

Sound System Basics for Live Indian Classical Music

By

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The purpose of this article is to introduce the basic concepts of sound system applicable to live Indian classical music performances. The intent here is to create awareness and generate interest in this very important aspect of live performances. This is *not* a technical paper and the recommendations given in this article are generic.

Much has been talked about the need for a sound system. Some musicians and critics in the past despised it and advocated against it. They had valid reasons. The sound systems were inadequate. The venues were smaller and the singers had powerful voices. It was the instrumentalists who initiated the drive for a better control. In those days they mostly cared only for amplification, ignoring control. But uncontrolled amplification leads to distortion. Therefore, many artistes were reluctant to use it. Good sound systems *are* currently available and could be effectively used for larger venues. Besides, this generation of musicians and audiences are accustomed to the sound from a sound system.

If the acoustics of the auditorium is good, a sound system may not be necessary. But if the voice needs to be projected over the accompanying instruments, it is better to have a sound system. The choice between having a sound system and not having it depends on the necessities. But once a conscious decision has been taken to use a sound system, it must be adequate.

A complete sound system is quite complex. But there are four basic components: a) Microphones (input), b) Mixing Console (processing the sound), c) Power Amplifier (amplification for the speakers) and d) Speakers (output). These are explained below and are also shown in the accompanying diagram.

1. Microphones:

There are a variety of microphones available in the market. Each one has a specific application. Typically, use Dynamic Cardioid mics for all Indian classical music concerts. It is also important to realize that vocal mics are different from instrument mics. From a physical appearance, vocal mics usually have mesh balls whereas instrument mics generally have flat grills.

There are mainly two types of microphone technologies: Dynamic and Condenser (Capacitor). These two technologies incorporate several pickup (polar) patterns. A pickup pattern is the microphone's response to the angle of sound incidence. Cardioid pickup is the most common for live applications. This is a "unidirectional" pickup. That is, it has optimum response from the front of the mic and a somewhat reduced response from the sides. It rejects sound from the rear of the mic. This helps to reduce the feedback.

If and only if the auditorium has very good acoustics, consider using Condenser Cardioid mics. Condenser mics may be used for instruments like the sitar that produce sharp sound pulses and

have lower sound pressure levels. This is because a Condenser mic is more sensitive and has a better “Transient Response” to respond to sharp pulses of sound. Please note that Condenser mics need external (DC) power supply called “Phantom Power”. This power supply either comes from the Mixing Console or from a battery. Condenser mics produce cleaner sound but they are costlier and delicate and should be handled gently. Some solo instruments like the veena might also benefit from contact pickup mics.

In addition to using the correct mic, it is necessary to position it correctly. There are no rules for mic positioning. Try out different positions and listen carefully. General rule of thumb is to align the axis of the mic with the principal source of sound. Dynamic Cardioid mics should be held close to the sound source, whereas, Condenser Cardioid mics should be placed about 1 ft away.

Usually, a “Flat (uniform) Frequency Response” is considered preferable. But sometimes, boosting the mid-high frequency ranges [2 to 5 kHz] adds “colour” to the voice and makes it more intelligible. This is called the “Presence Peak”. Good quality mics have a uniform Frequency Response for on-axis (front of the mic) and off-axis (sides of the mic) directions. Otherwise, as the singer moves in front of the mic, the quality of the voice changes. A proper Gain setting (explained in the next section) can mitigate this problem. Alternatively, to obviate this problem, a Condenser mic could be used. As the Condenser mic is placed 1 ft away from the singer, the head movement does not matter as much. But care should be taken not to let sound from the neighboring sources enter this mic.

There are a number of other technical specifications, such as “Impedance” - should be low for noise immunity and ability to use longer cables, “Balance” - should be balanced (3-wire system) for noise immunity, with 3-pin XLR connectors, high output or signal-to-noise ratio et cetera. Consult a qualified professional for further advice. Despite all the technical specifications, in the end however, the human ear is the final judge for mic selection. Different mics might suit different singers and instrumentalists.

Microphones should be stand-mounted. Wire-less mics may be avoided as they are expensive and need excellent remote sensing equipment to process. Sometimes a stage is put together with wooden planks. If such a stage is weak and makes rumbling noise, using *shock-mounts* to secure the mics on the stands and placing the microphone stands on damping pads can reduce rumbling vibrations. Tape the microphone cable to the stand leaving a loop at the mic end to absorb vibrations. Using a *windscreen* for vocal mics (also called a *pop filter*) guards against sputtering. This is particularly useful in outdoor applications to reduce the noise from the wind. But this screen could affect the higher frequencies. If the signals from the microphones aren't good, the best of the systems will be of no use. It is therefore imperative to use proper microphones and set them correctly. If possible, it is advisable for the artists to carry their personal microphones with them. Any mic can be used with any system without any compatibility issues. Use a “line-matching transformer” or a “DI Box” to connect a 3-pin XLR mic (low impedance) to a ¼ inch jack (high impedance) at the console.

2. The Mixing Console:

This is the most complex of the four components. This is where the sound is processed. In fact, the Mixing Console encompasses several sub-components. The three main sub-components are: (i) The Pre-amplifier, (ii) The Equalizer and (iii) The Mixer.

(i) *The Pre-amplifier*: increases either a microphone signal or a Line signal to set the appropriate Gain structure. A Line level signal has higher voltage and comes from an electronic sruthi box or a sitar, veena etc. using a pickup. Usually, there is a switch to determine a mic or a Line signal. Consoles may be labeled with Low Impedance for 3-pin XLR mic inputs and High Impedance for ¼ inch Line inputs.

(ii) *The Equalizer (EQ)*: helps to achieve tonal balance of each mic so that the sound is more pleasing and intelligible.

(iii) *The Mixer*: adds these equalized signals from different mics together. A balanced mix is the key to good overall sound.

The amount of amplification achieved at the Pre-amplifier stage is called “Gain”. This is a very critical parameter. This is how each individual mic input is controlled, necessary for a controlled mix. This Gain setting should be done with the artists actually singing/playing *before* the concert begins. But please be aware that the presence of the audience will change the acoustical characteristics and as a result, the Gain settings need to be further fine-tuned as the concert begins. Optimal Gain setting minimizes the feedback and reduces the system noise. Any distortions are indicated by small red lights called LEDs (Light Emitting Diodes). Attenuate (i.e. reduce) the Gain to eliminate any distortions.

It is important to know the number of mic inputs needed. For most Indian classical music concerts, four to eight mics should be sufficient. So, an 8-Channel Console should suffice. The number of mics actually used in a concert impact the Gain setting for that concert. The Equalization (EQ) of each input channel allows the operator to reduce or boost different low and high frequencies, to achieve the desirable tonal balance. This is a fine art requiring a good ear and experience. A Graphic Equalizer is used to ring out possible resonance on stage, between the Speakers and the stage Monitors. This can also help compensate for poor room acoustics. One Console setting doesn't apply to all concerts. Try out different settings for different artistes and note them down for future reference. But these settings can change if any of the factors such as the venue or the number of mics and audience change. The operator should walk around the audience area during the initial sound check and during the course of the concert to ensure that the sound distribution is uniform. The console should have “Phantom Power” switches for the condenser mics. These must be switched off for Dynamic mics. There should be a provision for headphones for the operator for recording purpose. Having a live recording facility is optional.

In the age of electronic sruthi boxes, it might be useful to have a provision for feeding the sruthi electronically into the system through the ¼ inch Line-In on the Pre-Amplifier. Use this option with discretion. Speaking of sruthi, it is vital that the sruthi be heard in the audience very clearly to create the necessary ambience and mood. Having a separate mic for the Tambura/Tanpura is recommended.

Ideally, the Mixing Console should be in front of the stage, forming approximately an isosceles or an equilateral triangle with the two Speakers but slightly off the center axis, as shown in the diagram. This is where the operator can listen to what the audience is actually hearing. Avoid using special effects although sometimes a little “Reverb” enlivens an otherwise dull sound. Never use surround sound for Indian classical music.

3. Power Amplifier:

The processed output signal from the Mixing Console is fed to the Power Amplifier. The Amplifier boosts this signal to drive the speakers. The power rating of the Amplifier defines the strength of the sound. Higher the power, lesser the distortion but higher the cost. The power requirement depends on the size of the audience. Approximately 1 watt of power per person for indoor concerts and double that power for open-air concerts is recommended. The power rating and the impedance of the amplifier must match that of the speakers. The Power Amplifier can be a separate component or encased inside either the Mixing Console or the Speaker cabinets. Having a separate Power Amplifier is recommended. When setting up a sound system, always remember to switch on the Amplifier last and when the system is being turned down, switch it off first. And, ensure that the speakers are connected to the Amplifier before turning it on.

4. Speakers:

Like the microphones, speakers should have low impedance and a flat (uniform) frequency response. Speakers should match the Amplifier. The most important parameter is “impedance matching”. Impedance is the resistance to AC (supply) current. This is frequency dependent. The combined impedance of all the speakers (with the cables) must match that of the Amplifier for optimum output and a clean sound. It is easy to calculate this and anybody versed in sound system basics can easily work this out. The performance characteristics of a sound system are frequency dependent. The power requirement is also frequency dependent. That is, more power is needed for lower frequencies, lesser for midrange and least for higher frequencies. Therefore, to achieve a better control and tonal quality; frequencies are separated into low, mid and high ranges. Low frequencies are usually referred to as “Bass” and high frequencies as “Treble”.

A “Crossover” network is used to achieve this frequency separation. Both active crossover and passive crossover systems exist. If the frequency separation is done before the Amplifier, the crossover is called active and if it is done after the Amplifier, it is called passive. For active crossover systems each crossover band will need its own Amplifier. These systems have better control but are costlier.

In active crossover systems, if the frequency range is divided into three separate ranges (low, mid and high); it is called a “Tri-amplified” system. Some systems use only a 2-way signal split, between the low and the high frequencies. Such systems are called “Bi-amplified” systems. In order to enhance the sound quality, speakers are also divided into three sections: a) Woofer for low frequencies, b) Mid-range for mid range frequencies and c) Tweeter for high frequencies. These three speakers are usually stacked up vertically. Speakers are directional (except for Woofers) and have a coverage angle (area covered). Therefore it is extremely important to orient them properly for optimum sound distribution. Improper orientation may also lead to feedback.

Multiple Tweeters may be used to ensure better distribution of sound, particularly for larger venues. Typically, the Speakers should be placed on either sides of the stage, approximately at head-height of the audience and directed at them or above their average head-height and angled downwards at them. Speaker positioning depends on the speaker properties and the acoustics of the auditorium. Try out different arrangements to find out the best position. In a good set up, the Speakers “disappear” and the sound emanates from the artistes on stage. The Speaker cabinets should be sturdy, shielded and properly mounted.

In case of passive crossover systems, where the frequency separation happens *after* the Amplifier, “full-range” speakers may be used, which are less expensive and integrate all the different frequency ranges into one cabinet. The frequency separation is done inside the speaker cabinet. In other words, full-range speakers could be used for passive crossover systems and separate (woofer, mid-range & tweeter) speakers could be used for active crossover systems. Budget and control requirements govern the choice. Either system is acceptable. Please note that the pitch perception changes with loudness and frequency. Due to the non-linear nature of the ear, it perceives a lowering of the pitch as loudness increases. As a result, the music may sound out of tune. Loudness distorts clarity.

Monitor Speaker:

This is a full-range speaker directed at the artists on stage, as shown in the diagram. A Monitor helps the artists to listen to their own performance enabling them to be in sync and maintain the sruthi. Therefore it should have a flat (uniform) frequency response for true sound. This is also called as a “Fold back”. This should be positioned on the floor and projected towards the back of the main artist’s mic (blind spot for a cardioid) to reduce the feedback. The main artiste decides what needs to be fed into the Monitor and how loud it should be. But, find out beforehand if the artists feel comfortable using it. Alternatively, use two Side-Fill Speakers located on the stage on either sides, directed at the artists. Avoid using Monitors in highly reflective environments.

Cables should be shielded and balanced (3-wire) for noise immunity (i.e., reduce the hum). Be aware that speaker cables are different from power cables, which are different from the other signal cables. Speaker cables should have very low impedance. Use different cables meant for different frequency ranges. The two most commonly used connectors are the ¼ inch jack (high impedance & un-balanced) and the 3-pin XLR connector (low impedance & balanced). 3-pin XLR connectors can be used for long cable runs. To connect a 3-pin mic to a ¼ inch jack on the Mixing Console, use a “line-matching transformer” or a “DI Box” *at* the Console. Cables running on the floor should be secured with a tape to avoid tripping over them and excess length cables should be coiled up for neatness. This also helps in troubleshooting.

The power supply should be stabilized using a voltage stabilizer. If the artist is using an electronic sruthi box, voltage fluctuations will affect the sruthi. Please be aware that different countries use different supply voltages and supply frequencies. Typically, 220 V & 50 Hz or 110 V & 60 Hz are used.

Good sound system management is the key to quality aural experience. It is more of an art than it is a science and one learns it only through experience. It therefore pays to initially rent a

professional sound system and learn from an experienced operator. It is a good practice to mark all the mics with serial numbers for proper identification.

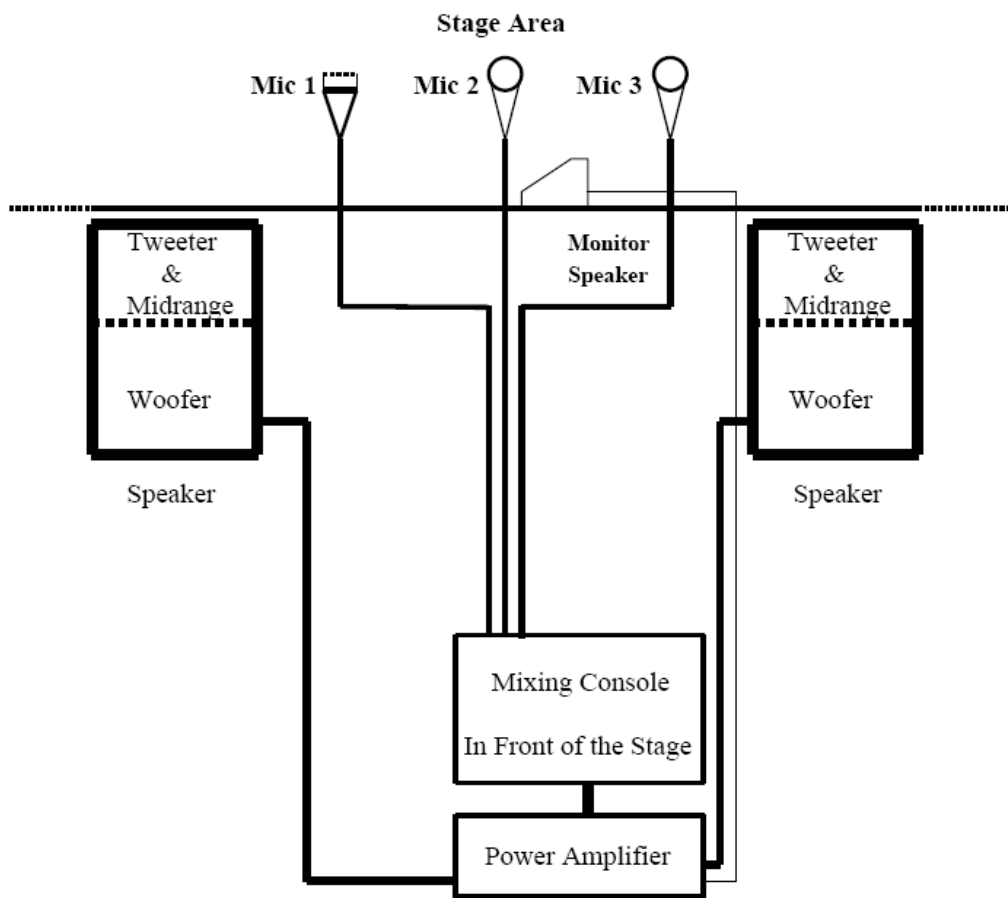
The environment of the concert is of paramount importance. That is, whether it is indoors or outdoors. If it is indoors, it should be an auditorium; halls and general-purpose rooms usually have poor acoustical properties. The acoustical characteristics of the auditorium shape the final sound quality. A sound system that sounds good in one venue might sound differently in another. Sound systems and the acoustical properties of the auditoria are inseparable. It is useful to know that room temperature and humidity also affect the quality of sound. The system must be grounded and adequately protected. The equipment must be carefully maintained, with enough spares on hand, such as extra mics, cables, fuses, etc.

Finally, this article is intended only to bring awareness of the basic elements of a sound system. A professional consultant must be hired to do the actual design and provide initial training. It is possible to set up a good sound system or upgrade an existing system within a reasonable budget. One might consider rentals to start with. Check local stores for models and prices. The ultimate sound system should be transparent to the audience. The music should sound original as if the sound system is non-existent. Clarity is paramount. This is achieved with good equipment positioned appropriately and controlled by a qualified person. Intelligible sound also depends on the acoustical characteristics of auditoria. The equipment must be set up and tested *before* the concert begins.

Indian classical music is very subtle. An insufficient sound system betrays that subtlety. A properly designed and operated sound system is an integral part of a successful concert. In fact, it may be a good idea to form a working committee to develop and formulate some basic guidelines specifically suited for Indian classical music. Concert organizers can then be encouraged to comply with these “standards” for the benefit of musicians and the audiences.

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See the next page for the diagram



Simplified diagram showing the basic components of a sound system