Musical instrument design : To design a product in the world of music

Project II

Project Guide

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APPROVAL SHEET

The project titled "musical instrument design" by Atul Paranjpe is approved for the partial fulfillment of the requiremnet for the degree of ` Master of Design' in industrial design.

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1. Introduction:

Music is the medium, through which one can express his thoughts and feelings. It is the sum total of the experiences and emotions which are not bound by time, community and rationality. It is the universal language of the pious souls of all times and places. The three fold arts of music namely Vocal Music, Instrumental Music and Dance have varied from time to time and space to space according to the aesthetic taste and likings of the people.

All true arts are expressive but they are diversely so. Music is without contradiction the most penetrating, profoundest and intimate art. There is marvelous relationship between sound and the soul (physically & morally). It feels like soul is an echo where sound takes new power. Music pays for the immense power that has been given to it; it awakens the sentiment of the infinite because it is vague, obscure and indefinite on its effects. It is insufficient merely to listen to music in terms of the separate moments, at which it exists. One must be able to relate to what one hears at any given moment to what has just happened before and what is about to come afterward.

Thus, music is an art that exists at point of time. Musical events are more abstract by nature, so that the act of pulling them all together in the imagination is not as easy as reading the novel. Popular styles of music vary widely from culture to culture, and from period to period. Different cultures emphasized different instruments, or techniques, or uses for music. Music has been used not only for entertainment, for ceremonies, and for practical & artistic communication, but also extensively for propaganda. As world cultures have come into greater contact, their indigenous musical styles have often merged into new styles.

Force of music is strange where it expresses everything but nothing in particular. Music is intangible, but can be felt and experienced. This is where the musical instruments play its role by making music an experience where one gets a medium to express oneself.

Thus a musical instrument is a device constructed or modified with the purpose of making music. In principle, anything that produces sound, and can somehow be controlled by a musician, can serve as a musical instrument. The expression, however, is reserved generally to items that have a specific musical purpose.

2. The thought (rationale of the study):

I have chosen to consider the topic `to design a product in the world of music' which is about relation of imaginative mind to different aspects of art of music. More I live the life of music the more I am convinced that it is freely imaginative mind that is at the core of all vital music making and music listening. Music is the medium through which one can express his thoughts.

Being a design student, and being genuinely interested in music, I desire to learn design process that involves systematic research, planning and its implementation towards the universal art form: music, and its variations. Being a musician, and even knowing music I observed, analyzed that I should work over areas with respect to musical instruments. Apart from redesigning and modification of such instruments, there could be new innovations.

3. Objective and expected learning:

The objective of this project is focused towards designing a product in the world of music, a new musical instrument that has definition sound and will introduce a unique experience and style of perceiving music.

The study is a systematic approach to do a research on acoustics, theory behind building of various string instruments, studying existing theories of music. These will help me understand and explore various aspects regarding musical instruments such as instrument building, tuning of an instrument, its evolution, the style, experience, sound and existence.

Also to develop an instrument which blends technology and music, it is imperative to understand various technical aspects, basics of sound engineering, science and contemporary musical products.

B. Understanding concepts:

Before actually stepping into the ideation its necessary to understand basic concepts, history, musical products those already exist and the way they evolved.

Here I desire tounderstand the following concepts:

1. Music
2. Sound and acoustics
3. Musical Instruments: Definition and classification
4. Musical string instruments
5. About Indian string instruments
6. About western string instruments
7. Existing experimental, redesigned musical instruments

1. Music

1. definition
2. history
3. aspects of music
4. music production
5. performance
6. Improvisation, interpretation, composition
7. composition
8. reception and audition
9. media and technology

1. Definition:

Music is expressed in terms of pitch, rhythm, and the quality of sound. Music can also involve generative forms in time through the construction of patterns and combinations of natural stimuli principally sound.

Music is a personal response to vibration since the same piece of music will affect people differently. Although it cannot contain emotions, it is sometimes designed to manipulate and transform the emotions of the listeners.
Music is an art form that involves organized and audible sounds and silence. It is expressed in terms of pitch (which includes melody and harmony), rhythm (which includes tempo and meter), and the quality of sound (which includes timbre, articulation, dynamics, and texture). Music may be used for artistic or aesthetic, communicative, entertainment, or ceremonial purposes. The definition of what constitutes music varies according to culture and social context.
Within "the arts", music can be classified as a performing art, a fine art, or an auditory art form.

Greek philosophers and medieval theorists defined music as tones ordered horizontally as melodies, and vertically as harmonies. Music theory, within this realm, is studied with the Pre-supposition that music is orderly and often pleasant to hear.

However, in the 20th century, composers challenged the notion that music had to be pleasant by creating music that explored harsher, darker timbres. The existence of some modern-day genres such as grind core and noise music, which enjoy an extensive underground following, indicate that even the crudest noises can be considered music if the listener is so inclined.

The border between music and noise is always culturally defined--which implies that, even within a single society, this border does not always pass through the same place; in short, there is rarely a consensus.... By all accounts there is no single and intercultural universal concept defining what music might be.

2. History:

The history of music predates the written word and is tied to the development of each unique human culture. Although the earliest records of musical expression are to be found in the Sama Veda of India and in 4,000 year old cuneiform. Most of our written records and studies deal with the history of music in Western civilization. This includes musical periods such as medieval, renaissance, baroque, classical, romantic, and 20th century era music. The history of music in other cultures has also been documented to some degree, and the knowledge of "world music" (or the field of "ethnomusicology") has become more and more sought after in academic circles. This includes the documented classical traditions of Asian countries outside the influence of Western Europe, as well as the folk or indigenous music of various other cultures. (The term world music has been applied to a wide range of music made outside of Europe and European influence, although its initial application, in the context of the World Music Program at Wesleyan University, was as a term including all possible music genres, including European traditions. In academic circles, the original term for the study of world music, "comparative musicology", was replaced in the middle of the twentieth century by "ethnomusicology", which is still considered an unsatisfactory coinage by some.)

Popular styles of music varied widely from culture to culture, and from period to period. Different cultures emphasized different instruments, or techniques, or uses for music. Music has been used not only for entertainment, for ceremonies, and for practical & artistic communication, but also extensively for propaganda.

As world cultures have come into greater contact, their indigenous musical styles have often merged into new styles. There is a host of music classifications, many of which are caught up in the argument over the definition of music. Among the largest of these is the division between classical music (and "art" music), and popular music (or commercial music - including rock and roll, country music, and pop music). Some genres don't fit neatly into one of these "big two" classifications, (such as folk music, world music, or jazz music).

Genres of music are determined as much by tradition and presentation as by the actual music. While most classical music is acoustic and meant to be performed by individuals or groups, many works described as "classical" include samples or tape, or are mechanical. There is often disagreement over what constitutes "real" music

3. Aspects of music:

Melody, harmony, rhythm, tone color or timbre, and form are various aspects of music. A more comprehensive list is given by stating the aspects of sound: pitch, timbre, loudness, and duration. These aspects combine to create secondary aspects including structure, texture and style. Other commonly included aspects include the spatial location or the movement in space of sounds, gesture, and dance. Silence has long been considered an aspect of music.

As mentioned above, not only do the aspects included as music vary, their importance varies. For instance, melody and harmony are often considered to be given more importance in classical music at the expense of rhythm and timbre.

A pulse is sometimes taken as a universal, yet there exist solo vocal and instrumental genres with free, improvisational rhythms with no regular pulse; one example is the alap section of a Hindustani music performance. According to Dane Harwood, "We must ask whether a cross-cultural musical universal is to be found in the music itself (either its structure or function) or the way in which music is made. By 'music-making,' I intend not only actual performance but also how music is heard, understood, even learned."

4. Music production:

Music is composed and performed for many purposes, ranging from aesthetic pleasure, religious or ceremonial purposes, or as an entertainment product for the marketplace. Amateur musicians compose and perform music for their own pleasure, and they do not attempt to derive their income from music. Professional musicians are employed by a range of institutions and organizations, including armed forces, churches and synagogues, symphony orchestras, broadcasting or film production companies, and music schools. As well, professional musicians work as freelancers, seeking contracts and engagements in a variety of settings. Beginning amateur musicians take lessons with professional musicians. In community settings, advanced amateur musicians perform with professional musicians in a variety of ensembles and orchestras. In some rare cases, amateur musicians attain a professional level of competence, and they are able to perform in professional performance settings.

A distinction is often made between music performed for the benefit of a live audience and music that is performed for the purpose of being recorded and distributed through the music retail system or the broadcasting system. However, there are also many cases where a live performance in front of an audience is recorded and distributed (or broadcast).

5. Performance:

Someone who performs, composes, or conducts music is a musician. Musicians perform music for a variety of reasons. Some artists express their feelings in music. Performing music is an enjoyable activity for amateur and professional musicians, and it is often done for the benefit of an audience, who is deriving some aesthetic, social, religious, or ceremonial value from the performance. Part of the motivation for professional performers is that they derive their income from making music. Not only is it an income derived motivation, music has become a part of life as well as society. Allowing one to be motivated through self intrinsic motivations as well, as a saying goes "for the love of music." As well, music is performed in the context of practicing, as a way of developing musical skills. Many musicians also participate in music competitions as a way of learning about the work of other performers and motivating themselves to attain higher levels of performance.

Solo and ensemble:

Many cultures include strong traditions of solo and performance, such as in Indian classical music, and in the Western Art music tradition. Other cultures, such as Bali, include strong traditions of group performance. All cultures include a mixture of both, and performance may range from improvised solo playing for one's enjoyment to highly planned and organized performance rituals such as the modern classical concert, religious processions, music festivals or music competitions.

Chamber music, which is music for a small ensemble with only a few of each type of instrument, is often seen as more intimate than symphonic works. A performer may be referred to as a musician.

6. Improvisation, interpretation, composition:

Most cultures use at least part of the concept of preconceiving musical material, or composition, as held in western classical music. Even when music is notated precisely, there are still many decisions that a performer has to make. The process of a performer deciding how to perform music that has been previously composed and notated is termed interpretation.

Different performers' interpretations of the same music can vary widely. Composers and song writers who present their own music are interpreting, just as much as those who perform the music of others or folk music.

In some musical genres, such as jazz and blues, even more freedom is given to the performer to engage in improvisation on a basic melodic, harmonic, or rhythmic framework. The greatest latitude is given to the performer in a style of performing called free improvisation, which is material that is spontaneously "thought of" (imagined) while being performed, not preconceived. Improvised music usually follows stylistic or genre conventions and even "fully composed" includes some freely chosen material. Composition does not always mean the use of notation, or the known sole authorship of one individual.

7. Composition:

Musical composition is a term that describes the composition of a piece of music. Methods of composition vary widely from one composer to another, however in analyzing music all forms -- spontaneous, trained, or untrained -- are built from elements comprising a musical piece.

Music can be composed for repeated performance or it can be improvised; composed on the spot. The music can be performed entirely from memory, from a written system of musical notation, or some combination of both. Study of composition has traditionally been dominated by examination of methods and practice of Western classical music, but the definition of composition is broad enough to include spontaneously improvised works like those of free jazz performers and African drummers.

What is important in understanding the composition of a piece is singling out its elements. An understanding of music's formal elements can be helpful in deciphering exactly how a piece is constructed. A universal element of music is how sounds occur in time, which is referred to as the rhythm of a piece of music. Even random placement of random sounds, which occurs in musical montage, occurs within some kind of time, and thus employs time as a musical element.

8. Reception and audition:

The field of music cognition involves the study of many aspects of music including how it is processed by listeners. Music is experienced by individuals in a range of social settings ranging from being alone to attending a large concert. Musical performances take different forms in different cultures and socioeconomic milieus.

Deaf people can experience music by feeling the vibrations in their body, a process which can be enhanced if the individual holds a resonant, hollow object. A well-known deaf musician is the composer Ludwig van Beethoven, who composed many famous works even after he had completely lost his hearing. Recent examples of deaf musicians include Evelyn Glennie, a highly acclaimed percussionist who has been deaf since the age of twelve, and Chris Buck, a virtuoso violinist who has lost his hearing.

9. Media and Technology:

The music that composers make can be heard through several media; the most traditional way is to hear it live, in the presence, or as one of the musicians. Live music can also be broadcast over the radio, television or the internet. Some musical styles focus on producing a sound for a performance, while others focus on producing a recording which mixes together sounds which were never played "live". Recording, even of styles which are essentially live, often uses the ability to edit and splice to produce recordings which are considered better than the actual performance.

Sometimes, live performances incorporate prerecorded sounds. For example, a DJ uses disc records for scratching, and some 20th-century works have a solo for an instrument or voice that is performed along with music that is prerecorded onto a tape. Computers and many keyboards can be programmed to produce and play MIDI music. Audiences can also become the performers by using Karaoke, invented by the Japanese, which uses music video and tracks without voice, so the performer can add their voice to the piece.

2. Sound and acoustics

1. Definition
2. perception of sound
3. musical acoustics
4. harmonics, partials and overtones
5. harmony
6. scales

1. Definition:

Sound is a disturbance of mechanical energy that propagates through matter as a longitudinal wave. Sound is characterized by the properties of sound waves, which are frequency, wavelength, period, amplitude, and speed.

Humans perceive sound by the sense of hearing. By sound, we commonly mean the vibrations that travel through air and can be heard by humans. However, scientists and engineers use a wider definition of sound that includes low and high frequency vibrations in air that cannot be heard by humans, and vibrations that travel through all forms of matter, gases, liquids and solids. The matter that supports the sound is called the medium. Sound propagates as waves of alternating pressure, causing local regions of compression and rarefaction. Particles in the medium are displaced by the wave and oscillate. The scientific study of sound is called acoustics. Noise is often used to refer to an unwanted sound. In science and engineering, noise is an undesirable component that obscures a wanted signal.

2. Perception of sound:

Sound is perceived through the sense of hearing. Humans and many animals use their ears to hear sound, but loud sounds and low-frequency sounds can be perceived by other parts of the body through the sense of touch as vibrations. Sounds are used in several ways, notably for communication through speech and music. They can also be used to acquire information about properties of the surrounding environment such as spatial characteristics and presence of other animals or objects. For example, bats use echolocation, ships and submarines use sonar and humans can determine spatial information by the way in which they perceive sounds.
Humans can generally hear sounds with frequencies between 20 Hz and 20 kHz (the audio range) although this range varies significantly with age, occupational hearing damage, and gender; the majority of people can no longer hear 20,000 Hz by the time they are teenagers, and progressively lose the ability to hear higher frequencies as they get older. Most human speech communication takes place between 200 and 8,000 Hz and the human ear is most sensitive to frequencies around 1000-3,500 Hz. Sound above the hearing range is known as ultrasound, and that below the hearing range as infrasound.

3. Musical acoustics:

Musical acoustics or music acoustics is the branch of acoustics concerned with researching and describing the physics of music — how sounds employed as music work. Examples of areas of study are the function of musical instruments, the human voice (the physics of speech and singing), and computer analysis of melody.

Physical aspects:
Whenever two different pitches are played at the same time, their sound waves interact with each other — the highs and lows in the air pressure reinforce each other to produce a different sound wave. As a result, any given sound wave which is more complicated than a sine wave can be modeled by many different sine waves of the appropriate frequencies and amplitudes (a frequency spectrum).In humans the hearing apparatus (composed of the ears and brain) can usually isolate these tones and hear them distinctly. When two or more tones are played at once, a variation of air pressure at the ear "contains" the pitches of each, and the ear and/or brain isolate and decode them into distinct tones.
When the original sound sources are perfectly periodic, the note consists of several related sine waves (which mathematically add to each other) called the fundamental and the harmonics, partials, or overtones. The sounds have harmonic frequency spectra. The lowest frequency present is the fundamental, and is the frequency at which the entire wave vibrates. The overtones vibrate faster than the fundamental, but must vibrate at integer multiples of the fundamental frequency in order for the total wave to be exactly the same each cycle. Real instruments are close to periodic, but the frequencies of the overtones are slightly imperfect, so the shape of the wave changes slightly over time.

Subjective aspects:
Variations in air pressure against the ear drum, and the subsequent physical and neurological processing and interpretation, give rise to the subjective experience called "sound". Most sound that people recognize as "musical" is dominated by periodic or regular vibrations rather than non-periodic ones (called a definite pitch), and we refer to the transmission mechanism as a "sound wave". In a very simple case, the sound of a sine wave, which is considered to be the most basic model of a sound waveform, causes the air pressure to increase and decrease in a regular fashion, and is heard as a very "pure" tone. Pure tones can be produced by tuning forks or whistling. The rate at which the air pressure varies governs is the frequency of the tone, which is measured in oscillations per second, called hertz. Frequency is a primary determinate of the perceived pitch.

4. Harmonics, partials, and overtones:

The fundamental is the frequency at which the entire wave vibrates. Overtones are other sinusoidal components present at frequencies above the fundamental. All of the frequency components that make up the total waveform, including the fundamental and the overtones, are called partials.
Overtones which are perfect integer multiples of the fundamental are called harmonics. When an overtone is near to being harmonic, but not exact, it is sometimes called a harmonic partial, although they are often referred to simply as harmonics. Sometimes overtones are created that are not anywhere near a harmonic, and are just called partials or inharmonic overtones.

The fundamental frequency is considered the first harmonic and the first partial. The numbering of the partials and harmonics is then usually the same; the second partial is the second harmonic, etc. But if there are inharmonic partials, the numbering no longer coincides. Overtones are numbered as they appear above the fundamental. So strictly speaking, the first overtone is the second partial (and usually the second harmonic). As this can result in confusion, only harmonics are usually referred to by their numbers, and overtones and partials are described by their relationships to those harmonics.

5. Harmony:

If two notes are simultaneously played, with frequency ratios that are simple fractions (e.g. 2/1, 3/2 or 5/4), then the composite wave will still be periodic with a short period, and the combination will sound consonant. For instance, a note vibrating at 200 Hz and a note vibrating at 300 Hz (a perfect fifth or 3/2 ratio, above 200 Hz) will add together to make a wave that repeats at 100 Hz: every 1/100 of a second, the 300 Hz wave will repeat thrice and the 200 Hz wave will repeat twice. Note that the total wave repeats at 100 Hz, but there is not actually a 100 Hz sinusoidal component present.

The combination of composite waves with short fundamental frequencies and shared or closely related partials is what causes the sensation of harmony.
When two frequencies are near to a simple fraction, but not exact, the composite wave cycles slowly enough to hear the cancellation of the waves as a steady pulsing instead of a tone. This is called beating, and is considered to be unpleasant, or dissonant.

6. Scales:

The material of a musical composition is usually taken from a collection of pitches known as a scale. Because most people cannot adequately determine absolute frequencies, the identity of a scale lies in the ratios of frequencies between its tones (known as intervals).
The diatonic scale appears in writing throughout history, consisting of seven tones in each octave. In just intonation the diatonic scale may be easily constructed using the three simplest intervals within the octave, the perfect fifth (3/2), perfect fourth (4/3), and the major third (5/4). As forms of the fifth and third are naturally present in the overtone series of harmonic resonators, this is a very simple process.
The following table shows the ratios between the frequencies of all the notes of the scale and the fixed frequency of the first note of the scale.

There are other scales available through just intonation, though this one is the most well known form. Scales which do not adhere to just intonation, and instead have their intervals adjusted to meet other needs are known as temperaments, of which equal temperament is the most used. Temperaments, though they obscure the acoustical purity of just intervals often have other desirable properties, such as a closed circle of fifths.

3. Musical instruments:

1. Definition
2. types of musical instruments
3. history

1. Definition:

A musical instrument is a device constructed or modified with the purpose of making music. In principle, anything that produces sound, and can somehow be controlled by a musician, can serve as a musical instrument. The expression, however, is reserved generally to items that have a specific musical purpose. The academic study of musical instruments is called organ logy.

2. Types of musical instruments:

Instruments are often divided by the way in which they generate sound:

• Wind instruments generate a sound when a column of air is made to vibrate inside them. The frequency of the wave generated is related to the length of the column of air and the shape of the instrument, while the tone quality of the sound generated is affected by the construction of the instrument and method of tone production. The group is typically subdivided into Brass, like the trumpet, and Woodwind instruments, such as the clarinet, bagpipes and flute.

• Lamella phones create a sound by the plucking of lamellas made from different materials (metal, rapier etc.). These Instruments are tunable, so they do not belong to the idiophones. An example is the Mbira.

• Percussion instruments create sound, with or without pitch, when struck. The shape and material of the part of the instrument to be struck and the shape of the resonating cavity, if any, determine the sound of the instrument. Examples: drums, bells and cymbals.

• String instruments generate a sound when the string is plucked, strummed, slapped, etc. The frequency of the wave generated (and therefore the note produced) usually depends on the length of the vibrating portion of the string, its linear density (mass per unit length of string), the tension of each string and the point at which the string is excited; the tone quality varies with the construction of the resonating cavity. Examples: guitars, violins and sitars.

• Voice, that is, the human voice, is an instrument in its own right. A singer generates sounds when airflow from the lungs sets the vocal cords into oscillation. The fundamental frequency is controlled by the tension of the vocal cords and the tone quality by the formation of the vocal tract; a wide range of sounds can be created.

• Electronic instruments generate sound through electronic means. They often mimic other instruments in their design, particularly keyboards, drums and guitars. Examples: synthesizers and Theremins. Electric string instruments generate sound by a pickup placed under strings. The electric guitar and the electric bass are the most famous examples, but there is a wide variety of new instruments, because the electro-magnetic amplification generates new possibilities.

• Keyboard instruments are any instruments that are played with a musical keyboard every key generates one or more sounds; most keyboard instruments have extra means (pedals for a piano, stops for an organ) to manipulate these sounds. They may produce sound by wind being fanned (organ) or pumped (accordion), vibrating strings either hammered (piano) or plucked (harpsichord), by electronic means (synthesizer) or in some other way. Sometimes, instruments that do not usually have a keyboard, such as the Glockenspiel, are fitted with one. Though they have no moving parts and are struck by mallets held in the player's hands, they possess the same physical arrangement of keys and produce sound waves in a similar manner.

3. History:

All classes of instruments save the electronic are mentioned in ancient sources, such as Egyptian inscriptions, the Bible and the many thousand year old Hindu Vedas, and probably predate recorded history. The human body, generating both vocal and percussive sounds, may have been the first instrument. Percussion instruments such as stones and hollow logs are another likely candidate. For instance, nine-thousand-year-old bone flutes or recorders have been found in Chinese archeological sites.

4. String instruments

1. definition
2. types of string instruments
3. string length, scale length
4. production of multiple notes
5. sound production in acoustic instruments
6. sound production through electronic amplification

1. Definition:

A string instrument (or stringed instrument) is a musical instrument that produces sound by means of vibrating strings. In the scheme of musical instrument classification, used in organ logy, they are called chordophones. The most common string instruments in Western music are those in the violin, piano and guitar families.

2. Types of string instruments:

String instruments are usually categorized by the technique used to produce sound. In order for a string instrument to produce sound, its string or strings must vibrate. There are three common ways to initiate vibration.

Plucking

Instruments such as the guitar nd sitar are plucked, either by a finger or thumb, or by some type of plectrum. This category includes the keyboard instrument the harpsichord, which formerly used feather quills (now plastic plectra) to pluck the strings.
Bowing

Instruments like the cello and rebec are usually played by drawing a bow across the strings. All instruments in the viol and violin families fall into this category. Occasionally instruments which are normally bowed are plucked (this is known as pizzicato) instead, and instruments normally plucked are also bowed.

Striking

The third common method of sound production in stringed instruments is to strike the string with a hammer. By far the most well-known instrument to use this method is the piano, where the hammers are controlled by a mechanical action; another example is the hammered dulcimer, where the player holds the hammers.

The piano is often considered a percussion instrument, since sound production through struck blows defines this instrument family; the proclamation that the piano is a percussion instrument has at times served as rhetoric for composers who relished sharp percussive effects.

A variant of the hammering method is found in the clavichord: a brass tangent touches the string and presses it to a hard surface, inducing vibration. This is a very inefficient method of sound production, yielding a very soft sound. The maneuver can also be executed with a finger on plucked and bowed instruments, where it gives equally soft results. Guitarists refer to this technique as "hammering-on".

Other methods

The Aeolian harp employs a very unusual method of sound production: the strings are excited by the movement of the air. Some string instruments have keyboards attached which are manipulated by the player, meaning they do not have to pay attention to the strings directly. The most familiar example is the piano, where the keys control the felt hammers by means of a complex mechanical action. Other string instruments with a keyboard include the clavichord (where the strings are struck by tangents), and the harpsichord (where the strings are plucked by tiny plectra).

3. String length or scale length:

This is the length of the string from nut to bridge on bowed or plucked instruments and ultimately determines the distance between different notes on the instrument.

For example, a double bass with its low range needs a scale length of around 42 inches, whilst a violin scale is only about 13 inches. On the shorter scale of the violin, the left hand may easily reach a range of slightly more than two octaves without shifting position, while on the bass' longer scale, a single octave or a ninth is reachable in lower positions.

In bowed instruments, the bow is normally placed perpendicularly to the string, at a point half way between the end of the fingerboard and the bridge. However, different bow placements can be selected to change timbre. Application of the bow close to the bridge produces an intense, sometimes harsh sound, which acoustically emphasizes the upper harmonics. Bowing above the fingerboard produces a purer tone with less overtone strength, emphasizing the fundamental.
Similar tumbrel distinctions are also possible with plucked string instruments by selecting an appropriate plucking point, although the difference is perhaps more subtle.

In keyboard instruments, the contact point along the string (whether this be hammer, tangent, or plectrum) is a choice made by the instrument designer. Builders use a combination of experience and acoustic theory to establish the right set of contact points.

4. Production of multiple notes:

A string at a certain tension will only produce one note, so to obtain multiple notes string instruments employ one of two methods. One is to add enough strings to cover the range of notes desired; the other is to allow the strings to be stopped. The piano is an example of the former method, where each note on the instrument has its own set of strings. On instruments with stoppable strings, such as the violin or guitar, the player can shorten the vibrating length of the string, using their fingers directly (or more rarely through some mechanical device, as in the hurdy gurdy). Such instruments usually have a fingerboard attached to the neck of the instrument, providing a hard flat surface against which the player can stop the strings. On some string instruments, the fingerboard has frets, raised ridges perpendicular to the strings that stop the string at precise intervals, in which case the fingerboard is called a fret board.

Modern frets are typically specially shaped metal wire set into slots in the fret board. Early frets were cords tied around the neck, still seen on some instruments as wraps of nylon monofilament. Such frets are tied tightly enough that moving them during performance is impractical. The bridges of a koto, on the other hand, may be moved by the player, occasionally in the course of a single piece of music.

5. Sound production:

Unamplified ("acoustic") instruments:

A vibrating string on its own makes only a very quiet sound, so string instruments are usually constructed in such a way that this sound is coupled to a hollow resonating chamber, a soundboard, or both. On the violin, for example, the taut strings pass over a bridge resting on a hollow box. The strings' vibrations are distributed via the bridge and sound post to all surfaces of the instrument, and are thus made louder. The correct technical explanation is that they allow a better match to the acoustic impedance of the air.

It is sometimes said that the soundboard or sound box "amplifies" the sound of the strings. Technically speaking, no amplification occurs, since all of the energy to produce sound comes from the vibrating string. What really happens is that the soundboard of the instrument provides a larger surface area to create sound waves than that of the string. A larger vibrating surface moves more air, hence produces a louder sound.

Achieving a tonal characteristic that is effective and pleasing to the player's and listener's ear is something of an art, and the makers of string instruments often seek very high quality woods to this end, particularly spruce (chosen for its lightness, strength and flexibility) and maple (a very hard wood). Spruce is used for the soundboards of instruments from the violin to the piano.

Electronic amplification:

Most string instruments can be fitted with piezoelectric or magnetic pickups to convert the string's vibrations into an electrical signal which is amplified and then converted back into sound by loudspeakers. Some players attach a pickup to their traditional string instrument to "electrify" it. Another option is to use a solid-bodied instrument, which reduces unwanted feedback howls or squeals. Amplified string instruments can be much louder than their acoustic counterparts, which allow them to be used in relatively loud rock, blues, and jazz ensembles. Amplified instruments can also have their amplified tone modified by using electronic effects such as distortion, reverb, or wah-wah.

5. Introduction to Indian string instruments

The Indian string instruments can be classified into the type based on the science behind the same.

Plucked:

- Ektara
- Sarod
- Sitar
- Surbahar
- Swarmandel
- Tanpura
- Veena
- taus

Bowed:

- Esraj (also called dilruba)
- Sarangi
- Sarinda

Struck:

- Santoor

Plucked:

1. Ektara:

Ektara (also called iktar, ektar or gopichand) is a one string instrument used in Bangladesh and India, and Pakistan. It literally means single-stringed (ek - one, tara - string).

2. Sarod:

The Sarod or sarode is an Indian classical musical instrument. It is similar to the Western lute in structure.

The lack of frets and the tension of the strings makes it very technically demanding to play, as the strings must be pressed hard against the fingerboard.

3. Sitar:

The sitar is probably the best-known South Asian instrument in the West. A Hindustani classical stringed instrument, it utilizes sympathetic strings along with regular strings and a gourd resonating chamber to produce a very distinctive sound.

4. Surbahar:

The surbahar (also known as bass sitar) is a plucked string instrument used in the Hindustani classical music of North India. It is related to the better-known sitar but has a lower tone.

5. Swarmandel:

The Swarmandel or Indian harp is an Indian stringed instrument. The Indian harp is used in many traditional Hindu and Muslim rituals, and is a traditional instrument. It has been used for many generations, dating back to the pre-Mughal era; though still used today, its use is not as widespread. It is actually very similar to the Autoharp or Zither in many respects.

6. Tambura:

A tambura (South India) or tanpura (North India) is a long-necked Indian lute, unfretted and round-bodied. The neck is hollow, and it has four or five (rarely, six) wire strings, which are plucked one after another in a regular pattern to create a tonic resonance field (bourdon or drone function)

7. Veena:

Veena (also spelled vina and veene) is a plucked stringed instrument used in Carnatic music. There are several variations of the veena, which is member of the lute family.
Veena designs have evolved over the years.

8. Taus:

This instrument is made in the shape of a peacock and the word 'taus' is in fact a Persian word meaning peacock. It has 28-30 strings.The taus is very similar to the dilruba in construction and in playing technique. However, the taus has a bigger sound box and therefore produces a much more resonant and mellow sound.

Bowed instruments:

1. Esraj:

2. Sarangi:

3. Sarinda:

Strucked:

1. Santoor:

The santoor is a trapezoid-shaped hammered dulcimer often made of walnut, with seventy strings. The special-shaped mallets (mezrab) are lightweight and are held between the index and middle fingers. A typical santoor has two sets of bridges, providing a range of three octaves.

5. Introduction to western string instruments:

1. Autoharp
2. Banjo
3. Theorbo
4. Electric upright bass
5. Kutiyapi
6. Mandolin
7. Musical bow
8. violin
9. guitar

1. Autoharp:

The Autoharp is a musical string instrument having a series of chord bars attached to dampers which, when depressed, mute all the strings other than those that form the desired chord. Despite its name, the autoharp is not a harp at all, but a zither. The generic term for the instrument is chorded zither.

2. Banjo:

The banjo is a stringed instrument of African origin, early or original examples sometimes being called the "gourd banjo". One predecessor to the banjo is called the "Akonting."

3. Theorbo:

A Theorbo is a plucked string instrument. As a name, Theorbo signifies a number of long-necked lutes with second peg-boxes.

4. Electric upright bass:

The electric upright bass (abbreviated EUB and sometimes also called stick bass) is an electronically amplified version of the double bass that has a minimal or 'skeleton' body.

5. Kutiyapi:

The kutiyapi, a Philippine two-stringed, fretted boat-lute, is the only stringed instrument among the Maguindanaon.

6. Mandolin:

A mandolin is a small, stringed musical instrument which is plucked, strummed or a combination of both. It is descended from the mandora.

7. Musical bow:

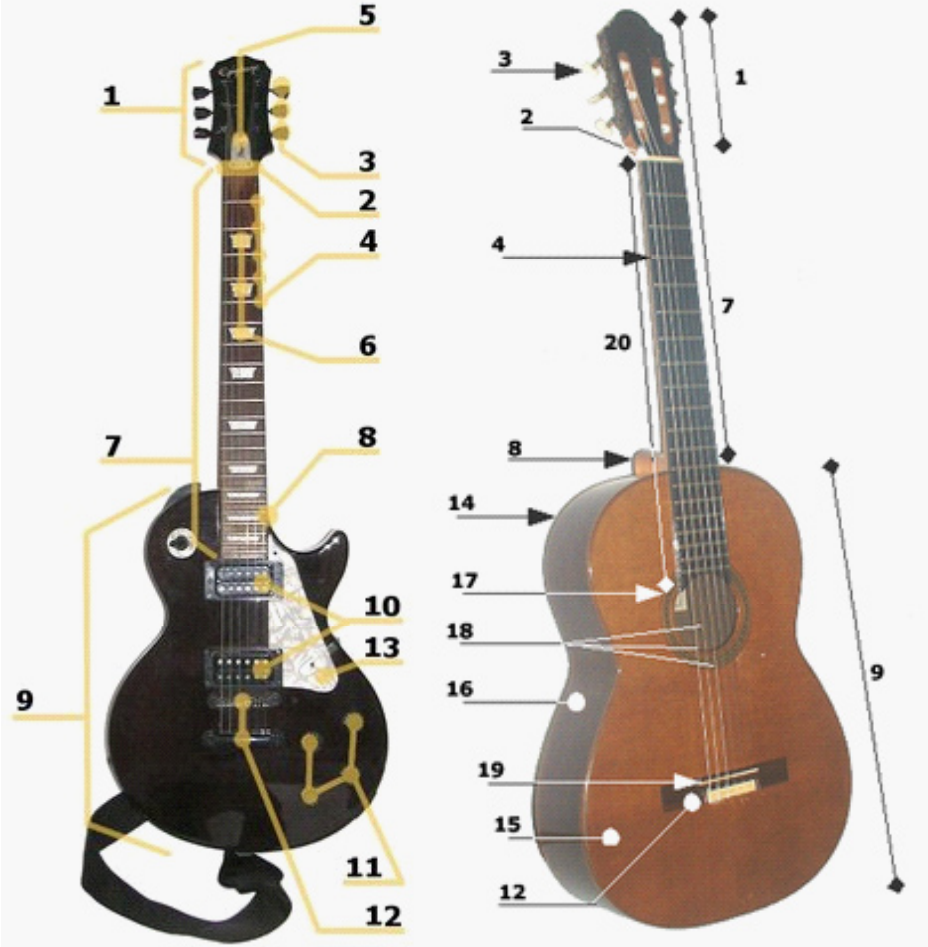
The musical bow is a simple string musical instrument consisting of a string supported by a flexible string bearer, usually made out of wood.

8. Violin:

The violin is a bowed string instrument with four strings tuned in perfect fifths. It is the smallest and highest-pitched member of the violin family of string instruments, which also includes the viola and cello.

9. guitar:

The guitar is a musical instrument, used in a wide variety of musical styles, and is also widely known as a solo classical instrument. It is most recognized in popular culture as the primary instrument in blues, country, flamenco, pop, and rock music. The guitar usually has six strings, but guitars with four, seven, eight, ten, and twelve strings also exist.



Parts of the guitar:
Parts of typical classical and electric guitars

1. Headstock
2. Nut
3. Machine heads (or peg heads, tuning keys, tuning machines, tuners)
4. Frets
5. Truss rod
6. Inlays
7. Neck
8. Heel (acoustic or Spanish) – Neck joint (electric)
9. Body
10. Pickups
11. Electronics
12. Bridge
13. Pick guard
14. Back
15. Soundboard (top)
16. Body sides (ribs)
17. Sound hole, with Rosette inlay
18. Strings
19. Saddle
20. Fret board

Plectrum:
A "guitar pick" or "plectrum" is a small piece of hard material which is generally held between the thumb and first finger of the picking hand and is used to "pick" the strings.

6. Experimental, redesigned string musical instruments:

1. The Amazing Pencilina
2. Bazantar
3. Bowafridgeaphone
4. The Dijbass
5. Electric violoncello
6. Former Guitars

1. The Amazing Pencilina:

Bradford Reed fights and tames the idiosyncrasies of the pencilina, an original instrument of his own design and construction.The pencilina is an electric board zither played primarily by striking the strings with sticks; also by plucking and bowing.

2. Bazantar:

Invented by Mark Deutsch, the Bazantar is a five-string acoustic bass, fitted with an additional twenty-nine sympathetic strings and four drone strings.
The instrument possesses a melodic range of over five octaves, while its sympathetic range spans four octaves. This results in interplay between melodic, sympathetic, and drone strings which weaves an unexpected landscape

3. Bowafridgeaphone:

That's right; the name of this mammoth beast is the Bowafridgeaphone (bow a fridge a phone). Experimental instrument maker Iner Souster has used refrigerator grates in quite a few of his instruments... Fridge grates, oh fridge grates I love you. Violin bows, on the other hand, are quite afraid of his instruments.

4. The Dijbass:

With a hollow body constructed of welded and machined 6061 anodized aluminum, the DIJBASS uses a system of internal baffles to 'fold' the air flow in half and direct it out the front holes. This allows the acoustics of a full-sized didgeridoo to fit into a 24-inch long package. An internal condenser microphone picks up the didge sounds while the externally-mounted electric pickup amplifies the bass strings.

5. Electric violoncello:

Electric violoncello built by luthier Dwight Newton. Original design based on modified Jensen 'cello. Dwight is a viola da gamba player so this cello has a relatively wide rosewood fingerboard.

6. Former Guitars:

The former guitars have two strings which share tension through a "head" that pivots under the control of a long whammy arm. This configuration causes one string to tighten as the other is loosened, creating a tonal center.

8. Inferences from data collection:

Understanding about music and musical instruments and its evolution has a wide spectrum where its study demands more and more thorough research that seems never ending. Within the limited time span available I tried to get the overall picture and the key factors.

About musical instruments, these are not consciously designed by someone called as designer, but originated from people who are crazy and passionate about the art form; music. Through centuries these instruments evolved and even in future they will undergo changes those take them towards betterment. Every musical instrument has gone through drastic changes to reach to a point where they look refined and they are source of creating music. Sarod is considered to be the youngest musical instrument which has history of evolution of only 200 years. That explains all facts about minute journey an instrument goes through before even establishing something that's called "musical instrument".

About experimental and newly designed instruments, people have tried many things but mostly experimentation ends up in making derivative of an instrument or modified instrument. Hence to design an all new instrument, I have to get away from this approach and in the beginning itself I should emphasis more on the areas those aren't addressed yet.

The detailed analysis and overall study about musical and musical instruments and a common mans approach towards it gives me one important clue or direction. Music is considered as fairly serious activity when it comes to creating or composing music and practicing music.

Most of the musical instruments demand serious regular practice or riaz as in Indian classical tradition. Most of the youth or beginners loose their interest as they couldn't readily commit to it and hardly able to spare time for music that starts as hobby.

Here I get the hint that can there be an instrument that is easy entry sorts and pretty easy to start with and get hooked to it. Again the same instrument can have the wide spectrum where after actually practicing over it gives you to perform or play serious kind of music.

This approach is towards pulling more attention and keeping alive the interest about music. Similarly there can be various possibilities with blending technology with the music which creates definite scope for musical installations or music for public.

In other way it can direct me towards simplifying music with relation to individual and his needs and expectations from performing solo music point of view.

New sound or unexpectedness in way of playing or interaction with the instrument has wide design opportunities. Though in the modern world one can create desired sound through programming or in digital ways finding acoustic solution to it has an advantage.

Data collection was not actually an activity that happened over one month after beginning the project but everyday life, living with the music, indirect observations, inspiration, concerts, and interaction with the music aficionados over the time and growing up with that has quite a sensitive inference and added meaning to it.

C. explorations:

1. Various directions and evaluation
2. The concept and evolution
3. The instrument

1. Various directions and evaluation

After deciding the objective of the project and parameters constraining the study, the next step is to start with the ideation. objective is `to design a product in the world of music' and the indirect constrain is product has to be based on the concept of `chordophones: string instrument'.

A product in the world of music: can be any object, installation, instrument, a toy (anything that can have defined parameters and detailed characteristics.)

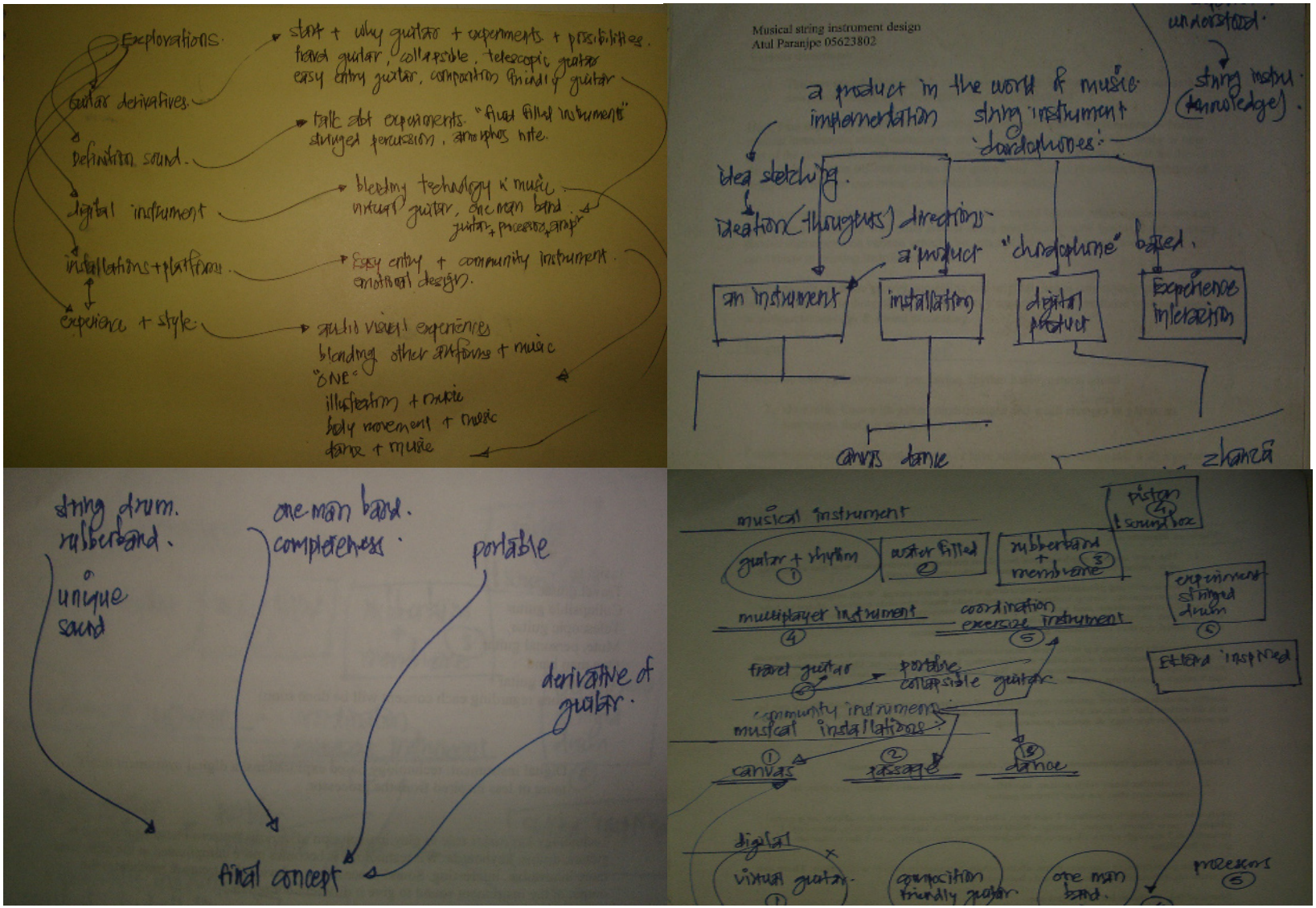
The product should be based on the concept of chordophones:
Different from any other practices of design, when it comes to product related to music; it becomes very important to have personal experience and motivation towards topic. I am familiar with the string instrument; guitar. Playing; practicing guitar introduces basics of sound generation in stringed instruments. This helps understanding scope for further possibilities and explorations.

Music in itself is infinite world with constantly extending boundaries. In this case it becomes very important to decide the controlling parameter that directs the project towards achievable objective. Deciding about chordophones' in the beginning itself makes the task confined to ` the product based on string instruments concepts', at the same time demands stretching the limits of existing pattern of products based on similar concept.

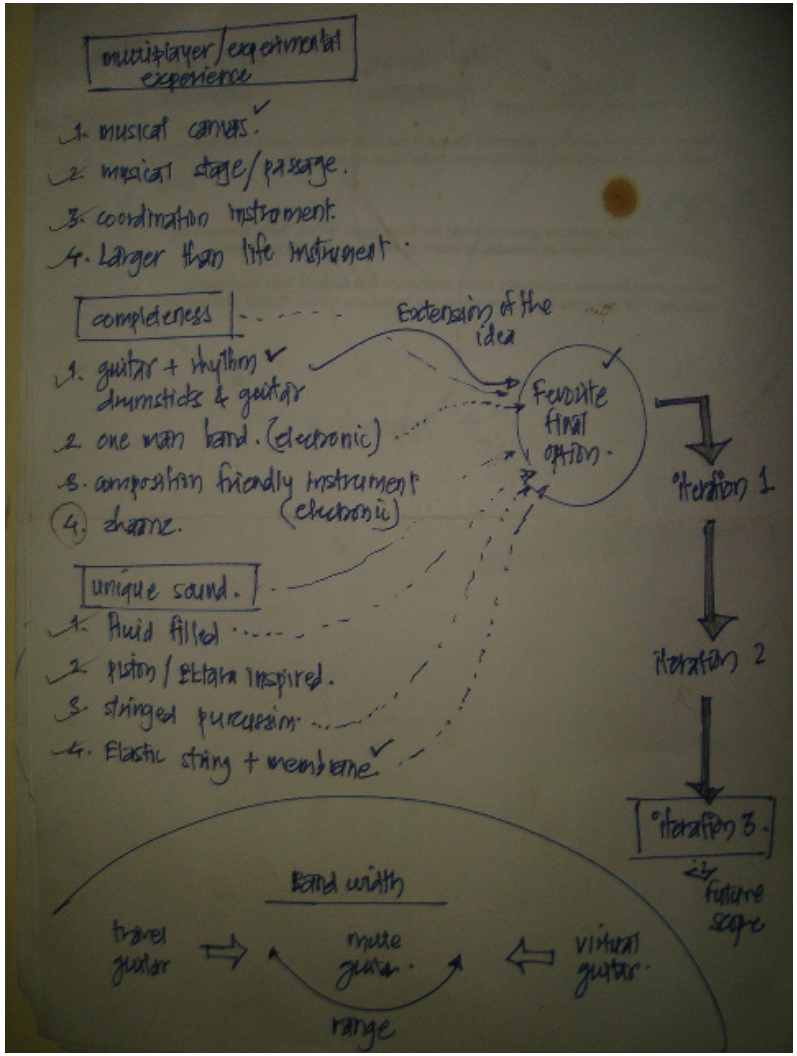
So I started thinking about it on these lines. In this project even a `thought' that triggers the idea became a mentionable element as ideation through sketching is more about form based products. Here the attempt is all about a new sound, experience, this demands more of `idea thought or dreaming about the product'.

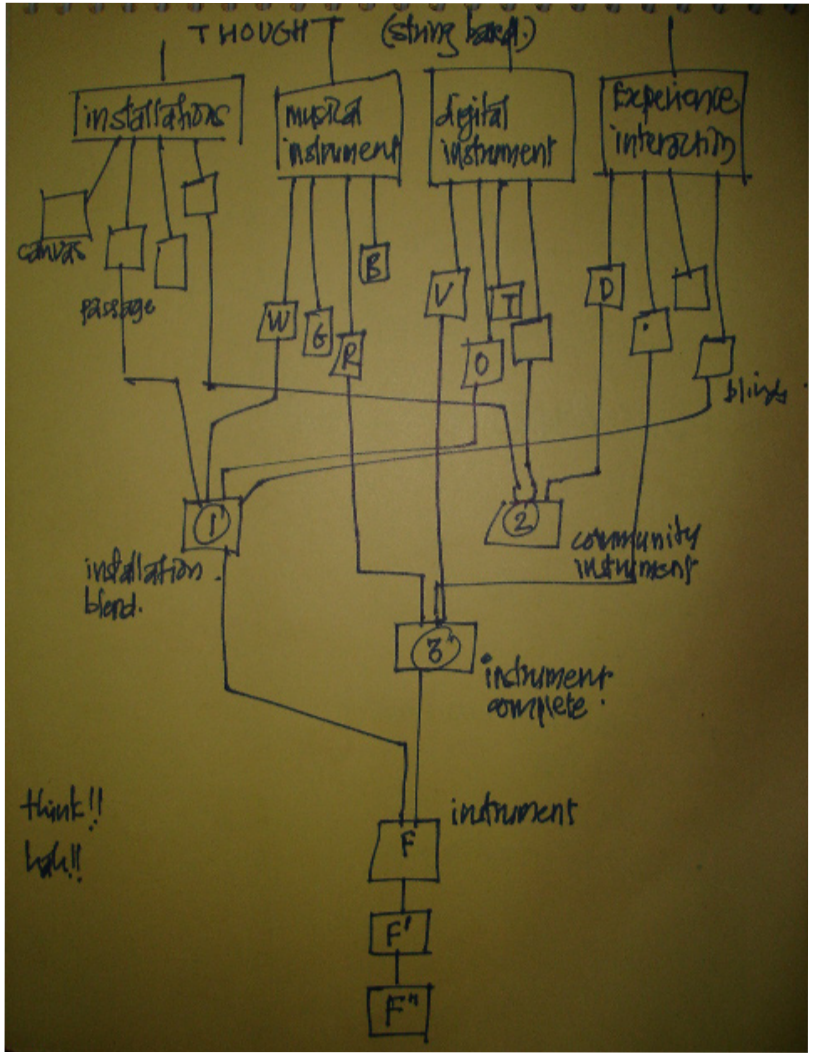
Initially I had starting randomly towards ideation and then consequently I could see interlinks and correlation amongst various ideas; thoughts. These thoughts are then grouped in the clusters. Each cluster has a unique flavour; characteristic. These ideas are then blended within each other to refine them to meaningful product.

Thinking aloud through writting things down



Thinking aloud through writting things down





Ideas are grouped into three basic categories.

1.A product that introduces new experience and style:

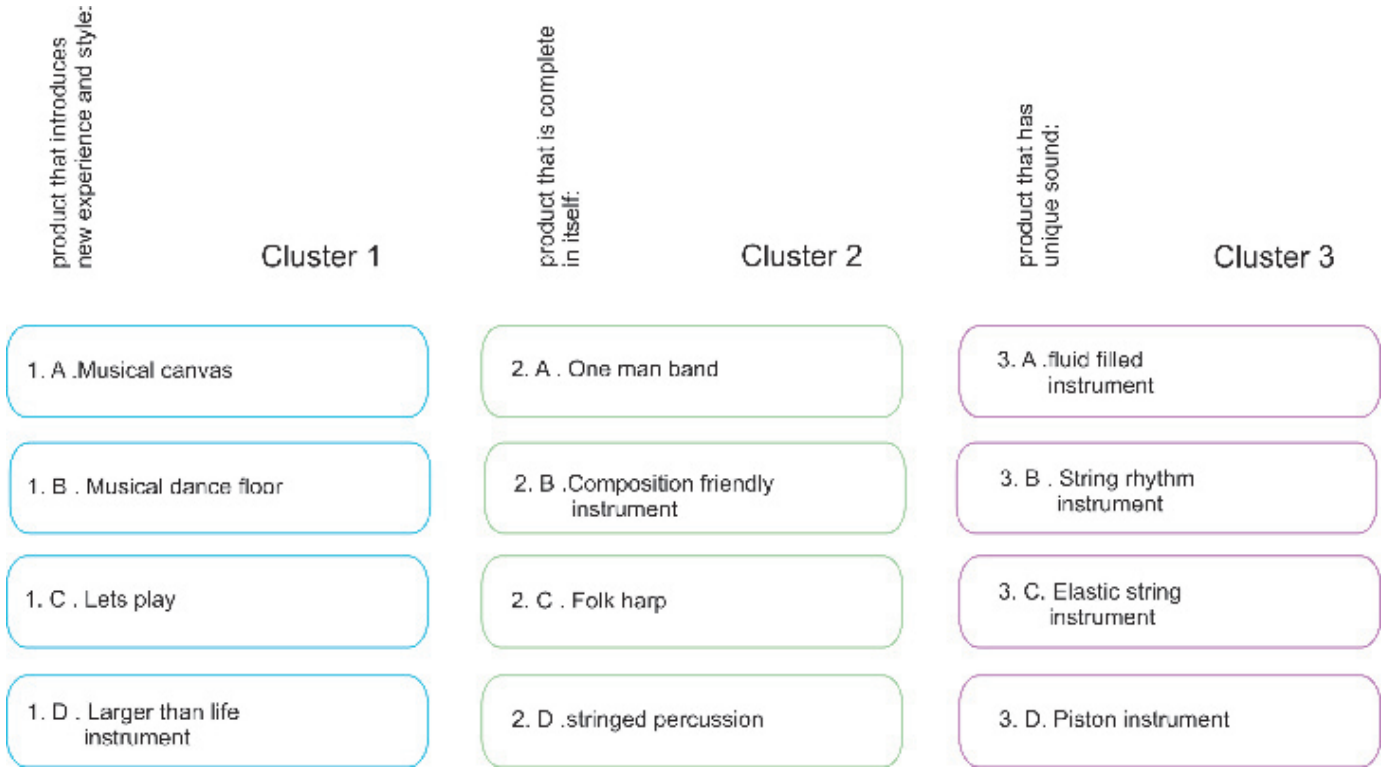
This group represents ideas those extend or brake the existing way of playing or experience with the instrument. This may have blend of music and other art forms. This can be an attempt to extend the concept of music from audible art to audio-visual experience. Ideas may introduce a product that is meant for anybody who has inclination towards music.

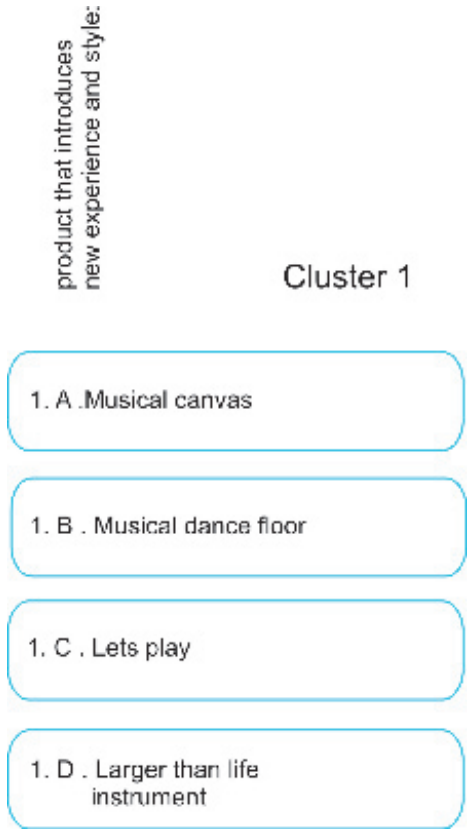
2.A product that is complete in itself from music point of view:

Music is group activity when it comes to performing and can be practiced individually alone. Performing music demands 3-4 musicians play together to give it a complete sense. Ideas belonging to this cluster throw light on completeness of a musical product and its relation to individual.

3.A product that has unique sound:

It consists of some ideas and experiments those generate a new definition sound that can't be readily related to existing instruments or sounds. With digital modulation and processing almost every kind of sound can be generated. But digital; processed sound has its own limitation in terms of feel and appreciation. Here attempt is to achieve a new earthy sound through acoustic experiments.


product that introduces new experience and style:
Cluster 1
product that is complete in itself:
Cluster 2
product that has unique sound:
Cluster 3
1. A .Musical canvas
1. B . Musical dance floor
1. C . Lets play
1. D . Larger than life instrument
2. A . One man band
2. B .Composition friendly instrument
2. C . Folk harp
2. D .stringed percussion
3. A .fluid filled instrument
3. B . String rhythm instrument
3. C. Elastic string instrument
3. D. Piston instrument


product that introduces
new experience and style:
Cluster 1
1. A .Musical canvas
1. B . Musical dance floor
1. C . Lets play
1. D . Larger than life
instrument

1. A .Musical canvas

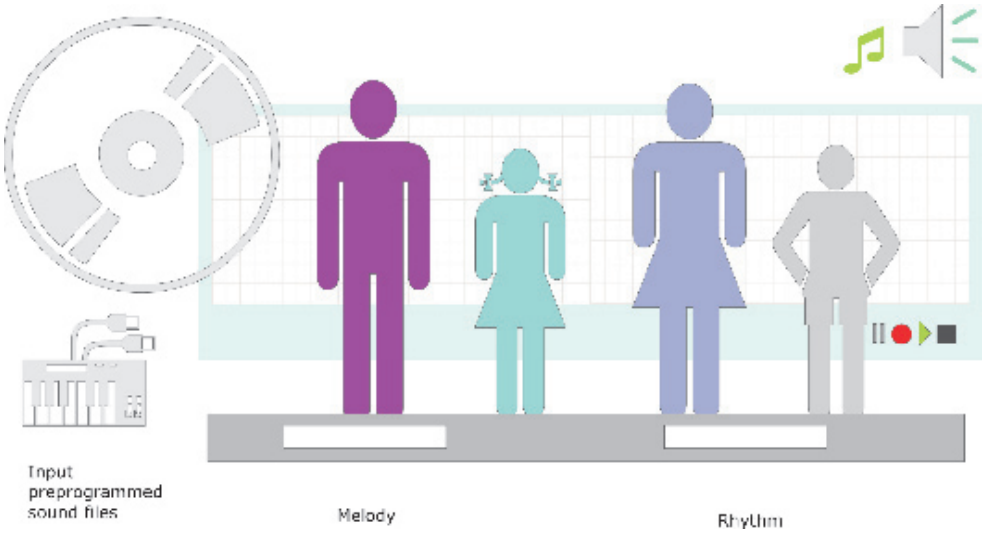
Musical graffiti is an interactive musical installation or canvas that blends music with art of sketching or painting.And to be installed at art school walls or any education institute and even can represent art on theatre level.

Canvas is a grid where each line of the grid represents each note or string. Musical canvas is an elongated Surface that has various parts of basic music generation like melody, harmony, rhythm. One can have basic input files to device but rest of the music is to be generated by an artist or performer. One has to sketch using stylus. There are three basic styluses those corresponding to melody (tune), harmony (chords) and rhythm (beats). Here three or more artist can perform together in coordination to create music through art. It can be a personal experience but has potential to introduce group collaborative art form that blending with music and making musical audio-visual experience.

Various sketch strokes corresponds to variations in generated sound, in a sense variation in coordinates of sketching is directly proportional to generated music variations. Here pressure of the stroke also plays important role in sound variation, as sound level varies according to pressure one applies.

This concept will help introducing harmony or better coordination amongst the people. Again sketching on musical canvas not necessarily demand extremely good skill set regarding music or painting. So any-one who has inclination towards art and music can participate. This will surely inspire people towards art.

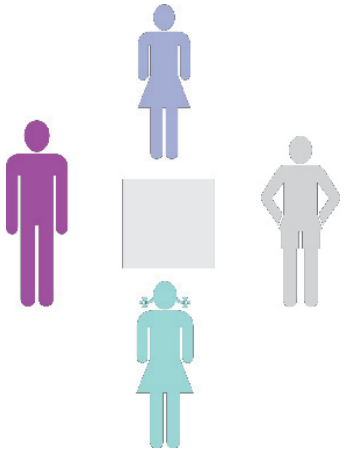
1. B . Musical dance floor



Musical dance floor is an installation that blends the art of dancing with the music creation. Tap dancing is a form where dance actually creates music but again tap dancing involves lot of practice and training. Musical dance floor is an easy entry platform where amateur dancer can also participate and enjoy.

Platform has various regions where dancing on them creates different sounds. So group of people dancing in synchronization will create meaningful musical experience.

1. C . Lets play



More than just an art form. It helps human mind in various ways. More or less everyone's living musical life where one listens to music, sing, play an instrument. Music is not only meant for music professionals. Most of the musical instruments demands hard work practice if one has to play or perform.

Can there be any easy entry sort's musical instrument??

Again musical instruments are very personal and designed for an individual. Although various musicians can play together and create good music but if there is musical instrument that demands more than 2-3 people to play, come together??

Playing music together helps establishing indirect communication between people. Here I can explain the need of community instrument through a scenario:
Imagine 3-4 theatre artist are practicing for the drama. For better coordination they all must feel at the same wavelength or equal involvement. So there can be a group musical instrument that has melody, harmony, rhythm together. And 4 people can play it together, when they all are jamming up nicely, they understand, that now they all are equally participating, involved. This will help them concentrating, and being focussed.

So here musical instrument demands people to come together and play.

1. D . Larger than life instrument

Instruments if extended and seen in magnified context can be used as day to day life installations.

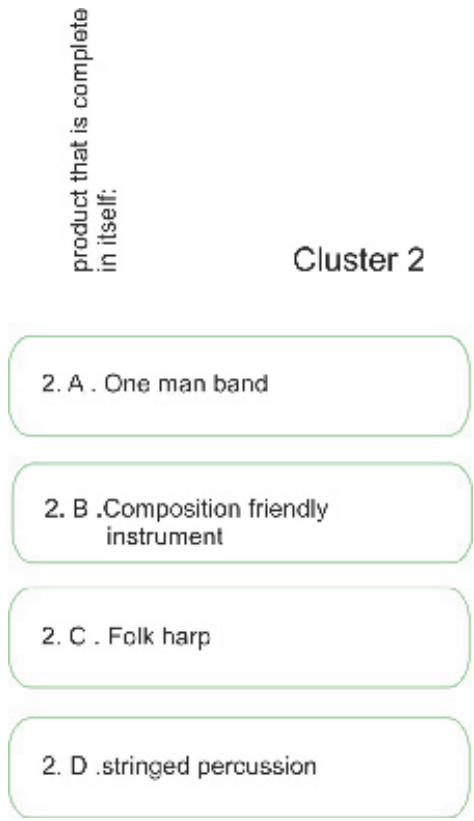
Generally musical instrument is designed for one; it's a personal experience when it comes to playing. Can there be instrument that is meant for more than one guy who can play simultaneously??

E v a l u a t i o n

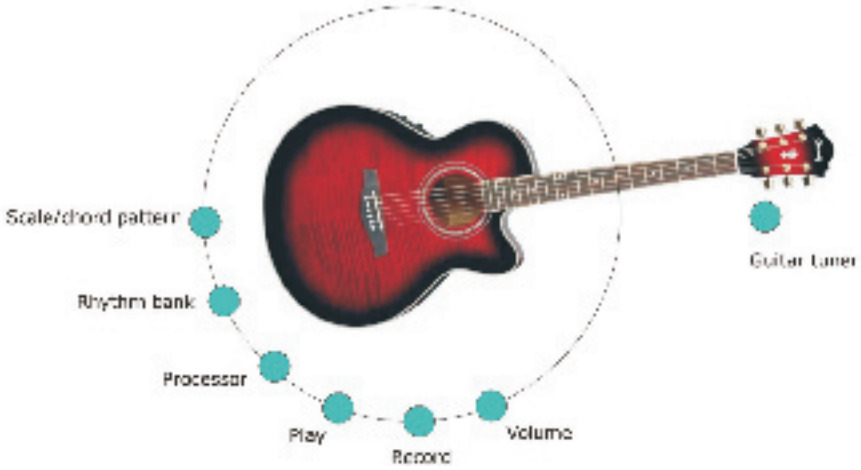
Cluster 1

A product that introduces
new experience and style:

	Unique sound	Control & specification	Completeness	Experience/ style	Feasibility / illustration	Total
1. A . Musical canvas	3	5	7	8	2	25
1. B . Musical dance floor	2	4	6	9	3	24
1. C . Lets play	3	7	7	8	8	33
1. D . Larger than life instrument	2	4	4	5	5	20

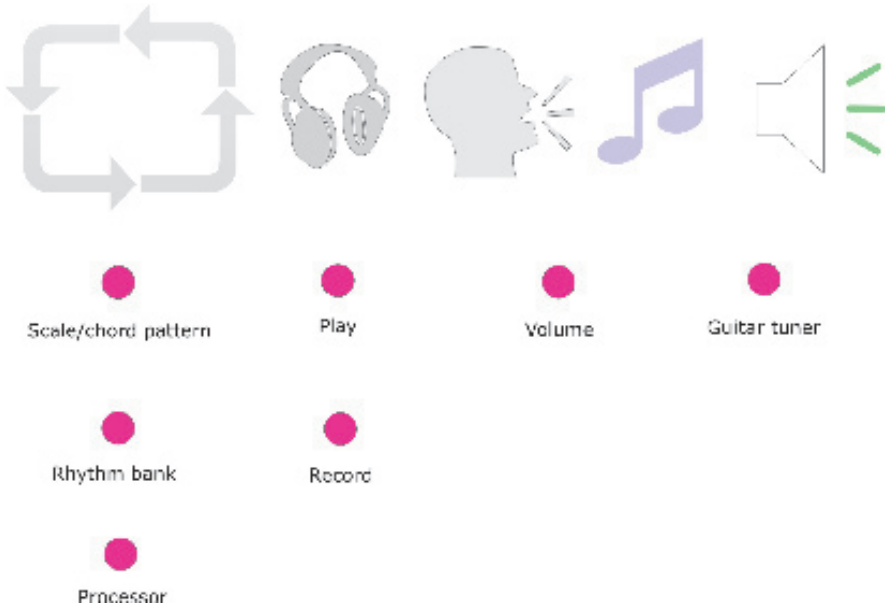

product that is complete in itself:
Cluster 2
2. A . One man band
2. B .Composition friendly instrument
2. C . Folk harp
2. D .stringed percussion

2. A . One man band



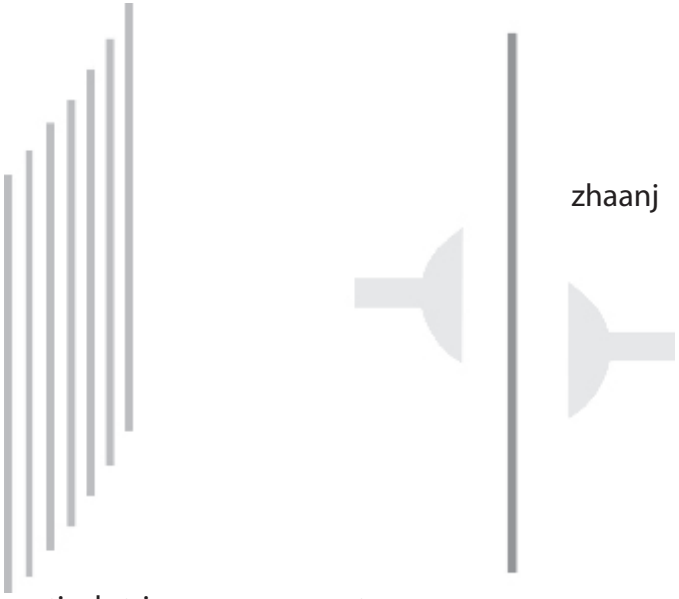
Rhythm, melody, vocals played simultaneously helps composing songs. Even it helps learning an instrument. You get all such things separately as of now like rhythm bank, processors to record and playback. So musician has to depend on such devices to compose or play music. So can there be a single guitar that takes care of above issues and helps creating new music??

2. B .Composition friendly instrument



Composition friendly instrument is digital derivatives that helps u creating new music or explore new composition possibilities. It's a small portable electronic device that has
Necessary inputs required for composition and accompaniment.

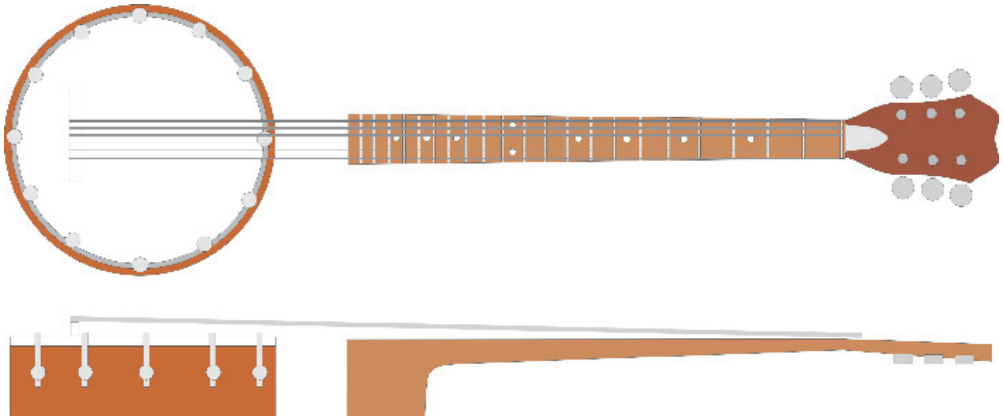
2. C . Folk harp



vertical string arrangement

Harp is an instrument that creates waves of notes those act a s a basics reference for the singer. It is very similar to Indian instrument swar-mandal. Folk harp will be a harp like string arrangement where player strums or strikes the instrument using zhaanz, clap discs.

2. D .stringed percussion



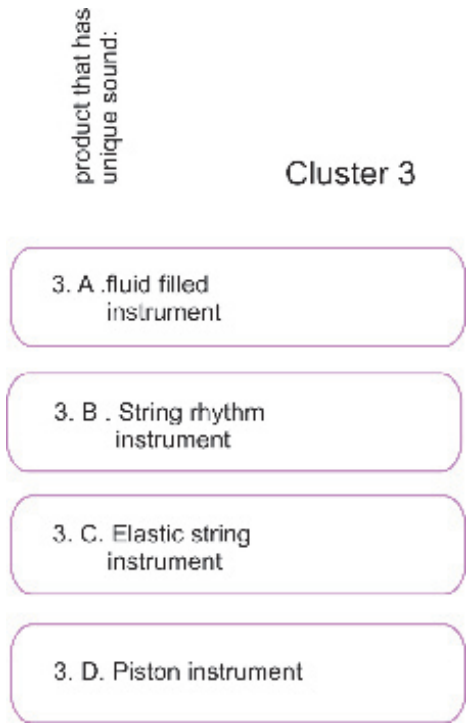
Stringed percussion is a combination of stringed instrument similar to guitar and percussion drum. Here strumming the guitar it self make strings to hit the membrane and that creates mixed effect. It's a complete instrument in itself as it gives complete a accompaniment and cal also used for solo performance.

E v a l u a t i o n

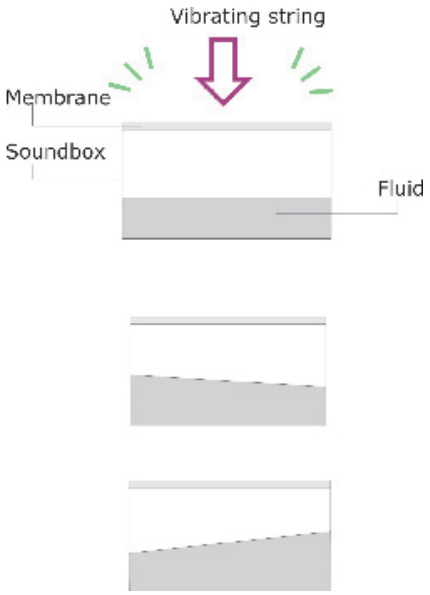
Cluster 2

product that is complete
in itself:

	Unique sound	Control & specification	Completeness	Experience/ style	Feasibility / illustration	Total
2. A . One man band	3	5	7	7	4	26
2. B . Composition instrument	2	4	6	6	3	21
2. C . Folk harp	6	4	7	6	5	28
2. D .stringed percussion	8	7	7	7	8	37


product that has unique sound:
Cluster 3
3. A .fluid filled instrument
3. B . String rhythm instrument
3. C. Elastic string instrument
3. D. Piston instrument

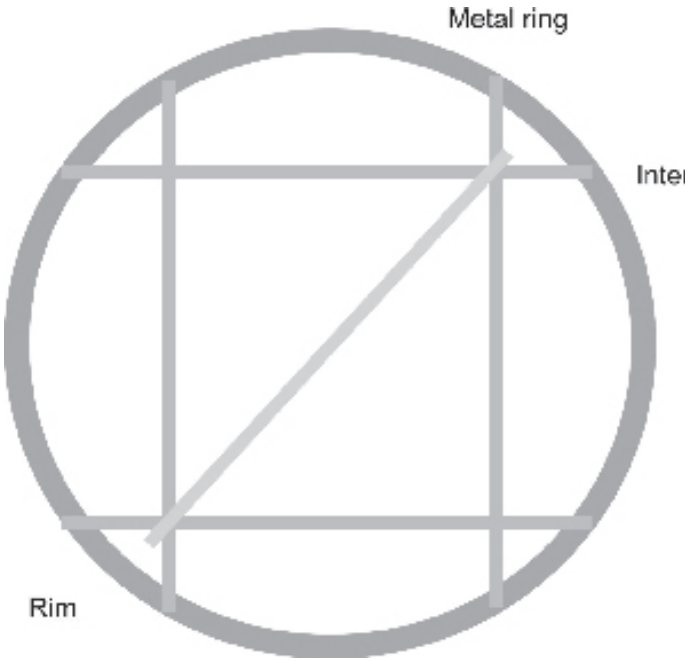
3. A .fluid filled instrument



Every stringed instrument has strings under tension and a sound box. When strings are plucked they vibrate and sound box amplifies the sound.

So imagine a case where the sound box is partly filled with the fluid, and string is plucked. Now moving the sound box moves the fluid inside that further displaces the air in the sound box. This gives a changing sound, notes those are in-betweens and amorphous.

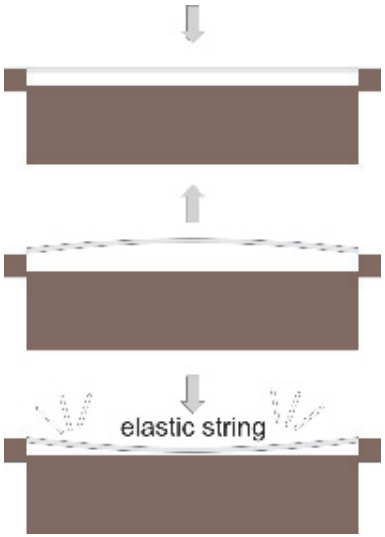
3. B . String rhythm instrument



Drum kit is a popular rhythm instrument for contemporary western music, rock, jazz, fusion. But drum kit has huge set up, size, and cost. Simulated drum pads are also available those give same feel as that of drums.

Stringed rhythm is an instrument that has base strings and rods or bars mounted on a rim. And one can play this using drum sticks. It's a low cost alternative for the drum kits and can be used where actual kit is not available. Here attempt is not to simulate drum sound but to have alternative option that fill in the rhythm.

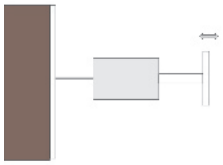
3. C. Elastic string instrument



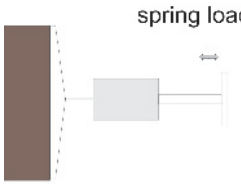
It's a kind of percussion instrument that has strings.
Stringed used will have elastic properties. Those string will b closely wound over a membrane. Imagine a rubber band over a tightly held membrane. Now pulling the string and leaving it will make a sound as string goes back to hits the membrane.
Due to elastic properties of the string, it makes unique sound when it hits and vibrates over the membrane.

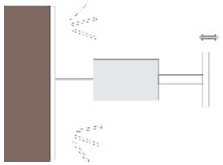
3. D. Piston instrument

principle



spring loaded piston





Instrument is a derivative of ektara. In ektara after plucking the string pressing the wooden sticks changes the scale length and hence the sound.

E v a l u a t i o n

Cluster 3

product that has unique sound:

	Unique sound	Control & specification	Completeness	Experience/ style	Feasibility / illustration	Total
3. A .fluid filled instrument	7	5	4	5	4	25
3. B . String rhythm instrument	6	6	4	6	6	28
3. C. Elastic string instrument	7	5	3	5	6	26
3. D. Piston instrument	7	4	3	5	5	24

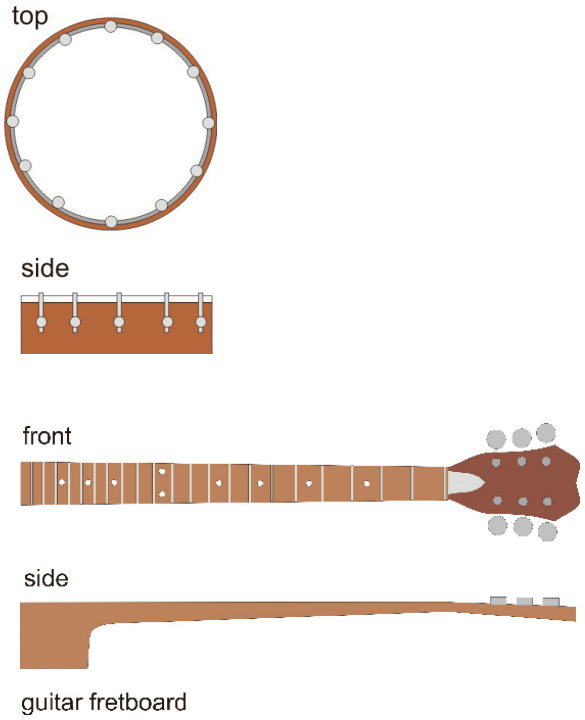

Unique source
Control & specification
Completeness
Experience/ style
Feasibility / illustration
Total
1. A . Musical canvas
3 5 7 8 2
25
1. B . Musical dance floor
2 4 6 9 3
24
1. C . Lets play
3 7 7 8 8
33
1. D . Larger than life instrument
2 4 4 5 5
20
2. A . One man band
3 5 7 7 4
26
2. B . Composition instrument
2 4 6 6 3
21
2. C . Folk harp
6 4 7 6 5
28
2. D .stringed percussion
8 7 7 7 8
37
3. A .fluid filled instrument
7 5 4 5 4
25
3. B . String rhythm instrument
6 6 4 6 6
28
3. C. Elastic string instrument
7 5 3 5 6
26
3. D. Piston instrument
7 4 3 5 5
24

1. A . Musical canvas
1. D . Larger than life instrument
2. C . Folk harp
3. A .fluid filled instrument
2. A . One man band
2. D .stringed percussion
3. C. Elastic string instrument
3. B . String rhythm instrument
1. B . Musical dance floor
2. B . Composition instrument
1. C . Lets play

2. Stringed percussion: The concept and evolution

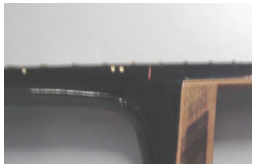
Stringed percussion- as name itself suggests, is a concept based on an idea where drum/ duff is played with string. Here vibration of the string also contributes in creating music, a tune.

Here I looked at two instruments, a simple duff and guitar. Duff is an instrument capable of creating rhythm and guitar play harmony, melody. Idea here is can there be an instrument that blends effect of these two instruments and creates a sound that is complete in itself.
As melody, harmony and rhythm played together.

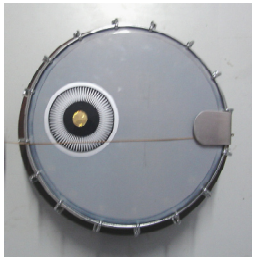


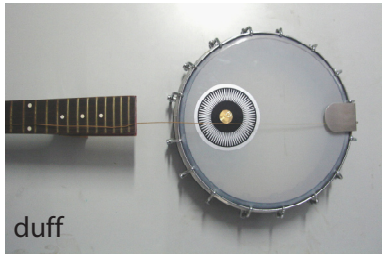
guitar fretboard

Duff is a rhythm instrument that is played by hand (fingers to tap and create rhythm). Other similar instruments like drum use sticks to play.
Guitar is played with plectrum usually or by fingers. in guitar sound box amplifies the vibrations of the strings. So as done in banjo I can blend duff and guitar.

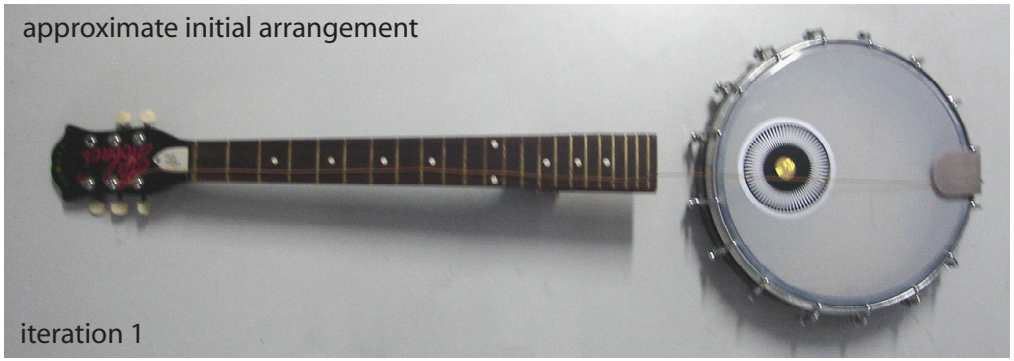


guitar fret board





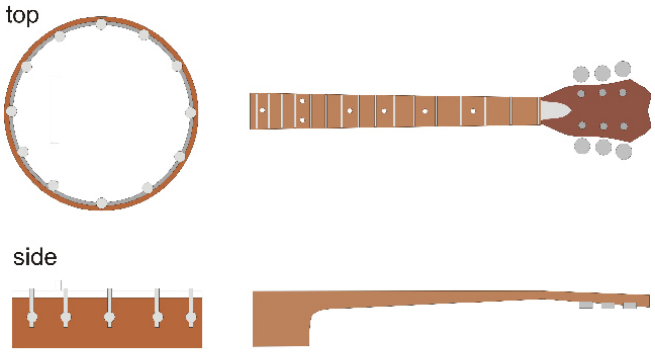
duff



approximate initial arrangement

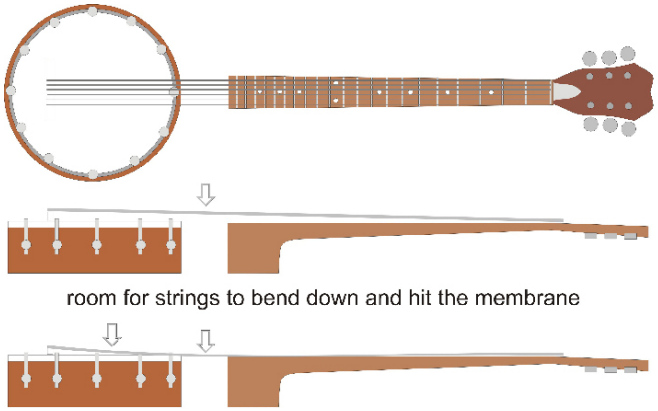
iteration 1

So approximate arrangement to start with is very much inspired by instrument- banjo:

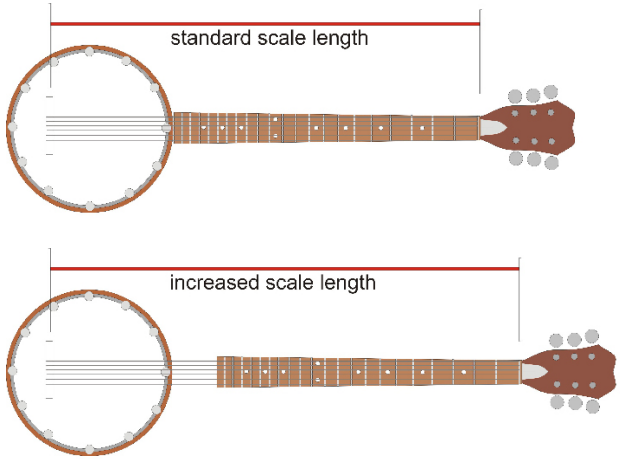


Iteration 1: arrangement

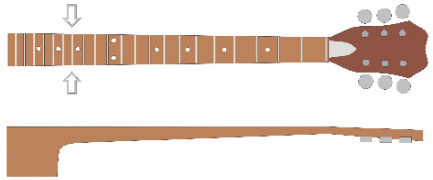
Unlike guitar, banjo here string has to make contact with the membrane of the duff so extra room must be provided. So fretboard has to be little away from the duff.



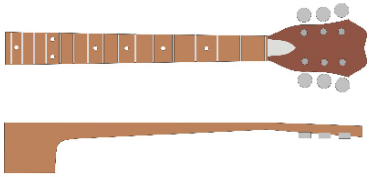
As scale length is increased now, guitar strings can't be comfortably used for the instrument as tension in the strings has to be increased to get the same standard tuning.



To avoid extra tension in the strings, to keep the scale length to standard comfortable length, fret board length adjustment is done.
End frets of the fret board are chopped off as they only contribute in creating high pitch melody, so are used less as compared to upper frets.

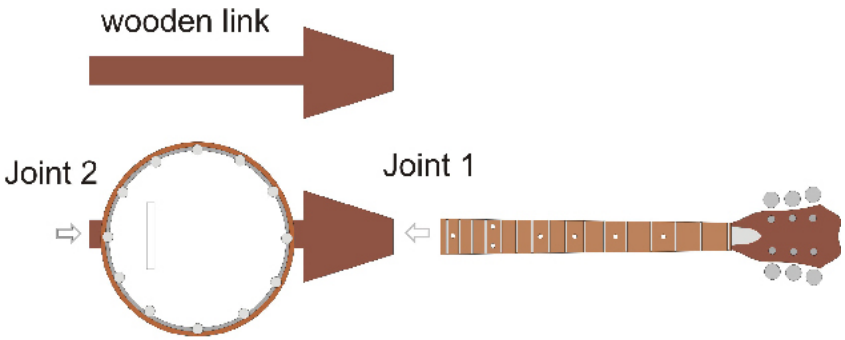


compensation for the fretboard length
to maintain the scale length



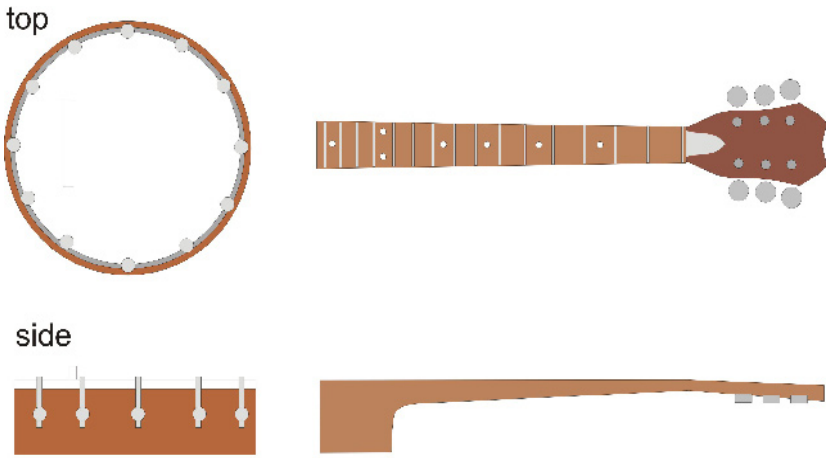
Short length fretboeard

After this the next thing is to decide overall structure of the instrument.
A wooden link that held together the fretboard and duff rim is added, this will also take care of tension due to strings and prevent bend.

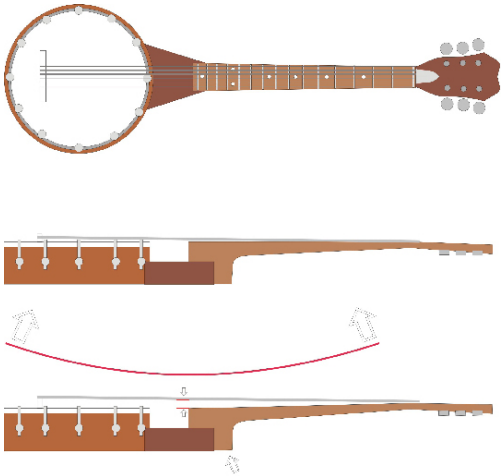


Iteration 1: construction

This is the approximate rendering of iteration1.



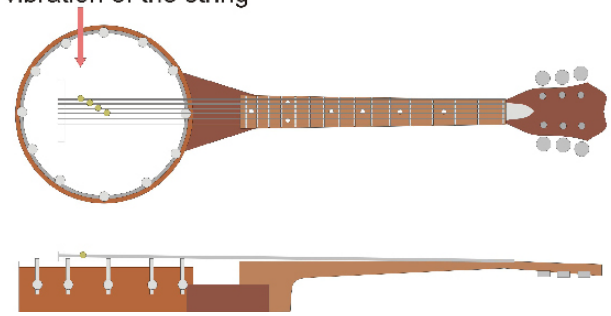
Strings once tuned are under large tension and this force acts on the structure of the instrument and it tends to bend a little bit. This increases the distance between fret board and the strings and it becomes difficult to play the instrument. Good quality wood and workmanship and design can take care of such issues.



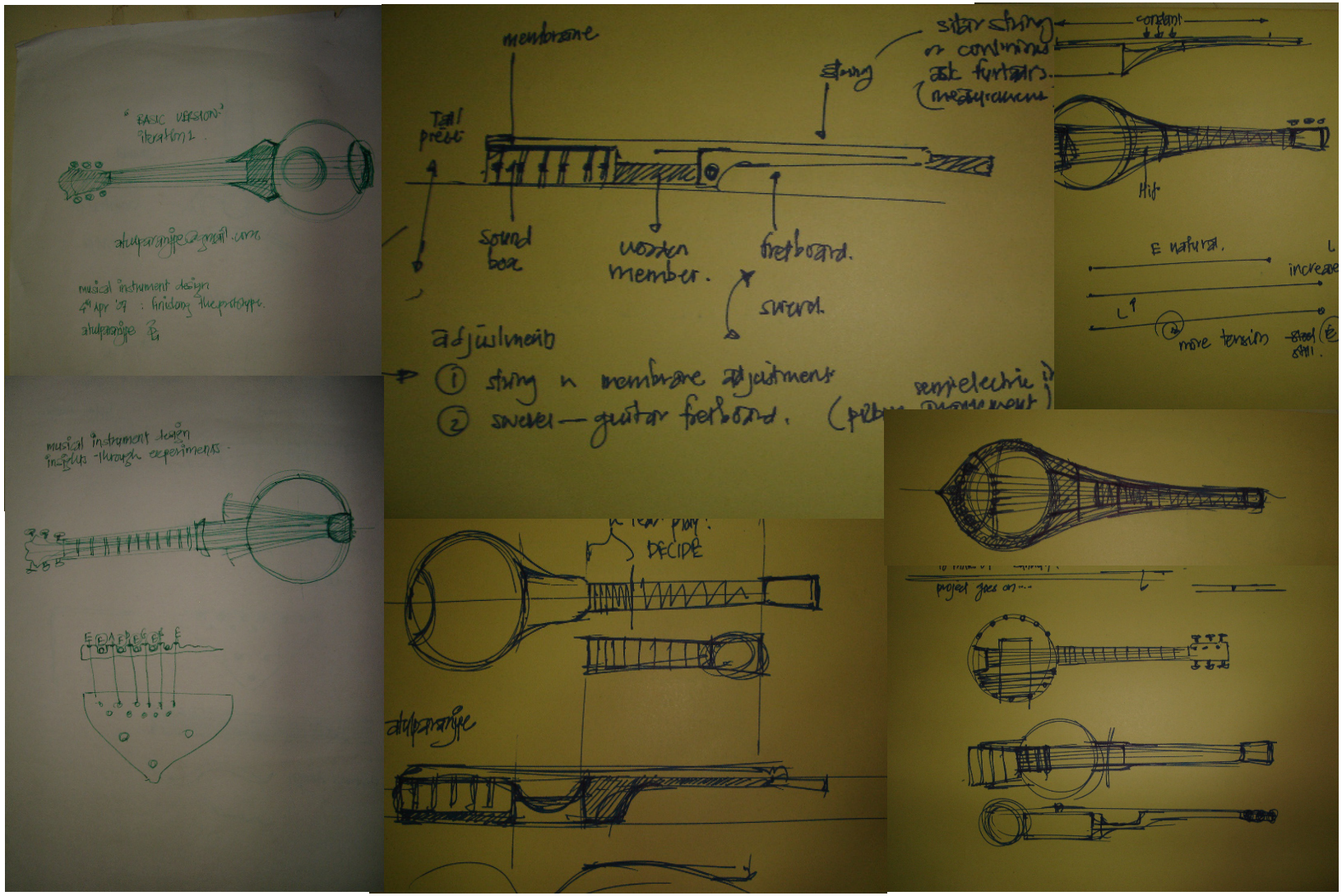
force on the structure due to tension in the strings

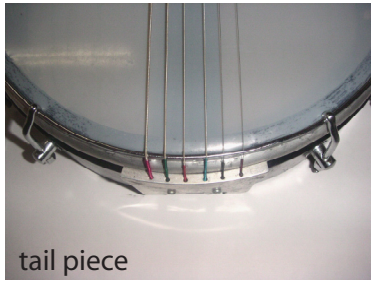
Creating rhythm simultaneously is the aim that makes instrument complete within itself. To achieve this clearance between strings and membrane of the duff has to be minimum and constant. But this creates difficulties in construction. To solve this problem beads are woven along the strings. Idea here is, when string will vibrate the beads will hit the membrane and create rhythm.

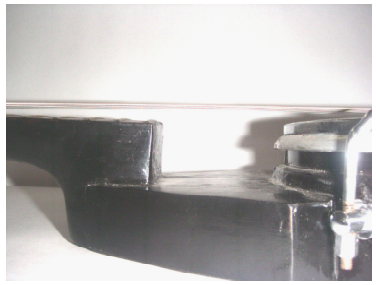
beads woven into strings those hit the membrane with vibration of the string



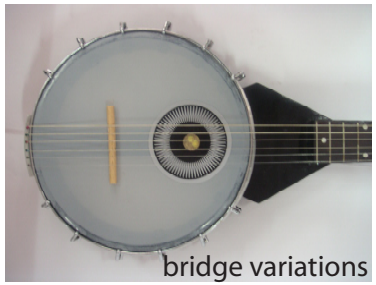
workshop sketches, rapid sketches



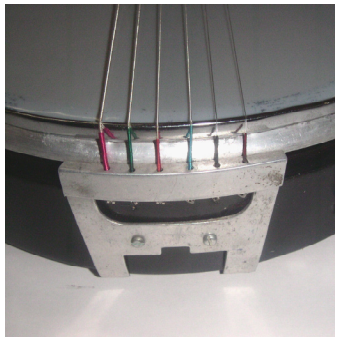

tail piece

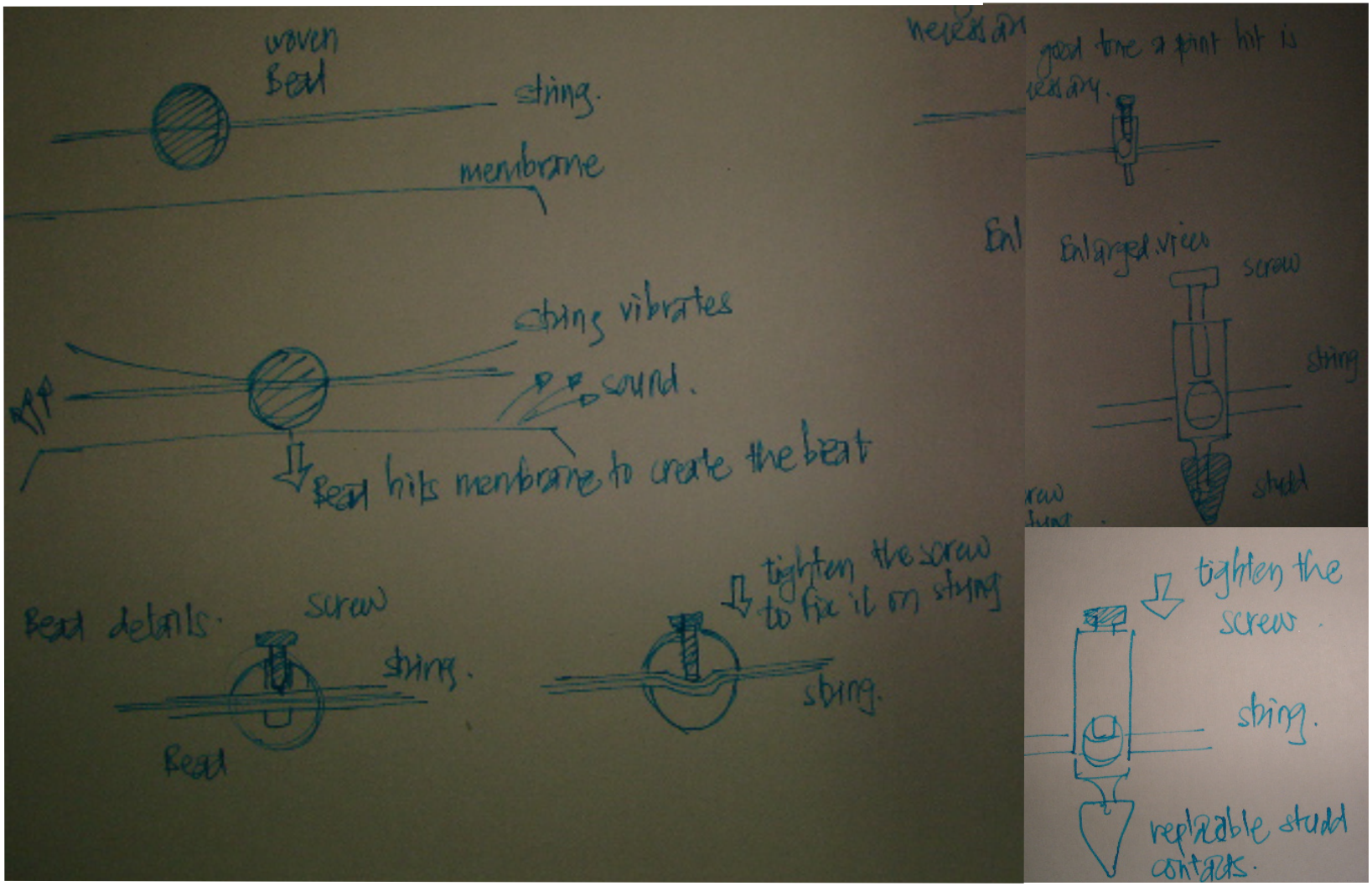



strings passing over
drum membrane


bridge variations

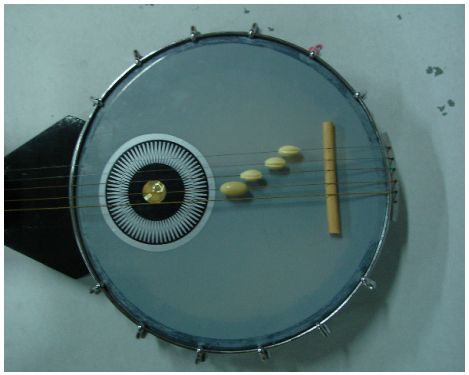
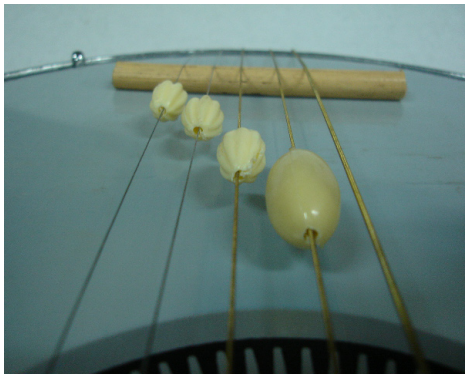
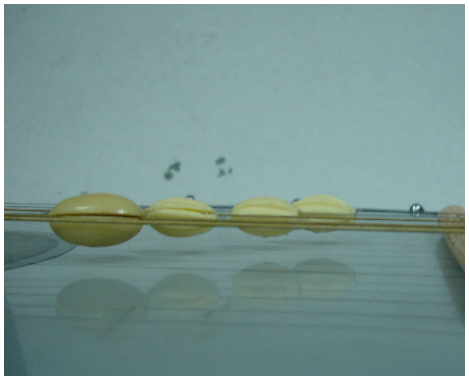

iteration 1



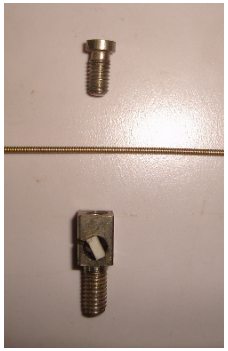
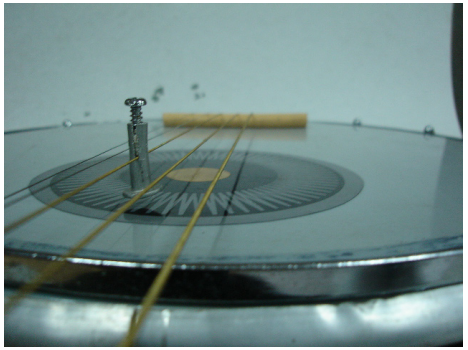
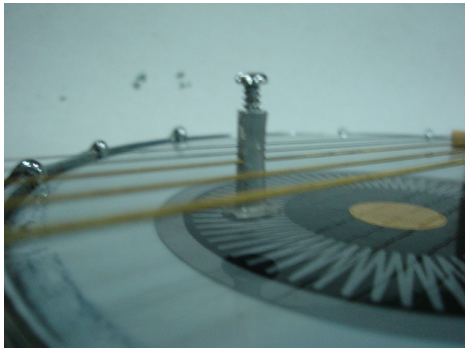

woven
Bead
string.
membrane
string vibrates
sound.
Bead hits membrane to create the beat
Bead details.
screw
string.
Bead
tighten the screw
to fix it on string
string.
Enlarged view
screw
string
stud
tighten the
screw.
string.
replacable stud
contacts.

Explorations, experiments with iteration 1 setup

Beads were woven into the strings, and as string vibrates beads touch the membrane to create beat. The problem here was , one end of the string should be open to weave a bead and the point of contact was not a point contact to get right tone.

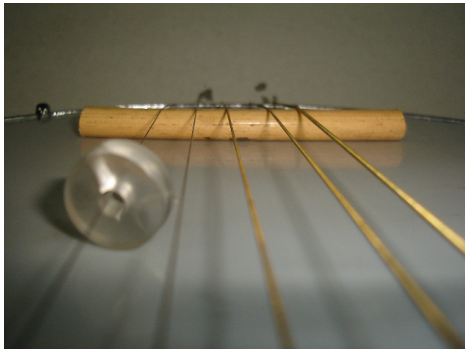
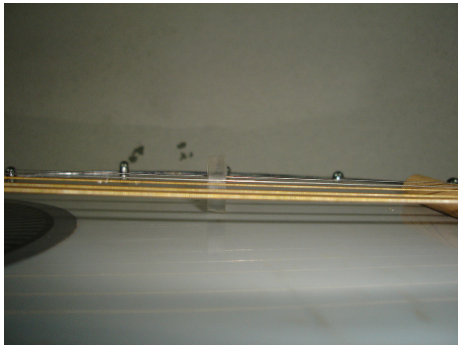
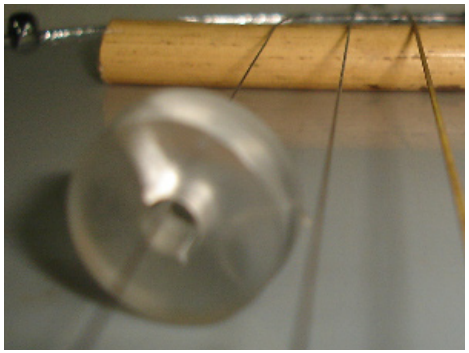




Here more mechanical arrangement was done where one can fix the contact element anywhere on the string and tighten it to be in that position. Height adjustment and nice tone can be achieved easily. Two variations were tried out, one with revette and screw and other with switch board nut. Both were successful but if membrane is goat skin the hitting contact element has to be of organic material like wood.

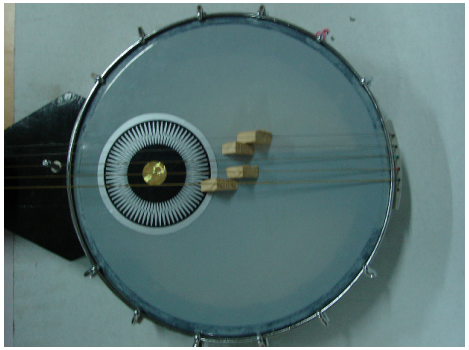





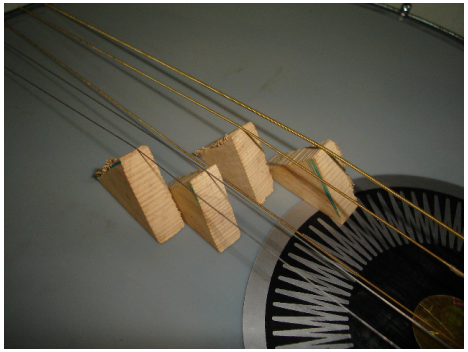
Explorations, experiments with iteration 1 setup

The washer was used as its more flexible material. It improved the overall tone of the sound but using available washers in the market was a constrain. If it is moulded specially for these strings then it will work fine.

Split bridge was used for individual string. The idea behind this was each string can transmit vibrations through individual bridge to create sound. Experiment was successfull but the output was varying and tone was not definite.

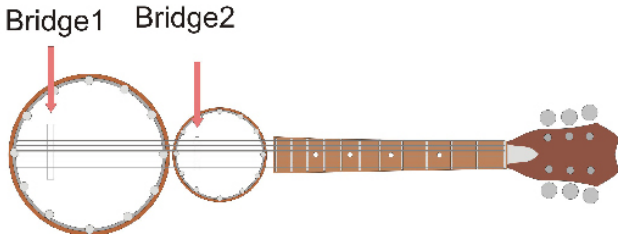




Real instrument is created to demonstrate and check the feasibility of design. Created model is studied in detail to understand problems, scope for betterment and related issues.

Variation in bridge position and beads helped triggering ideas for the improvement of the design.

Possibilities and changes for iteration2 are decided on this basis.

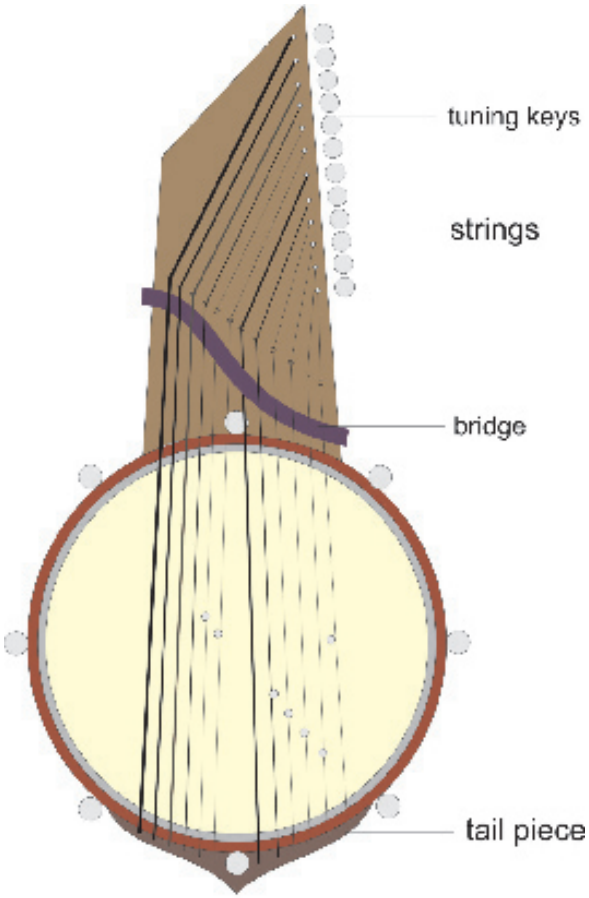


Iteration2

Iteration one helped understanding issues related to mechanical arrangement of the design. Iteration 2 is just the extension of that to test if its really workable. A mini instrument is planned to demonstrate experiments to understand minute scope for further improvement.

A small drum and a fret board is used to construct the instrument. Drum has got goat skin unlike iteration1 to test the difference in the tone of the instrument.

Iteration 3:



This approximate final instrument. Further work about detailing of the instrument is being done.

Detailing includes following:

About deciding appropriate form

Number of strings

String tuning

Bridge placement

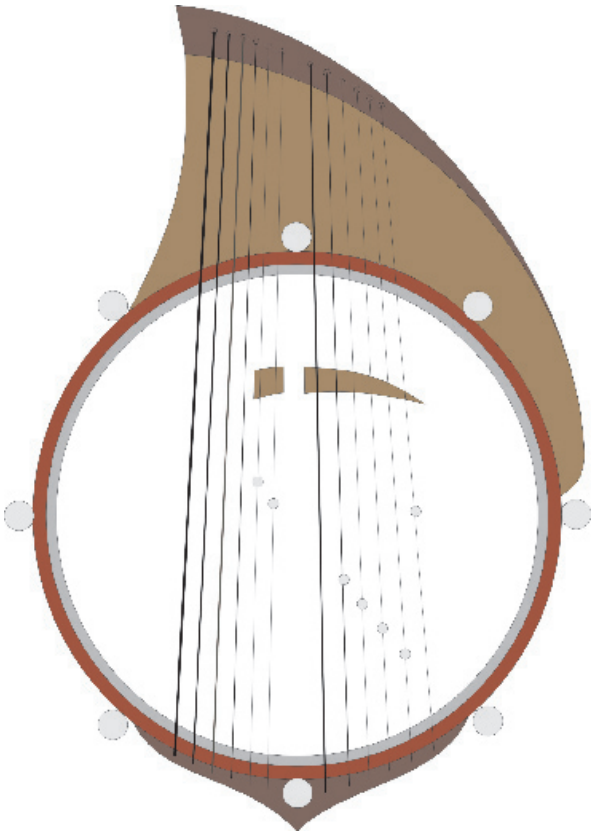
Tail peice detailing

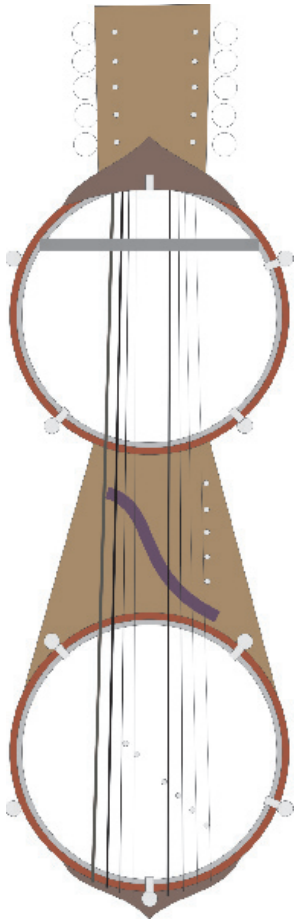
Size and dimensions of the instrument

Various parts and materials used

These details and the documentation of the final concept will be added to the report once they are documented.

Possible options:





4. Future scope:

The phase where I have reached now is just the beginning in broad sense. I have definite idea about the instrument; I can dream about it and understood how it can be possible reality. I need to emphasis on interaction domain and various different ways and arrangement of the components to make it more complete and minimalist.

Further progress should introduce the sense and qualities of a matured instrument.
Extreme refinement and optimized design should be attained.

Musical details:

This area has major scope about defining the spectrum of the instrument. Details like number of string and their tuning has wide possibilities those will depend on type of music, purpose and skill set of the performer. Though there has to be definite versions of the instrument those can be customized to minor changes.

About experimenting with materials:

As basic approach revolves around making an acoustic instrument wood has the best qualities required, hence the first benchmark would be to make it all refined with wood.

Conclusion

The musical instrument design is meaningful learning experience where after an attempt towards completing it I find myself someone who can understand whole spectrum about evolution and process behind musical instrument design.(and design that lives forever)

Musical instruments evolve through centuries, Sarod is considered to be youngest instrument who has evolution history of about 200 years. Each iteration on its way of evolution progresses minutely and silently towards refinement. Through this project I explored the root over which further research becomes more meaningful and can lead towards possibility of stand alone instrument thats complete in itself.

Musical instrument has its own stance and identity that blends design and art like a magic. Musical instruement becomes more than just a physical form or object, it speaks, interacts and takes seamless position in our life.

Being design student I am familiar with the design process that applies to most of the design problems., but musical instrument design project made me understand about process that is very indirect but profound. I felt like getting introduced to design at much bigger level and this unknowingly changed the way I looked at it.

Design is an activity that is more about coming up with the final refined product but through this project I feel even every step while moving towards better, is equally valuable. Some of the ideas those hit my mind are exciting enough to cheer up myself to keep the interest and faith towards project and design studies.

I can surely conclude stating, design for me is THE JOURNEY thats routed by undefined process and that sail us towards BETTER.

Bibiliography

For images and understanding concepts

http://www.oddmusic.com
http://www.guitarmachine.com
http://www.pyrocussion.com
http://en.wikipedia.org
http://www.windworld.com/
http://staff.tamhigh.org/lapp/studentproject.HTM
http://en.wikipedia.org/wiki/Musical_instrument
http://web.media.mit.edu/~vigoda/pemi/pemi.html
http://www.tidewater.net
http://www.furious.com/perfect/emi/expmusicalinstr.html
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http://www.indianmusicals.com/
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