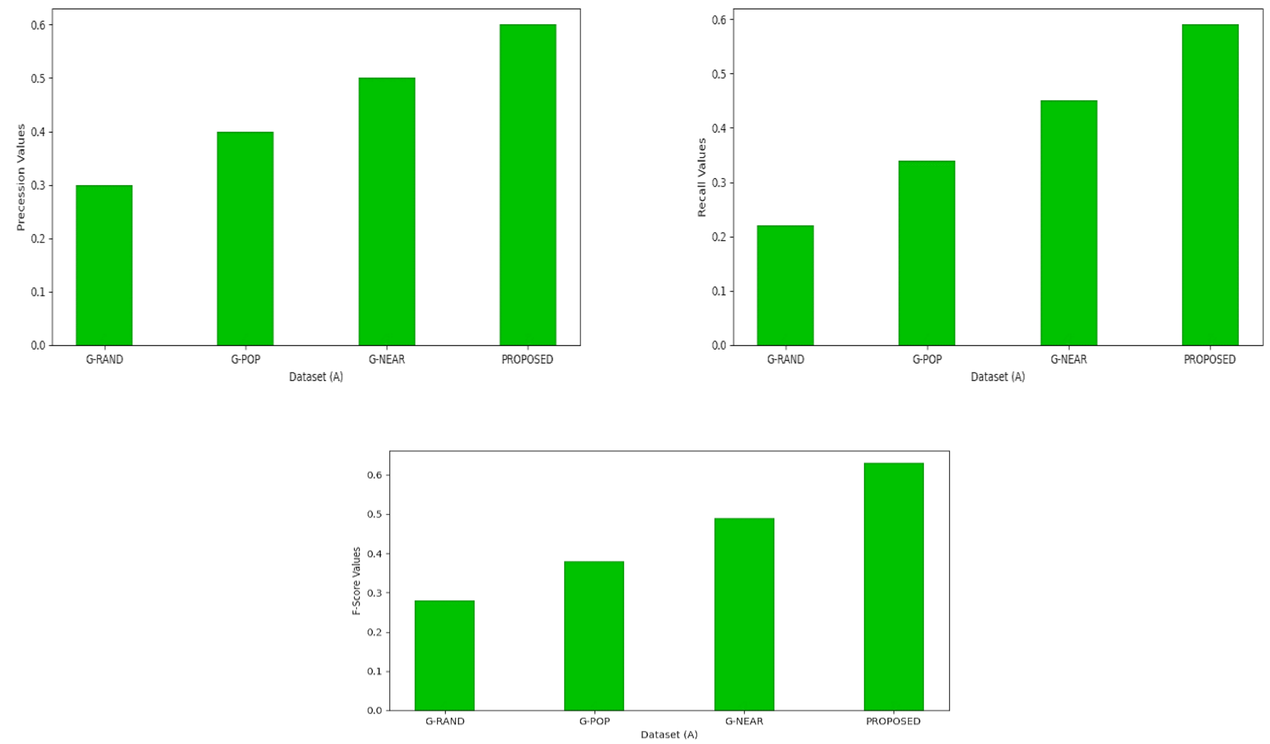


Fig.8.3. Precision, Recall and F1-score values for proposed approach and benchmark approaches for Dataset (A)

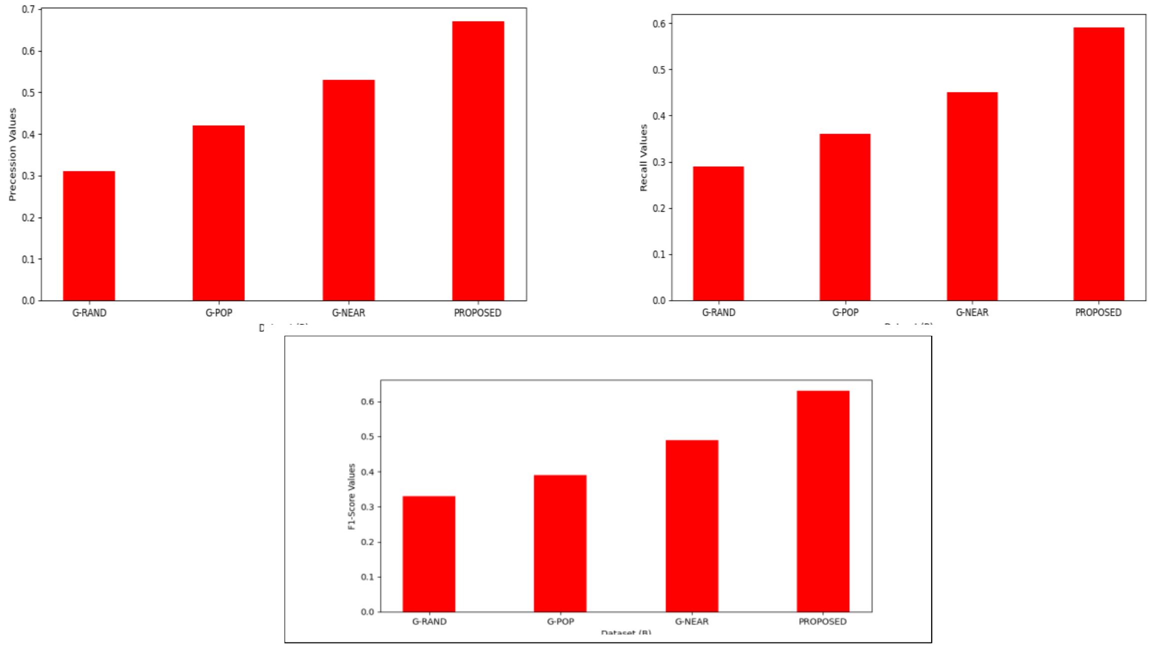


Fig.8.4. Precision, Recall and F1-score values for proposed approach and benchmark approaches for Dataset (B)

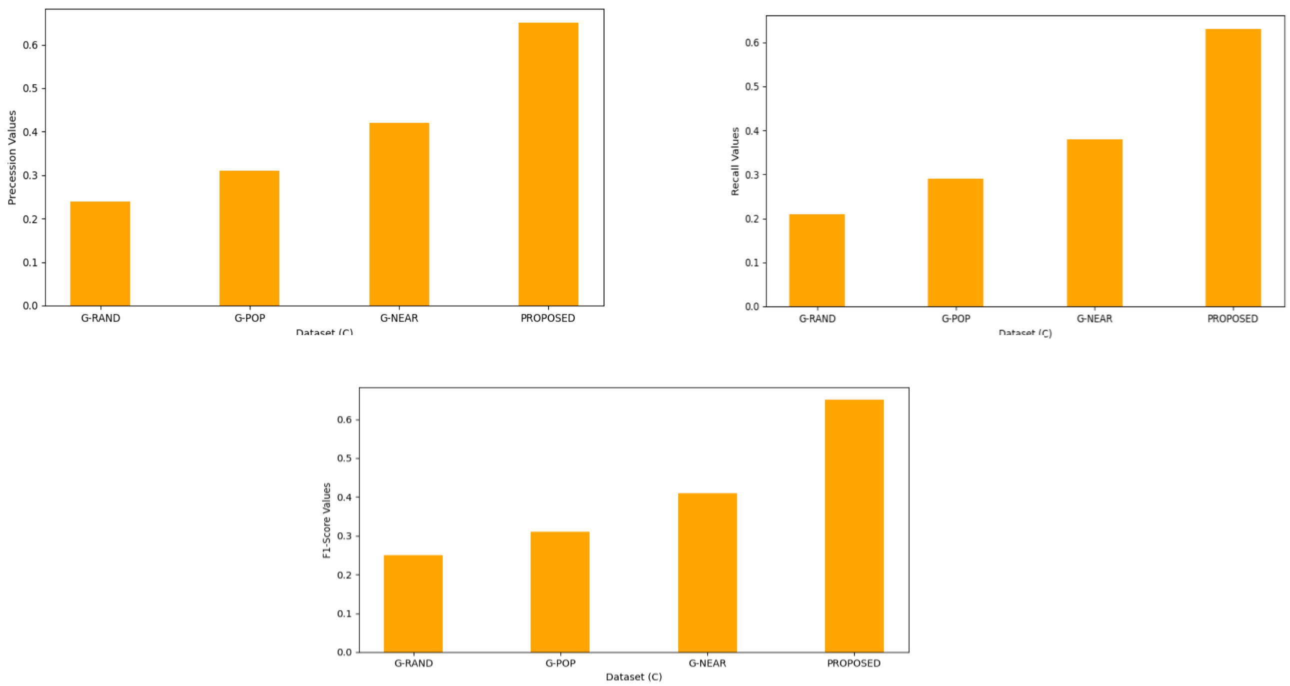


Fig.8.5. Precision, Recall and F1-score values for proposed approach and benchmark approaches for Dataset(C)

8.7 Conclusion

This research proposes a recommendation system for folk music using the NSGA-II based on several folk musical instruments. The suggested methodology considers the scenario in which the user's life is devoid of particular instrument listening. Based on the user's interest in a particular musical instrument, the cosine-similarity test is taken into consideration in the suggested procedure. While limiting total costs, the suggested method maximises user engagement and the appeal of the instrument. Due to the NP-hardness of the issue, an NSGA-II-based optimisation algorithm was employed, and the results show that our method performs better than a number of baseline methods. We compared our approach to the baselines using real-world measures including precession, recall, and F1-Score.

Chapter 9

Conclusion

This chapter summarizes the main findings of the research work presented in the previous six chapters 3, 4, 5, 6, 7 and 8. It also includes the future scope and possible extensions of the research work presented in this thesis.

9.1 Concluding remarks

In this research work, an analytical study of folk musical Instrument of North Eastern Part of India has been discussed. The North East India has many musical instruments which are mostly unknown to the people, played by the folk musicians popular mainly in the rural areas. Those instruments are discussed here. Their scientific studies have also been discussed. The detailed description such as the shape and size of various parts of the instruments, material used, quality of sound produced, cultural similarities etc have also been discussed. Various musical instruments of North-Eastern Part of India and their scientific studies have been mentioned. The Students have the chance to learn through this lab experiment that in which manner the strings are played significant affects of the harmonic structure of standing waves of the stringed Instruments. Before the experiment, many students thought that playing a certain note on any instrument would generate oscillations at that frequency. Students may relate the sound waves created by the sophisticated mechanical vibrations of the string by visually recognising that other harmonics are also present and correlating this observation with how the note sounds when the string is plucked at different positions. This study also looks at the influence of a Saroj Veena string on the distribution of energy between fundamental nuances and overtones. Saroj Veena recorded the sound samples, which were then quantitatively processed by a computer. Finally, it is stated that additional overtones were produced when the string was plucked close to the edge of the Saroj Veena. Because the publications were a physics research, the issue was empirically studied, and the conclusions were given with little or no statistical implications. The thesis examines Sumui Musical instrument construction, playing style, handling style, and notes. Furthermore, many Meghalayan musical instruments are described. Finally, an NSGA-II-based folk music recommendation system based on various folk musical instruments is provided in this study. The suggested technique considers the circumstance in which the user does not regularly listen to a single instrument. The suggested technique considers the cosine-similarity test based on user interest in a particular musical instrument. The suggested system maximises user engagement and the popularity of the instrument while decreasing total costs. Because the issue is NP-hard, an NSGA-II-based optimisation method was applied, and it was discovered that our technique beats several baseline approaches. Real-world measures like as precession, recall, and F1-Score were utilised to compare our technique to the baselines.

9.2 Future Scope of the study

The designs proposed in this thesis can be extended for further study some of which are addressed below.

- In the future, we will discuss about the scientific study that uses the Body Sensor Network (BSNs) and Electroencephalogram (EEG) and the globalisation of North-Eastern Folk Instrumental Music.
- The distinction between Folk Instrumental Music and classical Instruments from the North-East and other Indian states will be discussed in the future.
- Furthermore, we will look at Artificial Intelligance (AI) based north-east Folk Instrumental Music and how they are used as both solo and accompaniment instruments.

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List of Research Publications

Journals

1. **Sarkar, Joyanta**; Rai, Anil, "An Analytical Study of the Folk Musical Instruments of Meghalaya", Studia Universitatis Babes-Bolyai, Musica, June2021, Vol. 66 Issue 1, p23-38. 16p, 10.24193/subbmusica.2021.1.02
2. **Sarkar, Joyanta**; Rai, Anil, Verma Rajesh Kumar, Sarkar Joylal, Majumder Bibek "An Analytical Study of folk musical instruments of the rural area of Tripura", Research Journal in Advanced Humanities,4(2), https://doi.org/10.58256/rjah.v4i2.1064
3. **Sarkar, Joyanta**; Rai, Anil, "The Physics of Electric Saroj Veena: A folk musical instrument from India's North Eastern Region", Research Journal in Advanced Humanities, 4(1), https://doi.org/10.58256/rjah.v4i1.1090
4. **Sarkar, J.**, Rai, A., Kumar, K. K., Thatha, V. N., Manisekaran, S., Mandal, S., Sarkar, J. L. & Das, S. (2023). Folk Music Recommendation Using NSGA-II Optimization Algorithm. Journal of Computer Science, 19(12), 1541-1548. https://doi.org/10.3844/jcssp.2023.1541.1548

Patents

1. Dr.Anil Rai and **Joyanta Sarkar**, "Aatificial Intelligance Based Musical Instrument", Indian Patent, design no. 395296-001, date: 16/09/2023
2. **Joyanta Sarkar**, "Tripuri Folk Guitar", Indian Patent, design no. 397236-001, date: 10/10/2023

Brief biography of the supervisor

Dr. Anil Rai is an Assistant Professor (Music), Department of Humanities and Social Sciences, Birla Institute of Technology and Science, Pilani. He joined BITS in the year 1989 and since then he has been teaching various courses of music, and providing the practical training to the capable students in BITS-Pilani, (Pilani Campus). Dr. Rai was born in a musical family in Mau, near Varanasi, Uttar Pradesh; and was skilled at a young age at home. He has the skill of Banaras, Farrukhabad and Delhi Gharanas of Tabla. Dr. Rai is an Indian Hindustani Classical Sitar and Tabla Artiste. From an early age Dr. Rai started receiving his initial training at home from his father, Lt. Sri Ramakant Rai, a renowned Tabla Artiste and Vocalist. Later on he continued taking proper training and learning the techniques and secrets of Tabla-playing from his Guru- Lt. Prof. Lalji Shrivastava of Allahabad (Prayagraj) through Guru-Shishya tradition, who was the disciple of the great Pandit Jai lal Ji of Jaipur Gharana, Pandit Shyam Lal Ji of Banaras Gharana and Ustad Yusuf Khan Sahab of Farrukhabad Gharana. He also took Sitar training from Lt. Sri Ashim Kr. Banerjee, a renowned Sitar-artiste of Allahabad (Prayagraj). Dr. Rai is considered to be one of the proverbial figures of Indian classical music. He has completed his Graduation from Gorakhpur University (UP), Post-Graduation in Music (Sangeet Praveen-Tabla), from Prayag Sangeet Samiti, Allahabad (U.P.), M.A. in Sitar from Indira Kala Sangit Vishwavidyalaya-Khairagarh (Chhateesgargh), Post-Graduation in Sanskrit (Sanskritasahityacharya) from Sampoornanand University, Varanasi-U.P. He received Ph. D. in the year - 2008 from Banasthali University, (Rajasthan.). He has performed Tabla and Sitar at various places in India and abroad.

Brief biography of the candidate

Joyanta Sarkar is an Indian slide guitar player. One of the serious, young exponents of Indian Classical Music, who constantly endeavours to infuse interest and respect for this traditional art form in the heart and the minds of the younger generation. His father, Dr.Jowhar Lal Sarkar, a distinguished tabla player, taught him his first lessons in rhythm. Then he also learned from Alakendra Debbarman, Pandit Debasish Bhattacharya (Renowned Sarod Player) and Dr. Troilee Dutta. He started performing at the tender age of 13, since then he never looked back. He has completed B.A in Instrumental Music from Tripura University, Tripura and M.A in Instrumental Music from Rabindra Bharati University, Kolkata. He has also Completed Junior Diploma in Instrumental Music, Senior Diploma in Instrumental Music from Allahabad. He has completed the Basic Course on “Fishery Oceanography for Future Professionals”, under International Training Centre for Operational Oceanography and Indian National Centre for Ocean Information Services, Hyderabad, India. He is now working as a Rural Programme Manager in the Panchayat Department of the Tripura Government. He was awarded the Rastriya Samaj Seva Ratna Award (2021) and India Prime Icon Award (2021). He attended a Training Programme on “Multi-Scale Computational Fluid Dynamics: Fundamentals and Applications”, Organized by NIT Jalandhar, Punjab. Participated in One week International Research Orientation Programme organized by M.M Institute of Computer Technology and Business Management, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana in association with Elsevier India and RAx Labs Inc., USA. Participated in Training Programme on “Energy Conservation and Environment”, Organized by Academy of EcoScience and Power Ledger Australia. Participated in the training Programme on “Comprehensive Landslide Risk Management” organized by National Institute of Disaster Management, Ministry of Home Affairs, Govt. of India in collaboration with Indian Institute of Technology Mandi (IIT-Mandi).