

**USE OF MICROPHONES BY NIGERIAN SINGERS: STUDIO/STAGE ENGINEERS' PERSPECTIVES**

**Vincent C. UDEOZOR**

vc.udeozor@unizik.edu.ng

&

**Alvan-Ikoku O. NWAMARA**

ao.nwamara@unizik.edu.ng

Department of Music, Faculty of Arts  
NnamdiAzikiwe University Awka

**Abstract**

This research examines issues bothering on microphone usage among Nigerian artistes, exploring the trends, preferences and their significances. As an essential component in contemporary music production and live shows, microphones have greatly impacted vocal expression, sound clarity, and stage presence; yet a good number of Nigerian artistes face challenges in using the microphone either on stage or studio. Through personal experiences, interviews, market analysis, and review of literature, this paper investigates current preferences for microphones by Nigerian music artistes, such as the use of wireless systems, vintage condenser microphones for studio sessions, and the incorporation of sophisticated sound engineering tools. It also x-rays Nigerian artistes' ability in customizing global technologies to fit local styles. Summarily, the study portrays the microphone not only as a technical device, but as an enabler of creative identity and professionalism in the music industry, and emphasizes the effect of microphone quality on performance's credibility, audience interaction, and overall artistic representation.

**Introduction**

The term "mike," which is occasionally used informally, refers to a transducer that converts sound waves into electrical impulses. There are many applications for microphones, including telephones, hearing aids, public address systems for public events like concerts, film production, live and recorded audio engineering, sound recording, two-way radios, megaphones, and radio and television transmission.

In the context of Nigerian music, where diverse genres and vocal styles prevail, the selection and application of appropriate microphone technologies significantly influence the fidelity and artistic impact of a recording or live sound (Atkins & Giacobello, 2014). In the realm of audio recording and amplification, microphones are crucial tools. They play a vital role in capturing sound and converting it into electrical signals for processing and playback. To select the most suitable microphone for a specific use, it is important to understand the different types available. At its core, a microphone consists of a diaphragm and a transducer. The diaphragm is a thin membrane that vibrates when exposed to sound waves. The transducer, often in the form of a coil or a capacitor, converts these vibrations into electrical signals. Judging from their transducer technology, microphone can be categorized into three: dynamic, condenser, and ribbon microphones, with each category having its own unique characteristics, advantages, and disadvantages.

This paper investigates the nuanced considerations and strategic choices made by studio and stage engineers in Nigeria regarding microphone usage, exploring how these decisions shape the sonic outcome and preserve the authentic vocal characteristics of Nigerian singers. This study further aims to uncover the challenges and innovations engineers encounter when working with various microphone types in diverse acoustic environments, from purpose-built studios to open-air concert venues. Furthermore, it delves into the impact of technological advancements, such as ad-hoc microphone arrays, on their practices and the overall sound production quality within the Nigerian music industry (Liaquat et al., 2021). By examining the perspectives of these key technical personnel, this research provides insights into the intricate relationship between technology, artistry, and cultural expression in contemporary Nigerian music production. This also involves an analysis of how multichannel 3D microphone arrays are being integrated into the workflow of Nigerian sound engineers to enhance immersive audio experiences (Lee, 2021). This integration necessitates a deeper understanding of optimal microphone placement strategies to maximize spatial impression and overall sound preference, especially considering various musical sources and reverberant environments (Lee & Gibben, 2015, Rabinkin et al., 1997).

**Microphone Types and Characteristics**

The selection of an appropriate microphone is paramount for capturing accurate audio, with dynamic, condenser, and ribbon microphones each offering distinct operational principles and sonic characteristics suitable for varying applications.

Dynamic microphones, known for their robust construction and ability to handle high sound pressure levels, are often favoured for live performances due to their durability and resistance to feedback. In contrast, condenser microphones, with their extended frequency response and sensitivity, are frequently chosen for studio recording where nuanced vocal and instrumental capture is desired. Meanwhile, ribbon microphones, while more fragile, are prized for their warm, natural sound, making them ideal for capturing vocals and acoustic instruments with a smooth, vintage quality. Beyond these fundamental categories, specialized microphones such as boundary microphones, shotgun microphones, and USB microphones cater to niche recording and amplification scenarios, each designed to optimize sound capture for specific environments or convenience of use. The evolution of microphone technology also includes advanced designs such as wideband linear microphone arrays, which offer superior directional properties for high-quality audio recording in noisy environments, addressing limitations in the directivity of traditional shotgun microphones, especially at lower frequencies (Zhou et al., 2018). Additionally, multichannel 3D microphone arrays represent a significant advancement, offering enhanced spatial audio capture capabilities crucial for immersive sound experiences (Lee, 2021).

### **Dynamic Moving-Coil Microphones**

Dynamic moving-coil microphones, or transform acoustic energy into electrical by using the electromagnetic induction principle. The microphone built-in magnet creates a magnetic field, to which the diaphragm is fastened via a coil. When sound waves strike the diaphragm, it vibrates accordingly, and this causes the attached coil to move within the magnetic field generating a voltage which varies in accordance with the pattern of the original sound wave (a typical loudspeaker works by the same principle, only in reverse) moving-coil designs are usually sturdy and rugged and so are popular for live use, especially hand-held applications. They generate low self-noise, tend to be less susceptible to humidity and a wide temperature variation, and handle high sound without distortion. They are less expensive than other professional microphones.

### **Ribbon Microphone**

Ribbon Microphone is another type of microphone design that uses thin (usually) corrugated ribbon of metal foil is used as diaphragm electromagnetic induction. People refer to this design as "ribbons". In older ribbon designs, the ribbon material itself was extremely fragile, making these microphone more suitable for studio usage than live, Ribbon microphones are not widely used today, except in music recording and for the speaking voice. They are more expensive than many moving-coil mics and have to be handled with care particularly when it comes with loud sound levels. Recently developed ribbon microphone technology is the active ribbon microphone which uses an amplifier expensive than many voltages along the audio cable. Recently developed ribbon microphone technology is the active ribbon microphone which uses an amplifier system that requires phantom power. Phantom power is a method of remotely powering an amplifier or impedance converter by sending voltage along the audio cable. Among the advantages of the active ribbon microphone over conventional ribbons are higher output and sensitivity, wider and flatter frequency response and the ability to handle higher sound levels before distortion (Alten, 1981)

### **The Principles of Microphone Science**

The diaphragm of a microphone vibrates in response to sound waves. Electrical currents are produced in dynamic microphones by the movement of a coil that is affixed to the diaphragm inside a magnetic field. After that, this electrical signal is processed and amplified. Condenser microphones, on the one hand, utilize a capacitor-based transducer. A charged diaphragm is placed in close proximity to a fixed back-plate. When sound waves hit the diaphragm, the distance between the diaphragm and the back-plate changes, resulting in a variation in capacitance and generating electrical signals. Ribbon microphones, on the other hand, often considered a vintage option, employ a thin strip of metal (typically aluminum) as the diaphragm. The ribbon vibrates in response to sound waves, with the variations in the magnetic field generated by the ribbon coil producing electrical signals.

### **Performance Characteristics of Microphones**

Different microphones have their individualistic approach for particular applications and usages. We have earlier stated that moving-coil microphones are rugged, generate low self-noise, tend to be less susceptible to humidity and wide temperature variations and handle high sound pressure levels without distortion, they are usually less expensive than the other professional types and come in a wide variety of makes and models. The element of a moving-coil mic has more mass than that of a ribbon of capacitor microphone and, therefore, has greater inertia in responding to sound variations. This results in a slower response to transients sounds that begin with a quick attack, such as a drum hit, breaking glass, and then quickly decay.

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loud sound levels. Ribbon mics generally have low self-noise, but they also have the lowest output level of the three major types. This means a power signal-to-noise ratio if the microphone is too far from the sound source or if the cable runs is too long. Capacitor microphones are highly-performance instruments. They reproduce clear, airy, detailed sound and are the choice among professional-quality microphones when it is necessary to record sounds rich in harmonics and overtones. Capacitor microphones have high sensitivity, which make them the preferred choice for distant “miking”: high-end response is not hampered by extended mic-to-source distances. The capacitor microphones are generally more expensive than moving coil and ribbon microphones.

### **Behavioral Characteristics**

The way in which a microphone responds to sound in the air around it is expressed as the microphone's pattern. This, describes the microphone's sensitivity to sound coming at it from the front, sides and rear of the diaphragm-in other words, the microphone's directional characteristics. Microphones have three basic directional characteristics:

- a. Omni-directional: microphones respond with equal sensitivity to sounds from all directions (front, rear, sides).
- b. Bi-directional: the microphone is sensitive to sounds from the front and rear ( $0^{\circ}$  and  $180^{\circ}$  respectively) but rejects sounds from sides within  $90^{\circ}$ - $270^{\circ}$ .
- c. Uni-directional: the microphone is primarily sensitive to sounds from one direction (cardioids, super-cardioids, and hyper-cardioids) and rejects sounds from the rear.

### **Omni-directional Condenser Microphones**

As was previously noted, an omni-directional microphone that records sound from all directions is made up of a sealed enclosure with a disc-shaped diaphragm that is only open at the front. This indicates that direct pressure applied to the diaphragm's front is how all sound is detected. Pressure mics are another name for Omni- mics. Condenser microphones are widely recognized for their exceptional sensitivity and accuracy, making them a popular choice for studio recordings, broadcasting, and vocal performances. Their ability to capture subtle nuances and finer details makes them invaluable in audio production.

### **How Condenser Microphones Operate**

Condenser microphones consist of a charged diaphragm that is placed close to a fixed back plate. When sound waves hit the diaphragm, it moves, changing the distance between the diaphragm and the back plate. This variation in distance alters the capacitance and generates an electrical signal. One of the main advantages of condenser microphones is their high sensitivity and wide frequency response. They are capable of capturing even the softest sounds and reproducing them accurately. Condenser microphones are also known for their transparency and low self-noise, resulting in clear and precise recordings.

### **Advantages and Disadvantages of Condenser Microphones**

Condenser microphones offer numerous advantages for professional audio applications. Their ability to capture a wide range of frequencies and accurately reproduce sound makes them ideal for capturing vocals, acoustic instruments, and studio recordings. They are also generally very lightweight and compact, making them easy to transport and handle. On the downside, condenser microphones are typically more fragile than dynamic microphones and require an external power source. This power, known as phantom power, is usually supplied by an audio interface or mixer. Additionally, condenser microphones can be more sensitive to loud sources, requiring proper gain control to avoid distortion.

### **Bi-directional**

This pressure gradient design, also referred to as a bi-direction mic, occurs when sound waves from the side ( $90^{\circ}$ – $270^{\circ}$ ) strike both sides of the diaphragm simultaneously, creating equal but opposite pressure on the front and rear. As a result, the sounds from the sides are cancelled, meaning the microphone picks up sound waves from the front and rear and rejects sound from the side.

The microphone that falls under this category is condenser, and are they generally, more capable of having flat, and wide-range frequency response.

Bi-directional microphones are mostly used for choir applications. A cardioids microphone can cover up to 15-20 voices, arranged in a rectangular or wedge-shaped section, for larger or unusually shaped choirs, it may be necessary to use more than one microphone. An example of a bi-directional microphone is Ribbon microphone. Ribbon microphones have been around for decades and are renowned for their warm, vintage sound. Although less common in modern recording setups, they are treasured for their smooth response and unique tonal qualities.

### **The Functionality of Ribbon Microphones**

Ribbon microphones employ a thin strip of metal, typically aluminum, as their diaphragm. This ribbon vibrates in response to sound waves, producing electrical signals by varying the magnetic field generated by a ribbon coil. The delicate nature of the ribbon and their vintage design contribute to their distinctive sound. Ribbon microphones excel in capturing nuanced details, making them suitable for recording vocals, strings, and other acoustic instruments. Their smooth and natural sound reproduction, characterized by gentle high-frequency roll-offs, contributes to their vintage appeal.

### **Benefits and Drawbacks of Ribbon Microphones**

Ribbon microphones offer several benefits for specific applications. They are known for their excellent transient response and accurate representation of timbre, making them sought after by audio professionals. Ribbon microphones also have a unique ability to capture the natural ambiance of a room, adding a sense of space and depth to recordings. However, ribbon microphones tend to be more fragile than dynamic and condenser microphones. The delicate ribbon element can be easily damaged by excessive wind pressure or mechanical shock. Additionally, their low output levels may require a preamp with sufficient gain to achieve suitable signal levels.

### **Uni-directional**

Unidirectional comes into play where a more restricted pick up characteristics would be desirable. Sound waves arriving at the rear of the diaphragm are delayed, usually by rear entry ports (acoustic chambers) in the body of the mic. This delays the arrival of a sound wave relative to its arrival at the front of the diaphragm. In other words, it puts the sound coming in at the rear out of phase with the same sound coming in at the front. This type of mic is very sensitive to the sound coming from the front, and which rejects sounds from the rear. When the pattern of this kind of unidirectional design is plotted, it looks like a heart shape and so is commonly referred to as a cardioids pattern from the latin word for "heart". This type of mic can be used in mixing a bass drum since it has its concentration in the front. Also close mixing guitar cups, drum kits, close on trumpet bells. Dynamic microphones are pure example of this category of mic.

### **Dynamic Microphones**

Dynamic microphones are widely used due to their durability and versatility. They are particularly suitable for live performances and high-volume situations. These microphones utilize electromagnetic induction to convert sound waves into electrical signals.

### **The Working Principle of Dynamic Microphones**

Dynamic microphones consist of a coil attached to the diaphragm, which is located within a magnetic field. When sound waves hit the diaphragm, it vibrates, causing the coil to move within the magnetic field. This movement generates electrical currents, which are then amplified and sent to speakers or recording devices. One of the key advantages of dynamic microphones is their ability to handle high sound pressure levels. This makes them perfect for capturing loud sources like drums and guitar amps without distortion. Additionally, their sturdy construction allows them to withstand rough handling, making them a popular choice for stage performances.

### **Strengths and Weaknesses of Dynamic Microphones**

Dynamic microphones offer several advantages. Besides their durability and ability to handle high sound pressure levels, they are also relatively affordable. Their versatility makes them suitable for a wide range of applications, from vocals and instruments to podcasting and broadcasting. However, dynamic microphones usually have a lower sensitivity compared to other types. This means that they may require more gain from the audio interface or mixer to achieve optimal signal levels. Additionally, dynamic microphones tend to have a slightly narrower frequency response compared to condenser microphones.

### **Incorporation of Sophisticated Sound Engineering Tools in Nigerian Live Shows**

The incorporation of sophisticated sound engineering tools in Nigerian live shows has revolutionized the entertainment industry. Live shows now sound so similar with the original sounds as recorded works with the following trends and technologies being used:

#### **Live Sound Innovations**

##### Advanced Sound Reinforcement Systems

This is when the overall sound production is enhanced such that it is made possible for every concert attendee hear the sounds very clearly and undistorted.

##### Digital Mixing Consoles

Here, all sound elements are effectively controlled with precision, allowing real-time adjustments that enhance distortion free performance.

#### Wireless Microphone Technologies

Incorporating wireless microphone technologies aids flexibility in stage movements of performers devoid of clusters and unnecessary distractions.

#### **Immersive Audio Experiences**

##### Dolby Atmos

This is used to create multidimensional sound experience which offers sound engineers the opportunity of having greater control over the placement and movement of sound elements on stage.

##### 3D Audio Technologies

This technology is capable of transporting viewers into the world of the story for enhanced impact.

#### **Interactive and Immersive Live Sound Experiences**

##### Surround Sound

This enhances the overall engagement and emotional impact of live events.

##### Advanced Audio Effects

This is used to achieve the creation of a more immersive experience for the audience.

##### Real-time Audience Participation

Allows the audience to control certain audio elements or provide live feedback, creating a more personalized experience.

#### **Artificial Intelligence in Live Performances**

##### AI-powered Sound Engineering Tools

This tool continuously analyzes and optimizes sound mixing and effects in real-time, guaranteeing impeccable audio quality throughout performances.

##### Personalized Set-lists

Artificial Intelligence analyzes data to create set-lists that resonate with the audience's preferences, ensuring a more engaging performance.

In general, the entertainment business has seen a change thanks to the use of artificial intelligence and advanced sound engineering techniques in Nigerian live performances. It presents unique challenges, such as managing audio for large audiences, where sound engineers must ensure consistent sound quality throughout large venues; limited infrastructure and resources, such as when working with outdated equipment and little financial backup; and the entertainment industry's constant technological advancements, which necessitate daily upgrades from sound engineers to keep up with the required creativity and skills.

#### **Average Nigerian Artistes and their Microphone Preferences**

This section details the predominant microphone types and brands favored by Nigerian artistes across various genres, analyzing the reasons behind their preferences, including factors such as sonic characteristics, durability, and cost-effectiveness.

Furthermore, the choice of microphone often reflects a balance between an artiste's desired sound aesthetic and the practicalities of their performance environment, whether it be a controlled studio setting or a dynamic live stage. This preference can also be influenced by the recommendations of sound engineers and producers who understand the technical specifications and acoustic properties best suited for an artiste's vocal range or instrument. The increasing sophistication of microphone array technology, which can discern and amplify specific sound sources while minimizing interference, is also beginning to influence these choices, offering enhanced clarity and directional sound capture (Herold & Sarradj, 2014)(Liaquat et al., 2021). This trend is particularly relevant for genres with intricate vocal harmonies or complex instrumental arrangements, where precise sound separation is paramount. The availability of local audio datasets in Nigeria has opened new avenues for developing machine intelligence tools that are culture-aware and can better serve the specific needs of Nigerian musicians, including optimizing microphone selection for local languages and performance styles (Tapo et al., 2024).

This localized data can inform the development of bespoke microphone solutions that account for the unique acoustic properties of Nigerian musical traditions, potentially leading to a more nuanced and accurate capture of

indigenous vocalizations and instrumentation (Wu et al., (2014), Sadoh, 2010). This includes considering the spectral characteristics of diverse Nigerian languages and the dynamic range of traditional instruments, which might necessitate microphones with specific frequency responses or transient handling capabilities.

### **Simple Microphone Usage Deficiencies/Mistakes and their Implications**

1. Pointing the microphone towards a speaker when you are too close causes a high pitched noise called FEEDBACK.
2. Aiming the volumes too high will cause FEEDBACK and DISTORTION.
3. Holding the microphone too close or too far from your mouth. This results in your singing sounding multiple and distorted.
4. Wrong placement of microphones on live musical (percussive) instruments mars the entire output of the instrument as well as the general outcome.
5. Not using a pop filter increases the likelihood of plosives (sharp "p" and "b" sounds) and unwanted noise from breathing or wind, lowering audio quality.
6. Using cheap or worn-out cables and connectors could result in signal loss, interference, or unwanted buzzing noises in the audio output.
7. Leaving the microphone's pickup pattern set to the default (e.g., omnidirectional) in inappropriate environments can result in picking up excessive background noise when a cardioid or unidirectional pattern is more suitable.

### **Suggestions for Better Output**

Having noted the implications of nearness to the speaker, high volumes, and holding the microphone too close to the singer's mouth, we therefore, advise that one sets volume controls such that the backing track is lower than the lead singer's. One should ensure that the mic is held no closer than 2 to 3 inches from your mouth during normal singing. Also, when aiming for high notes, one should avoid moving the microphone closer to your mouth.

Furthermore, point the microphone at about a 45-degree angle above or to the side of the performer's mouth, depending on the microphone pickup pattern. Cardioid microphones are best suited for this. Ideally, hand held microphone should be positioned 6 to 12 inches from the performer's mouth at an angle of 45 degrees or less. Positioning the microphone at the angle of about 90 degrees may result in popping sounds when consonants like P and T are pronounced.

For the musical percussive instruments, the following are highlighted for guidance:

#### **Snare Drum**

Use a capacitor microphone which makes snare to sound richer or crisper or moving coil microphone that tends to give it a harder edge in mixing the snare drum. Point your microphone 6 to 10 inches from the drum head and aim the microphone so that its pickup pattern is split between the head and side of the drum.

#### **Bass Drums**

This drum's purpose in most music is to provide transient, low-frequency energy burst that help establish the primary rhythmic pattern of a song. The kick drum's energy is primarily focused in two areas: low-end timbre and "attack". Although this varies by individual drum, the attack tends to be in the 2.5-5kHz range.

#### **Toms**

The kick and snare establish the low and high rhythmic functions. The toms are multiple drums that will be tuned from high to low between the snare and kick. They are primarily used for fills during performance, but may also be consistent parts of the rhythmic structure. The attack range is similar to snare drum, but often with more sustain. An individual directional microphone on the top head near edge can be used on each drum and panned to create some spatial image.

#### **Hi Hat Cymbal**

The hi-hat cymbal produces two sounds; a clap and shimmer: depending on how important these accents are to the music, the hi-hat can either share the snare drum's microphone or have a microphone of its own. If it shares, place the microphone between the hi-hat and snare, and adjust the sound balance through its placement. When miking the hi-hat, place the microphone at the edge of the hi-hat to produce a brighter sound.

#### **Acoustic Guitar**

When recording an acoustic guitar, place your microphone about 6 Inches above the bridge and even within the front of the guitar brightens the natural sound of the instrument. Aiming a microphone at the centre of the guitar hole 2 to 3 feet away produces a sound with balanced highs, middles, and lows.

### Congas

This is a special instrument in Africa, “miking” such an instrument that has its sound concentration both in the middle and at the edge of the instrument would require a special skill in the sense that the instrument is played with the expression of the body as part of its skill. “miking” the instrument from top may engage the player and microphone in a "fight" but not that a good result may not be achieved “miking” from the top, but to achieve a more desirable result, it is preferably good to microphone beneath the instrument.

### Summary and Conclusion

In conclusion, understanding the different types of microphones is crucial for selecting the right tool for specific audio recording or amplification needs. Dynamic microphones offer durability and versatility, while condenser microphones excel in capturing subtle details. Ribbon microphones provide a vintage sound character, and lavalier microphones offer convenience and mobility. By appreciating the working principles, polar patterns, and pros and cons of each microphone type, audio professionals and enthusiasts can make informed decisions and achieve optimal stage performance, sound recording and/or reproduction results. Additionally, further research is needed to explore the potential for integrating advanced digital signal processing directly into microphones to enhance their adaptability to diverse Nigerian acoustic environments and performance scenarios (Zhang et al., 2021). Future studies could also investigate the long-term impact of microphone technology on the evolution of Nigerian music production techniques and the preservation of unique vocal traditions. Such investigations would provide valuable insights into how technological advancements can both support and shape the cultural heritage embedded within Nigerian musical forms (Adedigba et al., 2023)(Asemah et al., 2014). This holistic approach ensures that technological innovation serves to amplify, rather than diminish, the rich acoustic tapestry of Nigerian artistic expression.

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