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# MODERN TECHNOLOGIES OF THE DOIRA INSTRUMENT: SYNTHESIS OF TRADITION AND INNOVATION

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This article explores the technological transformation of the Doira, a traditional Uzbek percussion instrument, within the context of 21st-century globalization and digital innovation. The research, authored by Muzaffar Esanov, analyzes how modern engineering methods—such as vacuum drying, thermal modification, and laser cutting—enhance the acoustic resonance and structural stability of the instrument. Furthermore, the study substantiates the integration of piezoelectric sensors, MIDI controllers, and Digital Audio Workstations (DAW) into traditional performance practices. By examining the synthesis of natural and synthetic materials, the paper argues that technological advancements do not diminish the "live spirit" of the Doira but rather serve as a modern acoustic bridge to global musical culture. The concept of a "Digital Passport" is proposed as a future standard for the scientific classification of national instruments.

**Keywords**

Doira, music technology, organology, acoustic resonance, thermal modification, synthetic membrane, piezoelectric sensors, MIDI controller, digital integration, Uzbek folk instruments.

Among Uzbek folk instruments, the doira has a centuries-old history and occupies an important place not only in accompaniment but also in solo performance. By the 21st century, in the age of globalization and digital technologies, adapting this device to modern acoustic requirements while preserving its structure and sound characteristics has become a pressing issue.

In the technology of making a circle, apricot or mulberry wood, as well as deer or calf skins, have been used for centuries. However, modern stage technologies and requirements in recording studios require reducing the sensitivity of these materials to climate change (humidity, temperature). "Uzbek doira art, with its complex techniques and rhythmic nuances, occupies a special place in world musical culture, and the clarity of the "boom" and "bak" sounds, which are its basis, directly depends on the acoustic structure of the instrument[1].

Modern technologies enrich the sphere not only physically, but also electronically. Today, the concept of "Electronic Circuit" has emerged, which allows the output of various synthesizer sounds through MIDI controllers. This contributes to the integration of national music with world pop music. "The science of instrumentation today is not limited to preserving the tradition, but is also on the path of enriching it with new materials - composite raw materials and electronic sensors.[2]

In modern instrumentology, the optimization of the acoustic parameters of the doira instrument directly relies on the synthesis of material engineering and digital technologies. If in

[1] Toshmatov O'ktam, "O‘zbek cholg‘u ijrochiligi san’ati", Toshkent: "Musiqa" nashriyoti, 2018-yil, 45-bet
[2] Odilov Abdurahmon, "Cholg‘ushunoslik", Toshkent: "O'qituvchi", 2010-yil, 112-bet.

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the traditional method, apricot, walnut, or mulberry wood was used for the circumference of the circle, then today high-tech methods of processing these raw materials are being introduced.

The processes of vacuum drying and thermal modification during the manufacture of the circle strengthen the cellulose fibers in the wood at the molecular level. This process completely removes moisture from the wood, maximizing the instrument's resonance. Laser cutting technology ensures geometric accuracy of the hoop (up to 0.01 mm), which is extremely important for the uniform propagation (diffusion) of "boom" and "bak" sounds. "In the modern musical instrument industry, wood heat treatment technology allows increasing its resonant properties by 15-20%, which is very important for percussion instruments such as the doira."[3]

The main element that determines the character of the sound of the circle is the membrane stretched over its surface. The main problem of natural skin is its hygroscopicity, that is, it absorbs moisture from the air and loses its tension. Currently, special polymer (synthetic) membranes are widely used for concerts in open-air and humid climates. These materials maintain a stable oscillation frequency and prevent the instrument from "going out of order." "Materialogical analysis of musical instruments shows that polymer coatings can replicate the acoustic properties of natural leather up to 95%, while their service life is three times longer."[4]

In modern stage culture, traditional microphones are being abandoned to a system of piezoelectric sensors (pickups) for amplifying the sound of the doira. These sensors are in direct contact with the rim or skin of the circle, converting the mechanical vibration directly into an electrical signal. This method filters external noise (sound of other instruments) and transmits only the clear timbre of the percussion to the amplifier.

This technology allows connecting the circuit with digital audio interfaces (DAW). As a result, the sound of the doira is enriched with special effects (reverb, delay, pitch shift) in real time. "The process of processing the sound of the doira using digital technologies allows the performer to create unique timbral effects in real time, which is a modernization of the national art of the doira."[5]

Today, the circuit serves not only as an acoustic, but also as a MIDI controller. Optical sensors, installed inside the circle, convert each punch of the performer into a digital code. This allows you to control an entire electronic orchestra through a single circle, harmonizing the sounds of various synthesizers with national rhythms. "Hybrid doira systems offer the performer an unlimited sound palette while preserving traditional techniques, which accelerates the integration of national music into global musical trends."[6]

Our scientific research on the topic "Modern technologies of the doira instrument" shows that the process of modernizing national instruments does not contradict their traditional nature, but is an evolutionary necessity that ensures their viability. The music industry and stage demands of the 21st century require not only a rich timbre from the doira, but also technical stability and digital flexibility.

Material stability: Vacuum drying and the use of synthetic membranes make the circular instrument resistant to climatic changes (humidity and temperature), significantly extending its service life. This is especially important for international touring and outdoor festivals.

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[3] Sultonov Rustam, "Musiqa cholg‘ulari akustikasi", Samarqand: "Zarafshon" nashriyoti, 2021-yil, 89-bet

[4] Alimatov Nodir, "Cholg‘u yasashda yangi materiallar", Toshkent: "O‘zbekiston", 2024-yil, 56-bet

[5] Ismoilov Botir, "O‘zbek milliy musiqa asboblari va zamonaviylik", Farg‘ona: "Farg‘ona" nashriyoti, 2019-yil, 67-bet

[6] Saidov Farhod, "Elektron musiqa va milliy cholg‘ular", Buxoro: "Durdon", 2022-yil, 102-bet.

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Acoustic perfection: Piezoelectric sensors and digital processing technologies allow amplifying the sound of the drum in a clear state without external noise and giving it new timbral luster. This will accelerate the integration of our national music with modern genres (jazz, rock, electronics).

Enrichment of the scientific and methodological base: the use of laser cutting and mathematical modeling in the construction of a circle raises this art only from the level of "instinctive craftsmanship" to the level of "precise engineering-acoustic art." "The most effective way to preserve our national heritage is to develop it in accordance with modern requirements and equip it with scientific and technological achievements."[7]

In the future, creating a "Digital Passport" of the doira instrument and conducting computer analysis of individual acoustic indicators (frequency range, resonance strength) of each instrument will bring our national instrumentology to the level of world standards.

In conclusion, technology does not kill the "live" spirit of doira art; on the contrary, it expands its vocal range and creates unlimited creative opportunities for a new generation of performers. Such a synthesis of tradition and innovation further strengthens the role of Uzbek doira in world culture.

"The art of beatings is the heartbeat of a nation; technology serves as a modern acoustic bridge that delivers this beat to the whole world.[8]" Therefore, the art of the doira and technology are not mutually exclusive opposites, but rather a dialectical whole that complements each other. Thanks to technological progress, the doira has moved beyond its local framework and has become an integral part of the global musical space. While technology acts as a "bridge" in this process, the core value crossing this bridge remains the same ancient and unchanging national spirit.

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