Supporting ‘Learning to Sing’

Interaction Design, Design Project Stage I
IDC, IIT Bombay

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Approval Sheet

The Interaction Design Project II titled "Supporting 'Learning to Sing'" by Mr. Mandar N. Sarnaik, Roll no. 08633002 is approved in partial fulfillment of the requirement for the Master of Design degree in Interaction Design.

Signatures:

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Chairperson _____

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Abstract

Hindustani Classical is a great style of singing and has been codified to extreme details and is a science and art in itself.

This project aims at supporting the process of learning to sing (Hindustani Classical vocals) in cases where the students do not get to spend more time with the Guru. The long gaps between classes and no personal guidance during individual singing practice being a major problem.
By processing an individual's singing using digital signal processing, feedback can be given on the pitch, timing and energy of singing. These parameters are the digital counterparts of Swar (notes), Taal and Laya (beats and rhythm), etc. terms in classical singing respectively.

Design challenges like the acceptance and application of such an idea in the lives of the Guru and the students, an interface, ways to give feedback, have been attempted in this project. Through a combined effect of audio, text notations and real-time data visualisation, an attempt has been made to help a user understand the nuances of his own singing which when juxtaposed against a reference can help a great deal in correction by comparison.

The project also aims at helping potentially good singers and aspirants who have never been to a class to discover and appreciate classical singing and probably in future, join a class.

Acknowledgements

I am extremely thankful to my guide Prof. Ravi Poovaiah for his constant encouragement and for guiding me through the project. His resourcefulness and insights have been very useful.

I would also like to thank Prof. C. P. Narayan, IDC, IIT B for his directions and eye openers during the formative stages of this project.
I am thankful to Prof. Milind Malshe, HSS Dept., IIT B for giving his time in understanding my intent and then guiding me on conducting the background studies.
The technology aspects (the assurance that such a project could be implemented) would not have been clear without the able guidance of Prof. Preeti Rao, Electrical Dept., IIT B.

My Guru, Miss. Shweta Jog has been ever encouraging. I shall always be indebted to her for all her open-minded considerations and insights.
I would also like to thank Mr. Kiran Vyas from Vyas Sangit Vidyalay, Vile Parle (E), Mumbai for allowing me to conduct observations in their classrooms.

Last but not the least, I would like to extend my regards to all the artists and people whom I interviewed and received great knowledge and insights from.

Contents

Introduction

Music is interwoven in the fabric of life. Whether we listen, practice music consciously or subconsciously, we seem to have an instinctive liking for it.

Singing is an activity that many of us like. We may not specifically make a conscious attempt to sing but mostly we do it as candid acts – humming, recalling songs in our mind, singing them when we are alone or with our companions, etc. Most sing for personal joy and expression.

Out of the general population, many people might have a potential liking for singing and would like to learn how to sing. Some people might want to sing well but do not know what's going wrong. In many such cases, learning basic classical music would help.

This project aims at supporting the process of learning to sing (Hindustani Classical vocals) in cases where the students do not get to spend more time with the Guru. The long gaps between classes and no personal guidance during individual singing practice being a major problem.
The project also aims at helping potentially good singers and aspirants who have never been to a class to discover and appreciate classical singing and probably in future, join a class.

Project Need

The first inspiration for starting with this topic was my personal experience. I like to sing and had been singing in school, college events to a fair degree of success. I knew that to polish and develop the singing skills, knowledge and practice of classical singing is essential. However, I never did join a class. There was nothing holding me from joining a class apart from trivial reasons like a demanding academic schedule, non-availability of a known Guru nearby, procrastination, etc.

I have also observed that most people can find what's wrong when someone else is singing but cannot appreciate what's good about the singing or the song. Also when it comes to analysing their own singing, many people don't/cannot find mistakes; and if one does find a wrong area, it's difficult to tell why something is wrong.

To find out the exact reasons why people who like to sing do not join classes, and to validate the above hypothesis, some interviews were conducted.

Four people having interest in singing were interviewed. Two of them had never joined a class and the other two were singing class drop-outs.

The major findings from these interviews are as follows:

1. People have do not have an appreciation of the structure of classical music.
2. The fact that film/popular music is based on classical music is not obvious.
3. The various reasons why people do not join classes or drop out are:

    - Academic pressure (especially during high-school)
    - Hectic Work Schedules (tired due to work)
    - Finding a *Guru*
    - Travelling
    - Money (hesitation to invest since it is not a full time occupation)
    - Regularity (no surety of being regular)
    - Inhibitions (Age – 'I'm too old now', Shyness, etc.)
    - Procrastination

4. Motivation levels in people vary from being motivated – partly motivated – to being de-motivated (inhibitions, low self-confidence).

(A sample excerpt of one of these interviews can be referred in Appendix - I.)

Basic Intent – Idea

Apart from an actual class where a Guru teaches students to sing, the present media that exists includes text books, audio cassettes or CDs, videos, tutorials on the internet e.g. on YouTube, etc.

All these media give an idea of what and how to sing to a fair degree. One can follow the singing and recite it. However, all these media are passive; they have no role in the way a listener recites or sings while using these.

What happens in a music class is different. The Guru sings and pupils follow. In case a pupil is wrong, the Guru **corrects** him/her by pointing out the mistake.

Feedback which forms the crux of teaching to sing, is missing in the existing popular media.

Thus, the major intent in this project is to introduce feedback to a user's singing and help him/her analyse his own singing through various methods of visualisation and comparison.

Basic Study

To begin with the project it was very much essential to learn some things about Hindustani classical music. These would be prerequisites in moving ahead with the project.

Also, knowledge of the existing interactive media available and the technical dimension of singing was very essential.

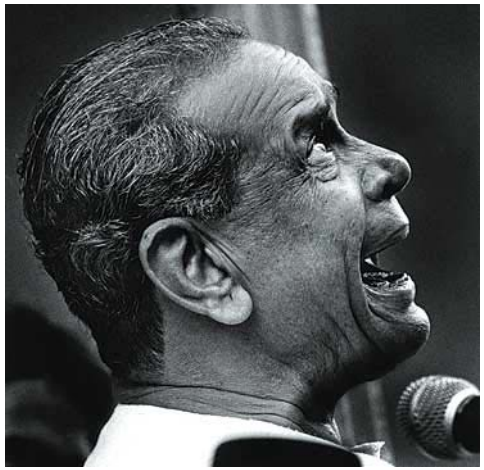
Following sections elaborate the ground research done in order to move ahead with the project.

Structure of Indian classical music

I have been learning Hindustani classical music since last 6 months. A basic understanding of the various parameters and the various constructs like the Rag, etc. have been studied.

Expert insight into the structure of classical music was gained by reading books; some of which included:

- 'Nad – Understanding Rag Music' by Sandeep Bagchi,
- 'Bhartiya Sangit ka Itihaas' by Ram Avtar Veer,
- Bhartiya Sangit Paddhati – Kramik Malika – 1' by Pt. Vishnunarayan Bhatkhande.



Exhaustive reading of these books gave an insight into the development and the elements of classical music. Later on, while conducting contextual inquiries, a lot of understanding of the pedagogy and the gradual methods of teaching classical singing was developed.

It would require volumes to describe the structure of classical music. However, a very concise description has been presented below.

Indian Classical music is highly developed and codified. It is classified into two types: Carnatic music and Hindustani classical music. The original and sole form was Carnatic; with the Mughal influence in the north during the last millennium, modifications occurred in the rendition styles etc. This new form became known as Hindustani Classical music (seldom referred to as north Indian classical music also). However, the fundamentals of both the styles are same.

A major distinction between Indian classical and western classical is that it is melodic as against being harmonic. This way, all supporting musical instruments and singing goes on in the same fashion – following the same notes and rhythm.

Just to mention a few, the basic elements of singing are:

Swar (Notes of specific frequencies, viz. Sa, Re, Ga, Ma, Pa, Dha, Ni. Apart from these seven major notes called the *shuddha* i.e. pure Swar, there are intermediate notes like *komal* i.e. soft Re Dha Ni and *teevra* i.e. intense Ma)

Saptak (a set of the seven major notes in progression)

Taal (The beats that form the temporal base of singing; mostly a percussion instrument like Tabla is used to produce these beats. A recurring rhythmic pattern of beats determines the start and pauses in singing.)

Laya (Tempo of Taal and the rate of flow of phrases)

Alankar (A combination of various Swar to be sung to improve the mastery over Swar and tempo)

Raag (A construct – a set of rules; only a few selected Swar are allowed to be sung within each particular Rag. However, enormous number of possibilities exists within the rules to make compositions. Each Rag has its own characteristic elements that make it distinct from other Rag. Also, the specific combinations induce distinct moods and emotions known as Ras i.e. emotions.)

These are not even 1% of the terms and fundamentals of Indian classical music. It is not claimed to deliver complete knowledge of Indian classical music in this report.

How is classical music taught?

To better understand the way classical music is taught, it was essential to get contextual insights into the actual process. For this purpose, contextual interviews and observing the music classes was undertaken.

Observations were conducted at three different music classes and students of various ages and at various levels on the learning curve were observed. The interactions between the Guru and the students were studied for gaining insights and learning problem areas, etc.

Apart from the observing classes, contextual inquiry was also conducted. It was an attempt to gain inputs from various points of view of:

- Aspirants
- Novices
- Advanced beginners
- Experts and practitioners
- Teachers

The focus of study w.r.t. to the above categories is as follows:

Aspirants were interviewed to know:

- Why do people not join / drop-out from classes?
- What are the individual objectives and expectations from a class?

- What are the motivators?
- What are the inhibitions (if any)?

Learners were interviewed to know:

- Their general idea of starting age and its effects.
- Their learning curve and the way they were taught.
- What areas do they consider as important.
- How would they teach?
- Problems faced by them during any stage of learning.
- How do they practice – Riyaz.

Teachers and experts were interviewed to know:

- The pedagogy they follow.
- The actual teaching methods they employ and the rationale behind them.
- Are there any alternative approaches to teaching singing?
- How does class-dynamics i.e. variety in the ages, gender, knowledge levels and grasping levels of pupils affect the teaching methods?
- What are the very basics and essentials of classical singing?
- Are there any communication gaps?
- What instruments/media do they use?
- When and what homework do they prescribe?

User no.	Age	Gender	Occupation	Category	Experience
U1	23	Male	PG student	Aspirant	
U2	23	Female	PG student	Drop-out / Aspirant	
U3	24	Female	Architect	Learning singing	4.5 yrs
U4	22	Male	B.Tech.	Learning singing	14 yrs
U5	24	Female	PG student	Learning singing	10 yrs
U6	22	Male	B.Tech.	Learning singing	8 yrs
U7	22	Female	B.E.	Learning singing	8 yrs
U9	26	Male	PhD. Student	Learning singing	14 yrs
U10	45-50	Male	Artist (TOI)	Teaching Alternate	20 yrs
U11	45-50	Male	Creative director	Expert	20 yrs
U12	55-60	Male	Professor	Expert	30 yrs
U13	27	Female	PhD. (Light music)	Expert	15 yrs

Table 1: Interviewees during contextual inquiry

Table no.1 shows the list of individuals with whom contextual inquiry was carried out. (A sample excerpt of one of these interviews can be referred in Appendix - II.)

Findings

In relation to the focus for conducting contextual inquiry, the following are the insights and problems noted.

The bullets help distinguish the insights and problems as:

- Insights
- Problems

Why do people not join / drop-out from classes?

- A music/singing culture at home is a major factor inducing interest in an individual.
- Classical music is generally less glamorous due to the lack of appreciation and knowledge of its concept model and structure.
- Many people do not realise that popular music is also based on classical music.
- Most people do not have a clear idea of what they would learn in a singing class.

- At a young age, most people are interested in learning musical instruments.
- Less immediate gratification or benefits e.g. learning a guitar for even 2 months lets you play certain songs giving you a sense of gratification and satisfaction. However, it's difficult to say so about classical singing.
- Personal inhibitions like age, shyness, low self-confidence also hold back many people from starting.
- While singing popular songs is enjoyable, many individuals are not able to imagine classical singing as an enjoyable vocation.
- Practical problems like money, time, travelling, company in class, etc. become a pretext for not joining a class for less motivated individuals.

Views of learners

- It's ideal that a child learns to sing and progresses. But it's relatively easier to teach a grown up (above 12-14 yrs).
- Grownups not only learn but can apply concepts easily. Also, their ability to read/write, encode-decode helps.
- Singing classes tend to get boring at the beginning stages for small children (till about 13-14 yrs).
- Basics cannot be skipped and tend to get routine. Many learners said that at the beginning they were clueless about what and why they were learning.

- Showing the final outcome and usefulness of the learning process helps in motivating the students.
- Immediate results like 'a public performance' require a certain time. Many learners said that they expected songs to be taught to them so that they could perform.

Views of teachers

- Listening is more important before starting to sing.
- Supplementing the Guru's voice, additional references like the Harmonium, Tabla, Tanpura are very helpful.
- Beginners are discouraged from making hand/body gestures . They should follow designed gestures .
- No Riyaz is recommended for begineers because it's difficult to unlearn any wrong practice internalized by an individual.
- Rote learning is essential but makes the process less interesting for students.
- Small children do not read/write Devnagari; notations are useless.
- Small children are taught Swar etc. using finger counting etc.
- Guru-shishya parampara , One to one teaching is the best way to teach.
- Batch strength, age distribution of pupils, girls and boys, individual talent and shortcomings, are to be considered while teaching a class.

There are many schools of thought which concentrate either on exams or on practical-performance evaluation or casual singing without any exams.

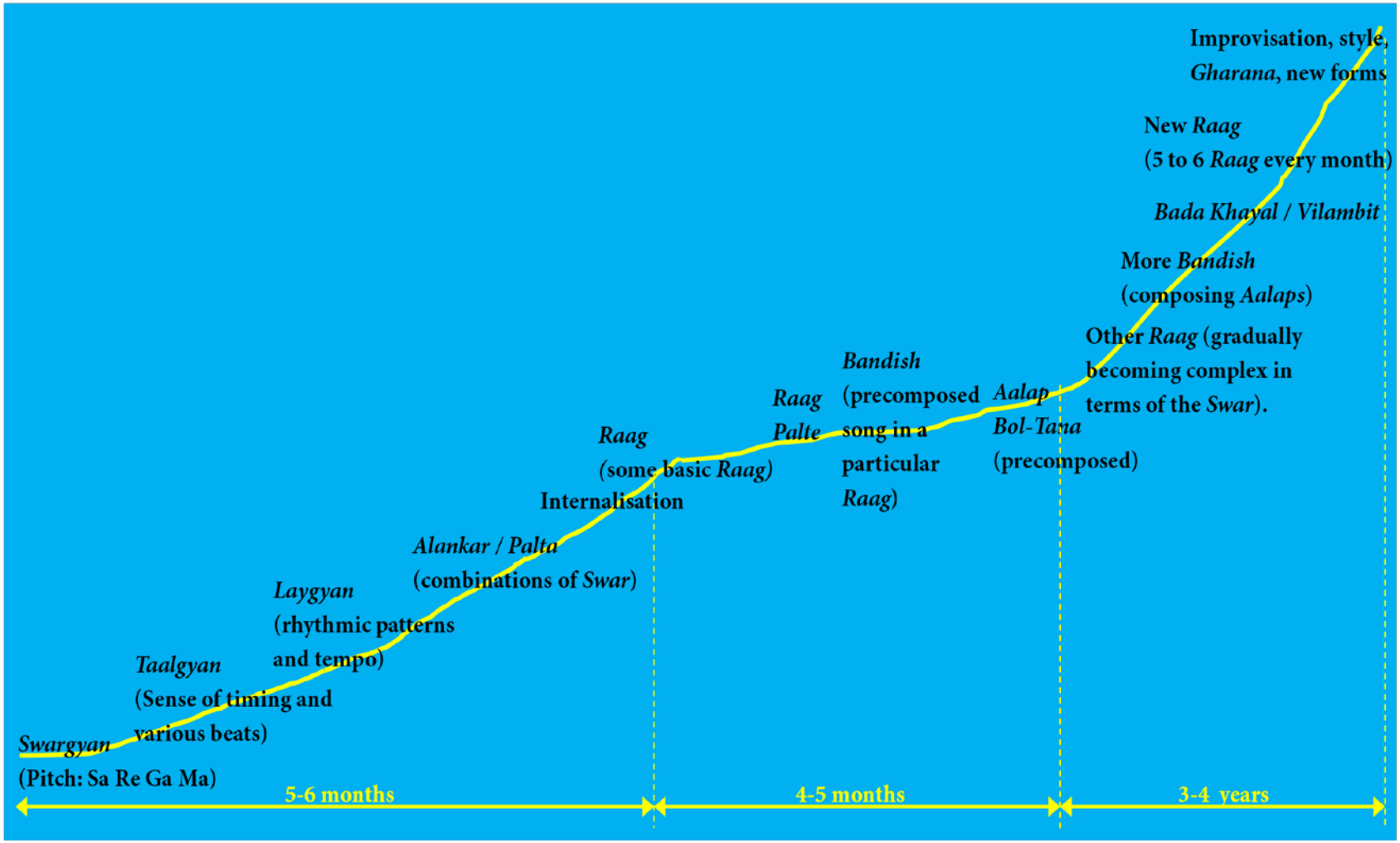


Figure 1: Typical learning curve (classical singing)

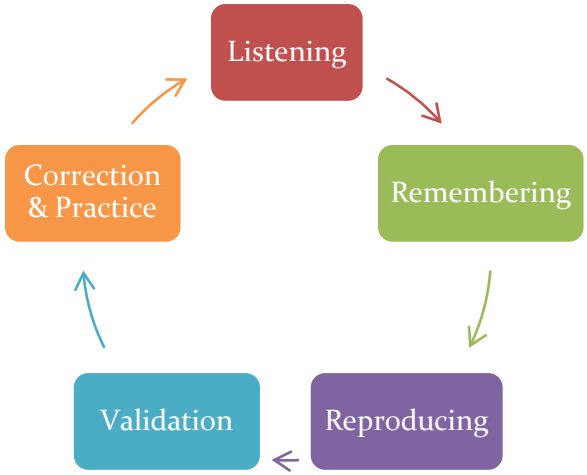


Figure 2: Cognitive processes while learning to sing

Cognitive processes involved

The general process that occurs in a classroom while teaching singing is as follows:

- Listening *to the Guru*
- Remembering (memory -- signature of a sound, temporal sense)
- Reproducing (Control over body – posture, vocal chords, breathing)
- Validation *by the Guru* (assisting comparison with the reference – pointing out mistakes – corrective measures)
- Correction (Reproducing the sounds, training the body)
- Validation *by the Guru*
- Practice

The process is like a closed loop where there is constant correction based on the feedback from the Guru *(Fig. 1)*.

Digital Counterparts of Parameters used in Classical Singing

Parameter	Digital counterpart
Swar	Pitch (frequency)
Taal	Beats (timed set of repeating sounds)
Laya	Rhythm (speed of singing based on beats)
Loudness	Amplitude of waveform (dB level)
Saptak	Octaves and harmonics

Table 2.: Digital counterparts of classical singing parameters

The basic parameters essential for evaluating a singing performance can be associated with their digital counterparts as shown in *Table 2*.

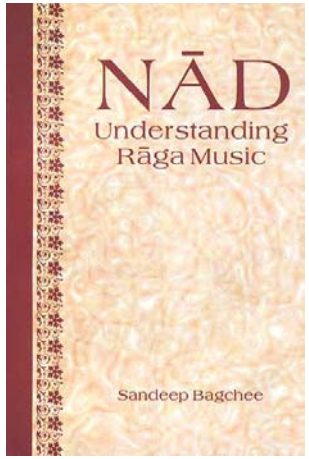
These are the major parameters that can be treated objectively.

Other parameters like emotions, moods, throw etc. are subjective. Also, sound quality is a very complex digital entity called Timbre which becomes difficult to process digitally and be used for comparisons etc.

Thus when we go about building a system that can give feedback, it can deal only with objective and measurable parameters.

Hence, the importance of a Guru – a learned human touch is undisputed.

Figure 3: Pandit Vishnunarayan Bhatkhande



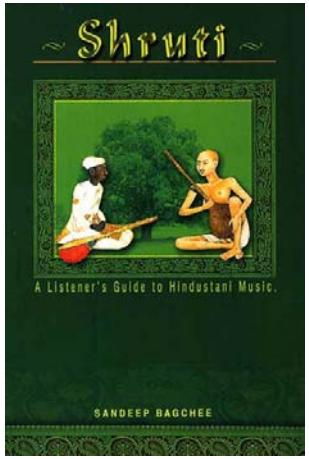


Figure 4: Books by Sandeep Bagchi

Technology and media research

The present popular media related to singing are:

- Books and internet resources(explaining the theory and practices)
- Audio CDs (which one can listen and practice)
- Video recordings / YouTube.com (audio-visual medium)

Some examples:

There are innumerable books available for learning the history, structure and traditions in Hindustani Classical music. Just to mention a few…

There is an entire series of books by Pt. Vishnunarayan Bhatkhande on how to teach Hindustani Classical singing. This series is named:

- Hindustani Sangit – Paddhati | Kramik Pustak Malikaa (Part 1 to 6)

- Publications by the Akhil Bhartiya Gandharva Mahavidyalay

- Nad – Understanding Raga Music, Sandeep Bagchi
- Shruti – A listeners guide, Hindustani Music, Sandeep Bagchi

Aalap – an audio series on Indian music, Times group.

Figure 5: www.parrikar.org

Figure 6: www.shadjamadhyam.com

Although there exist very nicely structured tutorials belonging to the above media, the basic need for feedback is not satisfied.

There are attempts to have online classrooms where a Guru and student are in conference and teaching-learning takes place. This is a good solution but with limitations like:

- Need for the Guru and the student to be available at the same time. In cases where a student is abroad, it sometimes might become difficult for the Guru to catch up with the time difference of night and day.
- Requirement of high speed internet connectivity.
- Voice quality over the internet.
- Costs involved.

Some examples:

http://www.parrikar.org/ (referral date: 10 Nov 2009)

A huge collection of information, write-ups, musical performances by great artists, photographs, etc., this site by Rajan Parrikar is a gift.

http://www.shadjamadhyam.com/ (referral date: 10 Nov 2009)

This is a virtual gurukul for learning Hindustani Classical Music (Vocal & Instrumental) from the renowned Gurus. Users can sign up to take lessons through reliable multimedia technology simulating a "Virtual Classroom" experience.

Figure 7: www.ee.iitb.ac.in/daplab/index.html

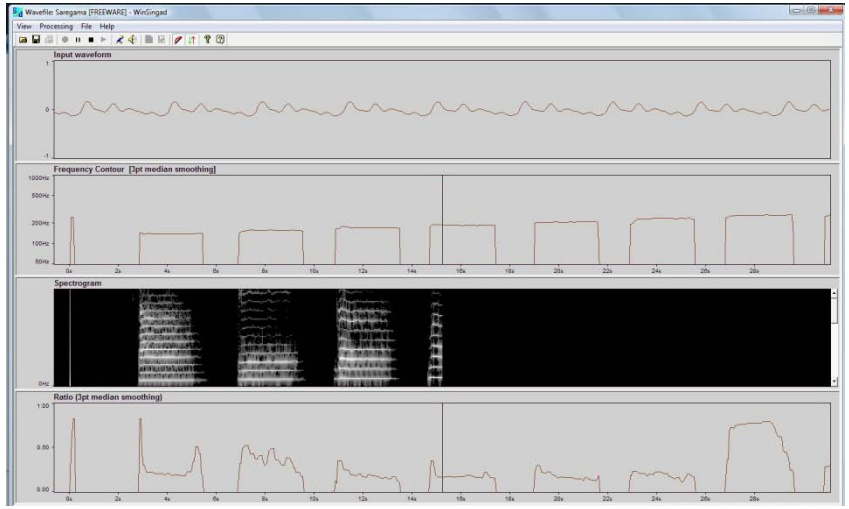


Figure 8: WinSingAD interface

Sound processing becomes the cornerstone of applications like the one proposed herein order to be able to give feedback on someone's singing.

The general domain under which the technical backend of such an interface would fall is Digital Signal Processing. In this case the signals are audio signals.

A lot of research is going on in this field and many universities have developed software that is capable of sound processing.

Some examples:

DAPLAB, IIT Bombay

http://www.ee.iitb.ac.in/daplab/index.html (referral date: 10 Nov 2009)

The Digital Audio Processing lab is a signal processing research facility dedicated to speech and audio processing applications. "Query-By-Humming" (QBH) music indexing and retrieval system "**TANSEN**" is based on melody, for retrieval of songs from a database of popular Hindi film music.

WinSing AD
http://www.winsingad.org/ (referral date: 10 Nov 2009)

WinSingad is software for use in singing lessons to provide visual feedback to support the teacher and student as they work on various aspects of singing.

However, the interface tends to be more scientific.

Figure 9: UltraStar startup screen

Figure 10: UltraStar inteface, playing 'Summer of '69', Bryan Adams

UltraStar

UltraStar is a clone of SingStar, a music video game.

UltraStar lets one or several players score points by singing along to a song or music video and match the pitch of the original song well. The interface displays lyrics as well as the correct notes similar to a piano roll. On top of the correct notes, the pitch recorded from the players is displayed. UltraStar allows several people to play simultaneously by connecting several microphones possibly to several sound cards.

To add new songs to UltraStar, a text file having codes of each pitch variation and its associated lyrics is required. Generating such files requires a pre-knowledge of how UltraStar works and a lot of information on how pitch values are designated specific numbers (as in midi format). An automated tool to do this was not found.

The pitch detection is not very accurate and it doesn't support multiple simultaneous tones detection.

A sample text file for the song: 'Summer of '69' by Bryan Adams is attached for reference in Appendix X.

Figure 11: Karaoke Party interface

Karaoke Party

http://www.karaokeparty.com/ (referral date: 10 Nov 2009)

Karaoke Party is an online resource to play by singing a song and getting judged.

A player is judged based on his/her matching the timing and notes. The pitch and timing of notes is displayed on screen and a moving cursor shows us when a line is to be started. The lyrics keep scrolling up as the song progresses.

Quite similar to UltraStar (described previously), a player is scored based on his/her matching the notes with correct timing.

Figure 12: CNMAT at UC Berkeley

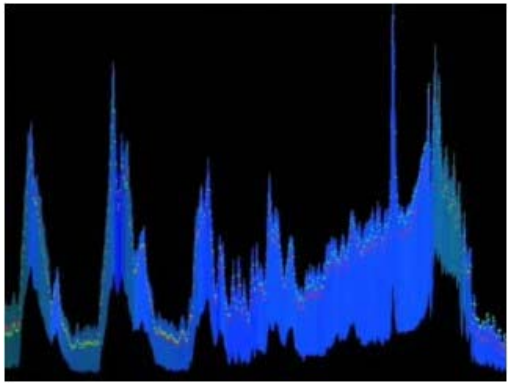


Figure 13: Timbre visualisation (CNMAT)

CNMAT

http://cnmat.berkeley.edu/ (referral date: 10 Nov 2009)

The UC Berkeley Center for New Music and Audio Technologies (CNMAT) was conceived and established by composer and Professor Emeritus Richard Felciano in the late 1980s — the operating budget officially commenced on July 1, 1989. CNMAT houses a dynamic group of educational, performance and research programs focused on the creative interaction between music and technology. CNMAT's research program is highly interdisciplinary, linking all of UC Berkeley's disciplines dedicated to the study or creative use of sound (such as music, architecture, mathematics, statistics, mechanical engineering, computer science, electrical engineering, psychology, physics, space sciences, the Center for New Media, and the Department of Theater, Dance, and Performance Studies).

Technical papers

A lot of technical research has been going on the field of audio signal processing. Some published papers which have been referred are included in the Bibliography section towards the end.

Constraints

In order to move ahead with the project and form a design brief, it is very essential to consider the possible constraints in the way.

- Social acceptance of such a system is very crucial.
- There are limitations to how much one can learn from a system.
- Fuzzy parameters like emotions, voice quality, throw, etc. cannot be taken care of by a system.
- The feel, knowledge and warmth of a Guru cannot be recreated.
- A user may not show the same discipline while using a system as he/she would, while attending a class.
- Evaluating and verifying the user's progress is another difficult task for a system to perform.

These constraints, the basic research done and based on the guidance of the project guide, it became clear that it's impossible to teach singing without a guru. Hence, it would be nice to think about a *system* that would support the teaching-learning process in stages when the interaction between the Guru and the student is limited.

Design Brief

Designing a system for supporting the process of learning to sing (Hindustani Classical), that will:

- Help bridge the gaps between the Guru and students when they are not together or when they spent very less time together
- Be an offline link between the Guru and the students by facilitating creation of personalized tutorials (by the Guru) and a consequent review (of the student) provisions
- Provide feedback to beginners in an easy to understand way and point out fundamental mistakes in singing by comparison with a reference (audio or notations)
- Cater to the self-study and practice regimes of advanced learners and facilitate creative improvisation experiments, trials and practice.
- Induce appreciation and understanding of classical music in the minds of aspirants and potentially good singers (It is not recommended to use such a system for children for getting them started with singing. It is best for them to join classes.)
- Have minimum hardware requirements and be installable on existing devices so as to be affordable to all individuals.

A relook at classroom teaching (singing)

As the design now tends to involve the Guru also, it was essential to look at singing classrooms more carefully and closely.

Fresh observations were done at Vyas Sangit Vidyalay, Vile Parle – East, Mumbai (also, relevant observations from the audio recordings of music classes attended by myself were noted).

Different age groups at the primary level of singing education were observed.

Adults (20 to 45 yrs)

- The students were constantly kept on their toes by asking random question and trivia.
- Most students recorded the classroom sessions on their walkman / mp3 players.
- The students were trained to strictly follow hierarchy and formats even while answering a question or describing and reciting a concept. Thus the students knew everything by-heart and never lost any information.
- However this did tend to make things boring and mechanical.
- A typical class consisted of 10 to 12 students and during some instances, the Guru (a veteran of about 45-50 years) identified a wrong note in the group singing. However it

took time to find out the exact culprit and what the mistake exactly was.
- A lot of stress was given on hand-gestures to keep track of the Taal.
- The general way of teaching was: Singing aloud – stopping when wrong – correction by asking the students to follow the Guru and repeating after the Guru – continuing to sing.
- Each student had handwritten notes. A few kept on referring to the notations.
- Accompaniment was provided by the Guru on harmonium to aid the starting and critical notes while singing.
- Students were well versed in identifying and following the Taal and Laya.

Children (8 to 12 years)

- Children were taught with more rigour and more discipline was demanded off them right from the way they sit to the way they sing.
- The children always were asked to sing the Taal (beats) first and then the Swar or the song.
- The students appeared highly practiced. They had memorised all theory like a parrot.
- Most children were not very enthusiastic during the class. It occurred to them like a routine and mechanical process.
- Most children had to keep looking in their textbooks for notations.

- Singing individual notes and holding on to a note was rigorously emphasised. Individual styles were not encouraged.
- A strict pattern and sequence was followed by each student while answering questions.
- Most of the approach seemed exam-oriented. Students even knew the syllabus by-heart.
- Some mistakes while all sang in a group seemed to be missed or neglected by the Guru (here a young lady of about 23-25 years).
- Accompaniments (harmonium, electronic tabla & tanpura) were used throughout the class.
- Students were given easily comparable tasks and instructions like: 'Your voice must be more than the harmonium'.
- The students were also taught to sing light songs like bhajans and popular devotional songs. This was enjoyed by the students.

These observations helped in understanding the Guru-student chemistry in typical music classes as the one studied above.

Scenarios and users

Given the irreplaceable role of the Guru in teaching singing, it becomes important to see how the eventual '*system*' would fit in users' lives.

Users:

- The Guru
- The students
  - Novice
  - Advanced beginner

There are various scenarios in which the *system* would fit in the users' lives. Some of them are described below:

Given the reasons why many people do not end up joining a class, a system like this could help in making an individual aware of the basics of classical music. An individual can play with the system and explore it through small tutorials and demonstrations. This way, there is a chance that such an individual gets interested and joins a singing class.

Generally, classes are held once a week and the entire week in between is wasted without much practice. A student could use the system to practice his lessons at a convenient time.

The Guru could record a tutorial (homework) for a student to be used during his practice hours. Later a student's progress can be reviewed also.

During a class of many students, a Guru does recognize an incorrect singer however, the mistake committed and the moment is lost. If each student had a system where he/she recorded her singing during the class, the exact moment of error and its analysis could be checked by the Guru. This would help in situations when there are many students in a class.

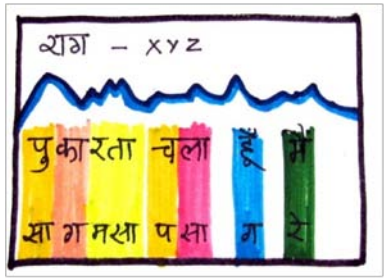
The problem of all students being treated at par with each other could be resolved as now personalized attention and homework could be arranged for by the Guru using the system.

In many cases, the students are irregular due to their own occupations. A pre recorded tutorial could be used to keep the student updated.

For students staying abroad and who are advanced beginners, the Guru could send tutorial files and then a student can send his/her progress file back to the Guru. This way the need for both to be present at the same time is taken care of.

Figure 14: (above) Demo of a concert

(below) Popular film songs analysed



सा Vadi swar; Varjya swar.

ग मसा Characteristic phrase

Design Ideas

Based in the problems found out during the classroom observations and contextual inquiry, some design ideas to address specific problems have been thought about.

These design ideas later go on to become a consolidate solution.

Problem	**Design Idea**
People don't know/realize that popular music is based on classical music.	*(Fig. 14)* Demo of a concert. • Step by step explanation of what singing consists of. • Instruments used etc...
	(Fig. 14) We could present popular songs and show an analysis of the song. That could include: • The notations of the song. • Concepts of *aalap*, etc. • Rag on which the song is based. • People, Composer etc. • Stories associated. • Classical music traditions.

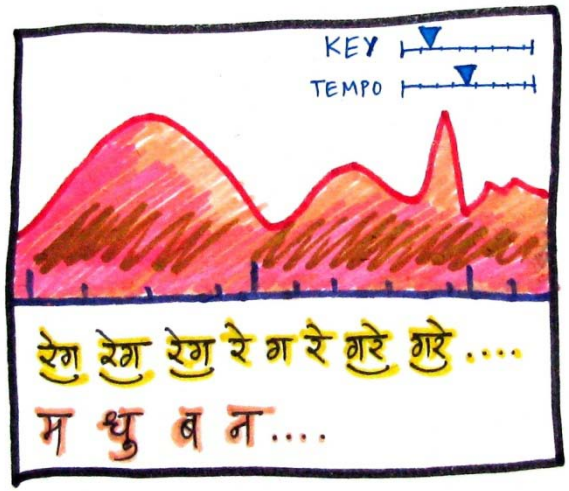


Figure 15: Playing with popular songs; Learning film songs; Trivia/ Quiz

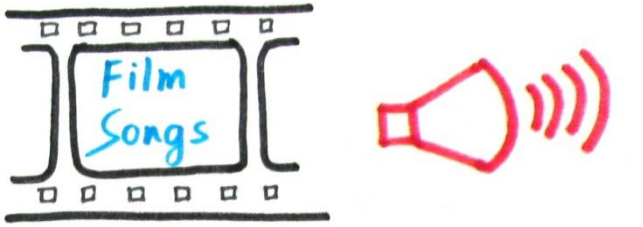


Figure 16: Film songs | Audio Trivia

No idea of what's learnt in a music class. "I came for learning *songs* but I didn't get what I wanted".	*(fig. 15)* Popular songs - play. • User selects song. • Manipulation of key, tempo. • User understands through play.
	(fig. 16) Learning film songs if bored.
	(fig. 16) Audio Trivia / Quiz Guess the Swar, Rag etc.
	Listening to stories on how songs are composed.
	Students compose / hum a tune and it gets reviewed – matched with a Rag.

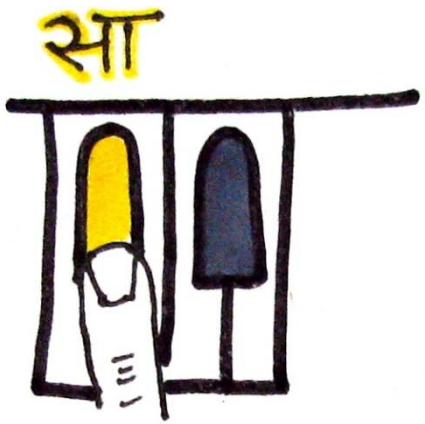


Figure 17: Singing by Involving actions

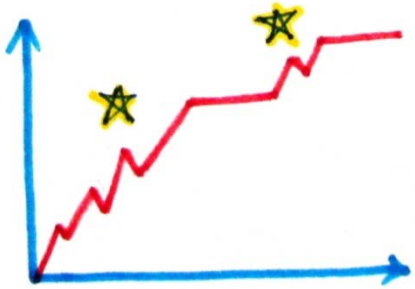


Figure 18: Ratings, progress report

Less immediate gratification as compared to musical instruments.	*(fig. 17)* Learning harmonium (screen)
	Singing by involving actions: User has to press and sing at the same time.
Personal inhibitions: age, shyness, low self-confidence.	*(fig. 18)* Ratings, Progress reports
	Personal device for shy people.
	Demonstrating advantages of being an adult learner.
	Confidence building through quiz and practical exercises (sing this piece etc...). Inspirational stories of great artists.

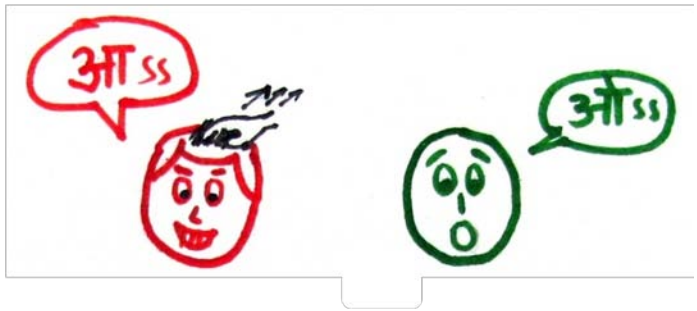
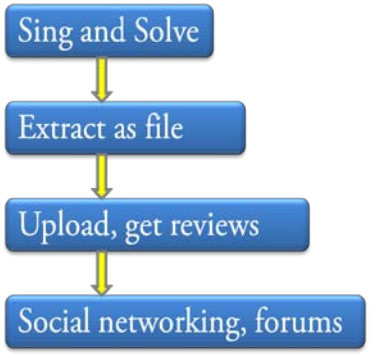


Figure 19: Daily life examples of producing sounds

Figure 20: Fill in the blanks with voice



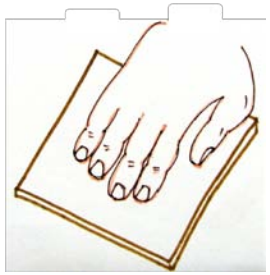


Figure 21: (left) Networking, (right) Sensitive touch pad

May be boring for small children – beginners.	*(fig. 19)* Daily life examples and analogies.
	(fig. 20) Singing along with voice which goes on / off randomly. Fill in the blanks with voice.
"I have no company". All are taught at par in a group.	*(fig. 21)* Standard exercises and Networking.
	Guru personalises the syllabus and home work for a student.
Small children do not read/write notations. Complicated notations.	*(fig. 21)* Designed gestures on a sensitive touch pad. The touch pad senses: Tempo, Taali; Khaali; Finger touch, etc...
	Following content by finger to follow tempo and content.

Figure 22: Sitting similar to a concert

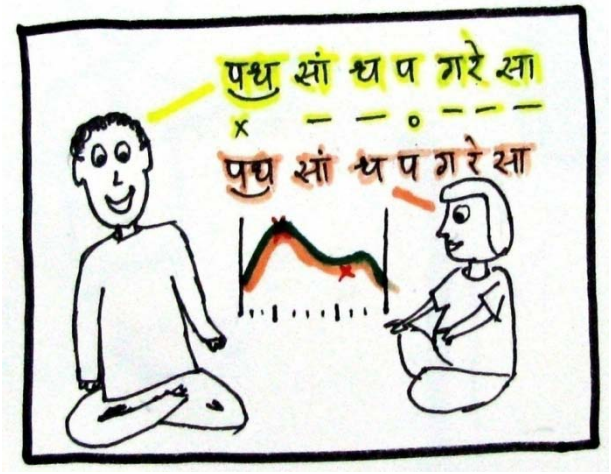


Figure 23: Animated character of a Guru

Another major part of the ideation is **visualisation**. It would be nice if the system if able to induce understanding of the concepts by connecting them with the sounds being produced on singing.

The whole idea is that of creating a photographic/visual identity for the peculiar sounds one produces.

Ideations for visualisation:

(Please see Fig. 22)
A sitting similar to a concert / class.
Interactive accompaniment: tabla, harmonium, tanpura.
Notations which is the written language to be presented.
Visualisation of notes against time.

(Please see Fig. 23)
Animated character of Guru and student.
Advantages of an animated character are that it can include hand gestures and expressions.
Visualisation shown.
Accompaniments in background.

Figure 24: Shapes getting filled

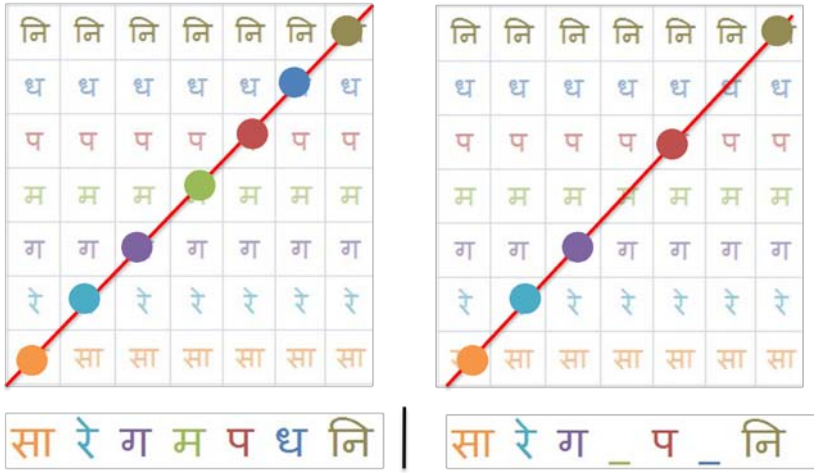


Figure 25: Visual Grid

(Please see Fig. 24)
Swar – shapes getting filled by singing (an association between textual notations and the visual)
Unfilled and overflown Swar are sung uncorrectly.
Colour coding could be used for different Swar.

(Please see Fig. 25)
A visual grid based approach.
Idea based on the much repeated phrase "place of a Swar" to be realised by a student.
Colour coding could be used to show different Swar.
Different Shapes could be used to further create unique and non-confusing identities of various Swar.

Towards a consolidated solution

The design ideas presented earlier were random and addressed specific problems. These ideas now need to be pooled up into a consolidated concept.

Following subsections describe the steps towards a consolidated concept.

Essential work areas

Based on the insights and problems gathered and the consequent ideation done, some areas appear to be essential to the building up of a consolidated concept. The areas are identified based on finding a general affinity across the problems, insights and the design ideas.

Following table shows how these different areas need to be incorporated or considered in building the final solution.

Scenarios	Content	Methods / Tricks	Interface and Interactivity
• Guru – Shishya model. • Use cases • Listening • Revision • Riyaz • Progress report • Quiz • Communication • Tutorials for advanced beginners.	• Lesson plan (Structuring tutorials) • Interaction non disruptive to class environment. • Textbook – media correlation • Situational feedback. • Riyaz. • Beginners associating with content.	• Visualisation of sound. • Examples and analogies. • Daily life examples. • Taal. • Accompaniment. • Hand gestures. • Special exercises (e.g. 30 sec test). • Inducing competition. • Exploiting one's inherent capability to listen and imitate and the temporal sense.	• Visualisation methods. • Metaphors. • Intuitiveness. • Simplicity. • FEEDBACK Stop Suggest Correct Practice Continue • Fun elements. • Quiz, Play, Stories, etc. • Sensitivity of the system. • Run-time depiction of user's actions.

Table 3.: Essential work areas

All these areas appear at the various stages and form the elements of the interface between the users and the system.

Many of the areas overlap with each other across the various domains of usage scenarios, tutorials and content, methods to enable learning and the interface and interactivity part.

The final solution needs to cover the above areas as an integrated entity – an interface.

Design Elements and Design Decisions

Keeping in mind the above essentials, the following design decisions have been made. The design elements involved in the interactivity, content and interface part have also been mentioned.

Interactivity

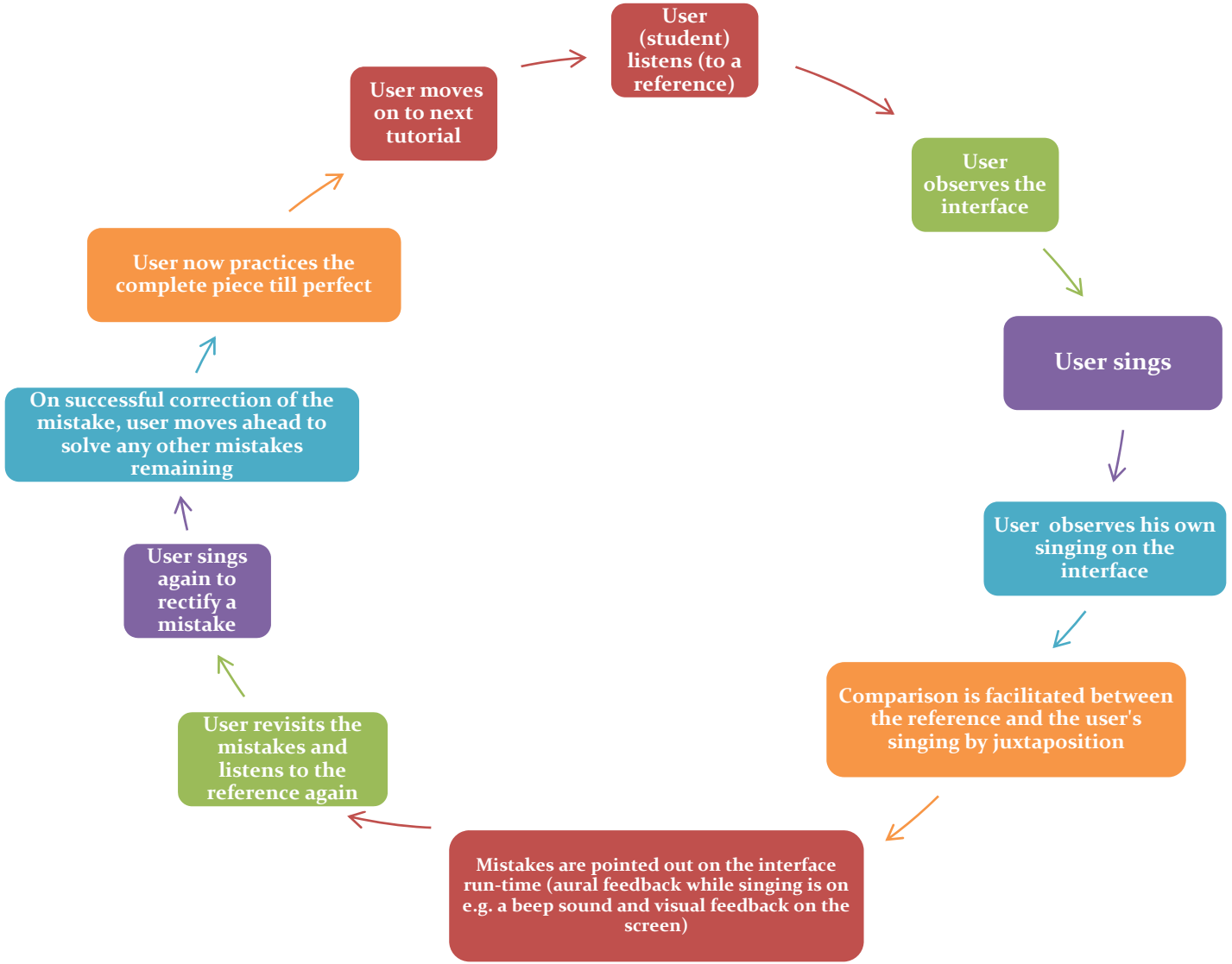
The basic process that shall occur during the interaction is as follows.

Activities that shall be taking place in the system are

- Listening
- Singing aloud
- Correction
- Practice
- Recording

The basic process would be as shown in Fig. 26

Fig 26 : Interactivity



The feedback that a user would get will be visual and aural. As the user sings, the visuals would gradually change along a timeline. This display of the singing activity would be run-time and during a mistake immediate aural signal like a beep would be generated. Visual feedback also would be seen on the screen as red areas.

Also, the system would be aware (through self learning and adapting to a user) of generally occurring errors during a particular tutorial. Thus the feedback would be contextual and specific.

However, since the feedback is mostly related to a wrong note sung or rhythm/beat infringement, the red areas in the visualization where the user's singing contour is juxtaposed with the reference sound, itself would be sufficient to alarm the user.

The user shall be shown his mistakes as red areas on the screen. By clicking on the red area, the mistake would be highlighted and then the user can go on to correct it.

The system would also have elements of play as seeing one's own voice create visuals would be fun. A user can experiment and play with the system also.

Content

The system shall have modules based on the general learning curve. The modules shall be divided in three major areas:

- Understanding and appreciating

As pointed out in the findings and design ideas, a major hurdle in the path of a user starting to learn classical is the understanding and appreciation of its structure. For this purpose, interactive videos of great artists depicting the nuances of classical music would be presented. Through these videos, the user shall also be introduced to the general interface for later modules.

- Learning through tutorials

In these modules, the user shall be able to hear to recordings, study the theory and see their corresponding notations and visualization. This way, the target is set for the user to now reproduce and practice the singing exercises.

The tutorials shall be structured so as to increase complexity gradually. This way the user can work around the tutorials at his/her pace.

- Self study

Classical music encourages improvisation and creativity in the rendition of a Rag in various ways (Aalap, Bol-Taane, Rag vistaar). As the user gets adapted to the interface and moves up the ladder

to a stage of self study and exploration, he/she can practice freely without any references and analyse their own performance and compositions.

- Creating tutorials

The Guru can create tutorials by simply recording his voice with required accompaniment (tanpura, harmonium, tabla) support from within the system itself. The notations shall be generated automatically and can be verified and corrected by the Guru. Also, lyrics can be entered against the timeline of the singing. This tutorial now becomes a reference for a student to learn and practice.

Interface

The interface would be screen based to enable the visualisation and interactivity.

The basic idea would be the association of three entities:

- Audio
- Notations (text laid over time and intervals as per the rhythm)
- Visuals (different visualisations to aid the association)

The aim behind providing these three layers is to create a combined effect that can aid understanding, multi-sensory

associations and get the user adapted to process the complex information (the singing) comfortably.

The interface shall also have the provisions of playing the traditional accompanying instruments like the tanpura, harmonium and table.

The user shall be able to learn and practice predesigned tutorials and later as he/she shall get adapted to the interface, be able to play along with the different elements like tempo and rhythms.

The interface would have the least possible controls while the actual learning process is taking place. Much similar to a video game, the user shall be guided through selection options first and then when he/she is all is set to start, the screen would show just the necessary elements and controls to operate. This will help reducing the unnecessary clutter of menus and options on the screen; the user can now concentrate solely on the task. This approach would also be useful in case the interface is to be adapted for variety of devices ranging from mobile phones to computer screens.

The visualisation skins made available shall be from basic to abstract. For novices, the basic visualisation of Swar (notes), Taal and Laya (Beats, rhythm and tempo) is recommended. For advanced beginners, the visualisation can become more abstract.

The margins of error allowed shall be carefully set based on the tutorial and its importance and place in the structured syllabus.

The interface shall have provisions to save and replay a user’s session.

Hardware

The system would be a software that could be installed on a personal computer and would use its internal sound card for audio signal processing. Apart from that, the only external hardware that would be required would be a basic microphone.

It is aimed to have minimal hardware requirements so that the system can be used by users without much additional costs.

The use of other gadgets, like mobile phones, PDAs, etc. is possible. However, it is another intensive area of design and hence has not been worked on keeping the time constraints in mind.

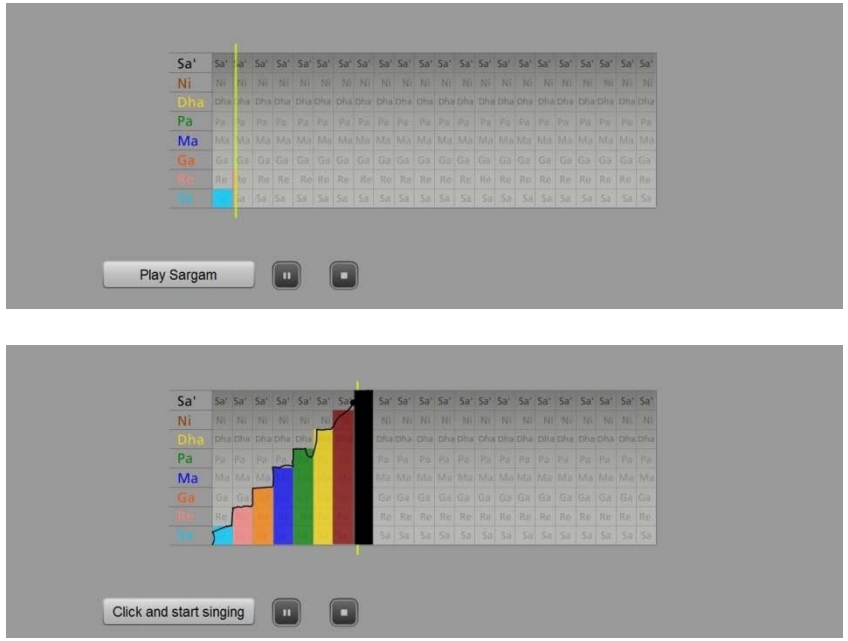


Figure 26: First Simulation

First simulation

Figure 25 shows the screen shot of a crude simulation done as a first attempt.

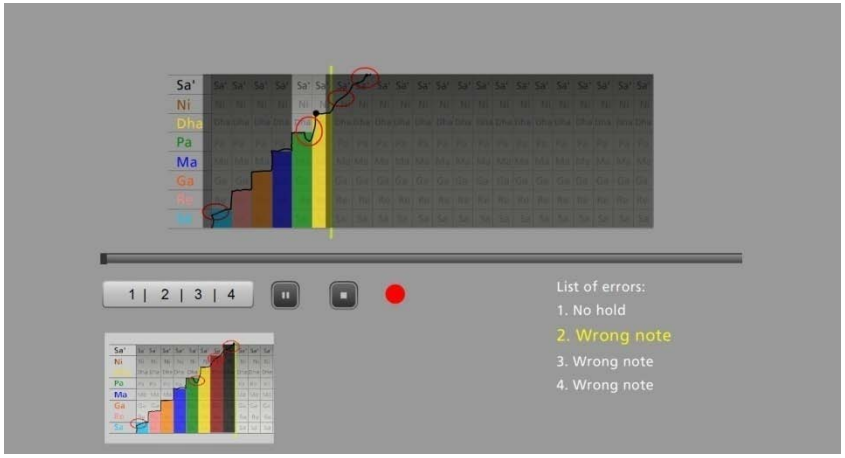
Here, the visual grid is shown.

Horizontal layers of notes in progression:
Sa, Re, Ga, Ma, Pa, Dha, Ni, Sa'

The yellow cursor line traces a singers pitch contour against time. Here, the coloured bars are ideal curves obtained on singing Sa, Re, Ga, Ma, Pa, Dha, Ni, Sa'.

A user listens to this reference and now sings. His/her pitch contour is observed as a curve (black line curve)

Errors are marked Red.



The user can now have a look at individual errors and correct them one by one by listening and reciting again and again.

Feedback is provided on what error has occurred at each place.

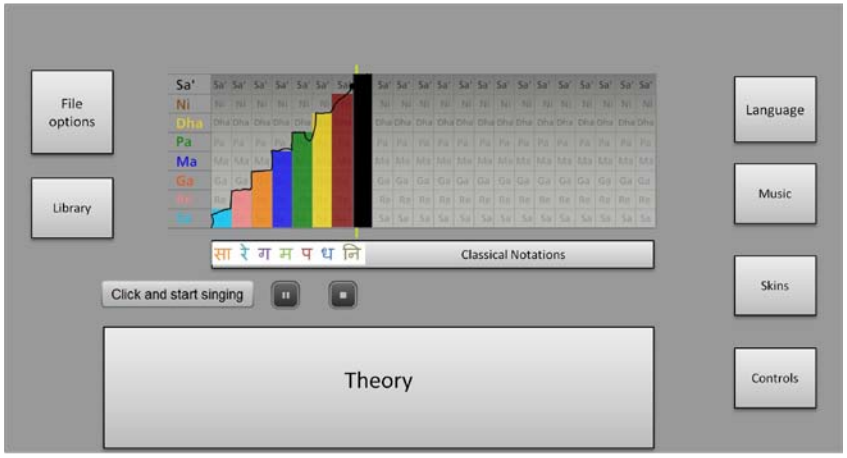


Figure 27: Features to be added

However, the above interface is extremely crude and it has to have much more areas like:

- Language options
- Accompaniment controls
- Notations
- Visualisation skins
- Theory
- A library of recordings and tutorials, etc.

The final concept is underway; and shall encompass the design elements and decisions stated above.

Building a software

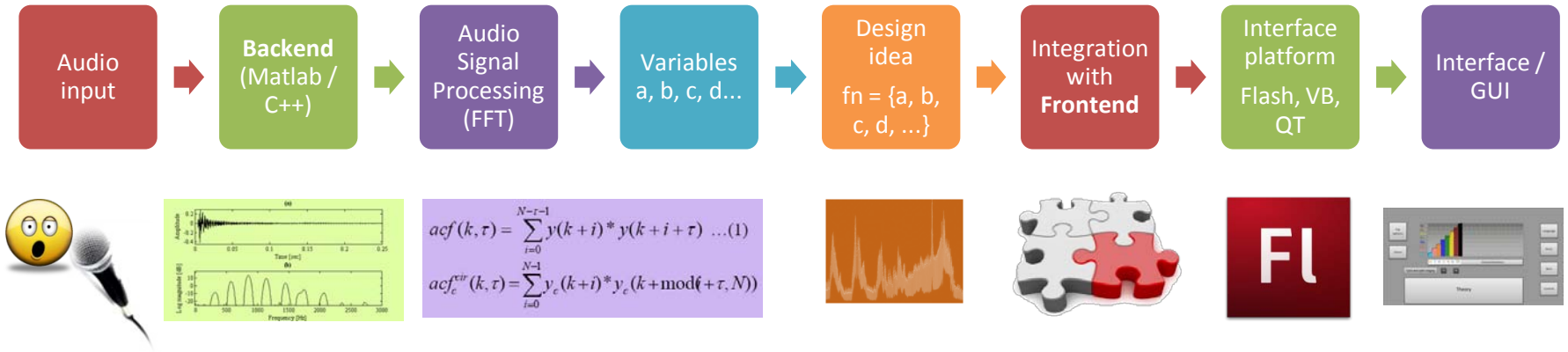
The software would mainly consist of two areas:

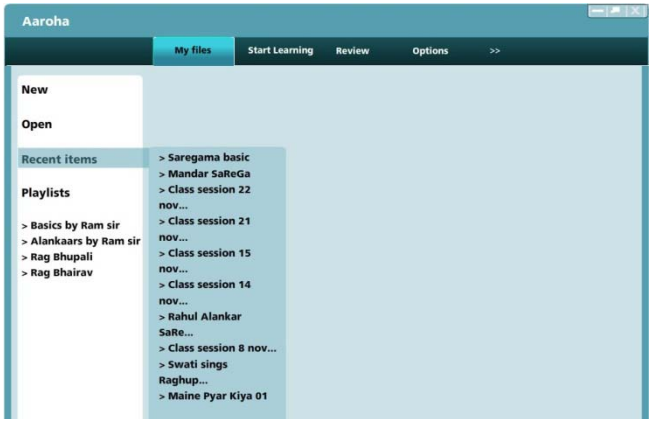
- Frontend
- Backend

The backend would be the technology base where the actual audio processing would take place. The backend would generate some variables as an output and feed it to the frontend.

The frontend which is the designed interface would now use these variables to render the visualisation and show the notations, etc. on the interface.

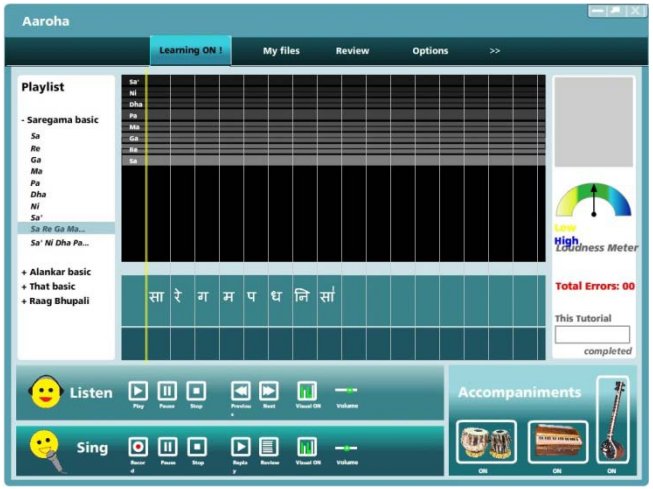
It's very important to have technologies merge with each other in order to realise a prototype. Since the interactions are being designed, the frontend has been dealt with in details. It would be difficult to integrate the backend in the project time available.





Final Interface

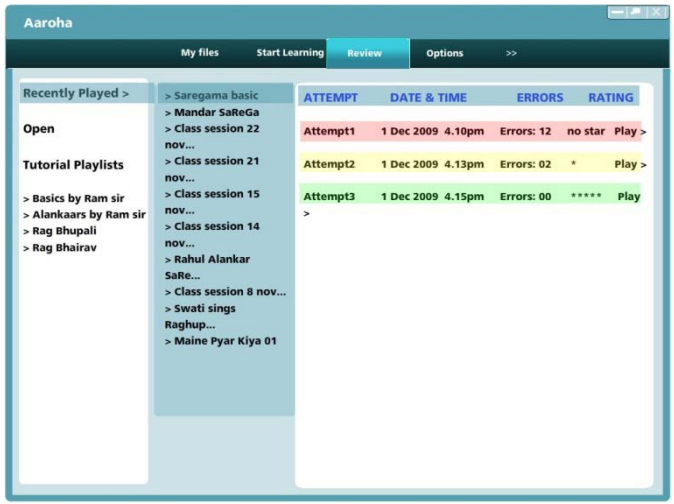
The final software interface has a tab structure with menus viz. My Files, Start Learning, Review, Options, etc.



The interface has options for musical accompaniments, playlists and a visual grid from Sa to Ni. The visualisation area gets divided into vertical columns equal in number to the *matras* in the *taal* being played.

The learners have two menus: Listen and Sing. In the listen menu, one listens to the tutorial files that a Guru has created and observes the visualisation.

In the Sing menu, one sings over the tutorial reference visual and can compare his own performance. Feedback on the voice stability (loudness), pitch (notes) and the timing (tempo) is available to the learner. A user can make repeated attempts and go on improving.



The Guru can later review a learner's performance and give him feedback on additional parameters like emotions, voice quality, etc.

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Appendices

Appendix – I: Excerpts from interview of singing aspirants.

User no.	[redacted] (Name)	User Statement	High	DO
1	Male	Observation	Medium	MUST DO
	Age 23	**Insight**	Low	DON'T
	Design student	**Breakdown / Problem**		STRICTLY DON'T
		Design Idea		**Problem Area**
		Cultural Influence		**Opportunity**
U1-1	While user was in his 9th and 10th std. he felt that he could sing well (above average)	User statement	High	
U1-2	User felt that if he worked on his voice, he would become a good singer	User statement	High	
U1-3	However, user did not join a class because he also wanted to learn to play instruments like Guitar, Violin, Tabla, Flute and was confused	User statement	High	
U1-4	Also, user was of the opinion that a class would go waste if one did not learn it to the professional standard	Observation	High	
U1-5	User stated that as his aim was not a professional stage performing artist, a class would have been a waste of money (*sirf iccha ke liye kyu karneka*)	User statement	High	

Appendix – II: Excerpts from interview of learners.

User no.	[redacted] (Name)	User Statement	High	DO
5	Female	Observation	Medium	MUST DO
	Age 25	**Insight**	Low	DON'T
	M.Tech student	**Breakdown / Problem**		STRICTLY DON'T
		Design Idea		**Problem Area**
		Cultural Influence		**Opportunity**
U5-1	User has learnt from Ms. Anjali Ponkshe in Pune since the age of 8-9 yrs till she was 18 years old. User has completed her Visharad. This class was held twice a week.	User Statement	Medium	
U5-2	User started with learning Swar > Aaroha-Avaroha > Palte / Alankar > Rag > Rag specific Swar+Palte > Rag specific bandish (7 to 8)	User Statement	High	DO
U5-3	User initially learnt to perfect her knowledge and skills to pick up and sing Swar. User believes that one must be able to hit a note without being conscious and without much thinking. It must be internalised. It must be like the language we speak.	Insight	High	MUST DO
U5-4	The user was taught Rags and their precomposed *Bandish - Chota Khayal.* The different Rag were taught in increasing order of their complexity.	User Statement	High	DO
U5-5	Bandish helps one in understanding and learning a Rag.	Observation	High	Opportunity

Appendix - III: Excerpts of a UltraStar ‘encoded text file’

Song: Summer of ’69, Bryan Adams.

```
#TITLE:Summer Of '69
#ARTIST:Bryan Adams
#MP3:Bryan Adams - Summer Of '69.mp3
#START:0,5
#BPM:138,77
#GAP:5800
: 0 1 74 I
: 2 1 74  got
: 4 1 74  my
: 6 2 74  first
: 10 3 74  re
: 14 4 78 al
: 18 2 76 six-
: 20 2 74 string
- 25
: 28 3 76 Bought
: 32 1 76 it
: 34 2 76 at
: 36 1 76 the
: 38 4 78 five-
: 42 2 76 and-
: 46 5 76 dime
- 55
: 58 5 74 Played
: 64 1 74  it
: 66 2 74  til
: 68 1 74  my
: 70 4 78  fin
: 74 2 76 gers
: 78 4 74  bled
- 86
: 90 1 76  t'was
: 92 1 76  the
: 94 2 76  sum
: 96 1 76 mer
: 98 2 76  of
: 102 3 78  six ...
```