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## ORIGINAL

# INNOVATIVE APPLICATIONS OF AI AND VIRTUAL REALITY IN MUSIC-BASED CULTURAL HERITAGE: ENHANCING ATHLETIC TRAINING AND PERFORMANCE

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## ABSTRACT

**Objective:** This study aims to enhance the effectiveness of music education by integrating AI and virtual technology into its framework, particularly focusing on the transformative impact on athletic training and performance. Methods: We developed an AI-driven recognition approach to overcome the inaccuracies in traditional image-based music education technologies. By analyzing the deployment of AI within music education, we propose a new model that leverages virtual instruction and smart algorithms for a comprehensive educational experience. **Results:** The proposed framework significantly improved the precision of musical instruction by utilizing AI to analyze and adapt to the needs of students. The application of virtual technology not only increased the accessibility of music education but also its adaptability to various learning environments. **Conclusion:** The integration of AI and virtual reality into music-based cultural heritage represents a significant advancement in educational techniques, with promising applications in enhancing athletic training. This approach provides a novel pathway for the digital transformation of music education, highlighting the potential for broader application in sports and fitness training programs.

**KEYWORDS:** Artificial Intelligence, Virtual Technology, athletic, Innovation, Non-genetic, Heritage culture

# 1. INTRODUCTION

The fusion of artificial intelligence (AI) and virtual reality (VR) technologies with music-based cultural heritage signifies a revolutionary stride in both educational methodologies and athletic training programs. This paper explores the innovative applications of these technologies in music education, specifically focusing on their potential to enhance athletic performance and training efficiency(Kayis, Hardalaç, Ural, & Hardalaç, 2021).

## 1.1 Background and Rationale

Historically, music and sports have been intertwined, with each domain influencing the other in various aspects of performance enhancement and psychological resilience. Recent advances in AI and VR have opened new possibilities for leveraging music-based cultural heritage not only for entertainment but also as a tool for substantial improvements in sports training. This integration promises to bring detailed analytics, immersive learning environments, and personalized training regimens that were previously unattainable(J. Chen, Ramanathan, & Alazab, 2021).

## 1.2 The Role of AI in Music Education

AI's capacity to process vast amounts of data and learn from patterns makes it an ideal tool for dissecting complex musical compositions and performances. In the realm of music-based cultural heritage, AI can be utilized to preserve, analyze, and replicate traditional musical styles and practices, providing a rich learning resource for both musicians and athletes. AI-driven systems can identify optimal music training methods that enhance an athlete's rhythmic accuracy, concentration, and overall performance(Lee, Nazki, Baek, Hong, & Lee, 2020).

## 1.3 Virtual Reality: Creating Immersive Training Environments

Virtual reality transforms the way athletes engage with music by creating immersive environments that simulate real-world conditions without the associated risks or logistical challenges. VR can recreate historical musical events or performances, allowing athletes to experience and interact with music-based cultural heritage in a fully immersive setting. This not only enhances the learning experience but also helps in psychological conditioning, providing athletes with the mental resilience required during actual performances or competitions(J. Li et al., 2019).

# 2. Objectives and Contributions of the Study

This paper aims to delineate the mechanisms through which AI and VR can be integrated into music-based cultural heritage to support athletic training.

It will investigate how these technologies can be tailored to fit the needs of athletes across different sports, focusing on the enhancement of performance through improved cognitive and physical training. The study will also explore the potential of these technologies to make cultural education more accessible to athletes, thereby enriching their training experience with cultural depth and context(Brenchat et al., 2009).

### 2.1 Structure of the Paper

The paper is structured to first provide a comprehensive overview of the current state of AI and VR in educational and athletic contexts(Ye, 2020). It then delves into specific case studies where these technologies have been applied to music education and athletic training, analyzing the outcomes and lessons learned(Ye, 2020). Following this, the paper discusses potential future developments in this interdisciplinary field, emphasizing ongoing research and emerging technologies that could further enhance the integration of music-based cultural heritage into sports training regimes. (Shang, 2019). Understudies' musical ability isn't exceptionally compelling because of educators' absence of ideal course, which makes it hard to move understudies' advantage and drive in music learning.

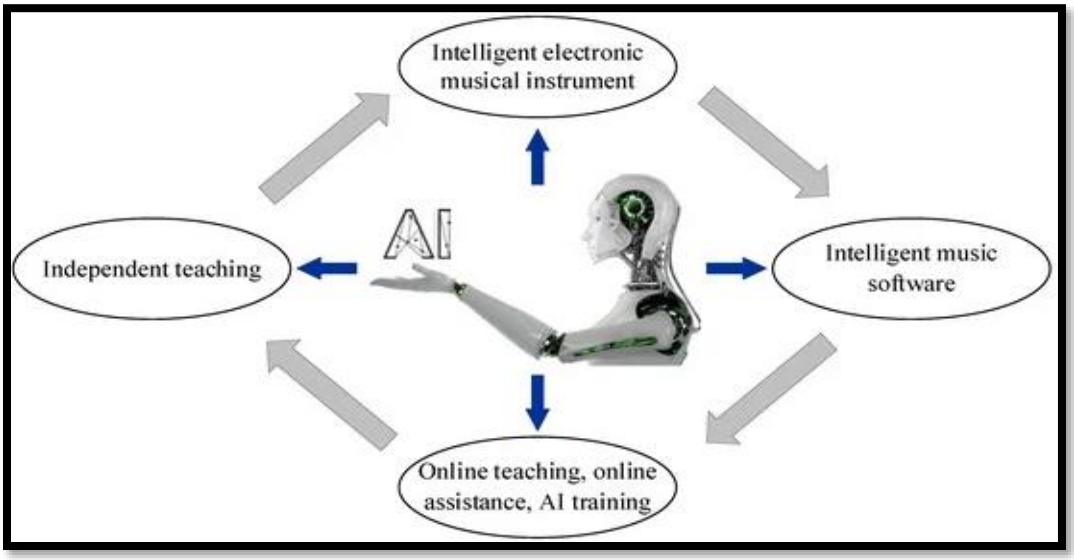


**Figure 1:** The Connection among artificial intelligence and music

### 3. Literature Review

The organization of electronic music creation, online music schooling exhibitions, and remote organizations under AI was explored by (Xu & Zhao, 2021). Because of the ebb and flow fast progressions in science and technology, advanced technology, online electronic music execution, and remote organization cooperative exploration are currently huger than AI technology. An electronic music creation system that understands the joint effort of electronic music online schooling and remote organizations was created through AI research. It forms into another sort of smart electronic musical instrument by concentrating on the thought and technology of PC sensor organizations, insightful calculations, and remote organizations. The re-enactment try is utilized to check the level of matching between the assets for the Computer based intelligence electronic music course, and the oscilloscope is used to change over the sound characteristics into the relating sound and picture plans, consequently understanding the goals of online electronic music savvy coordinating and online schooling (Xu & Zhao, 2021). Guo et al., proposed a unique method for managing showing the piano (Guo et al., 2022). They embraced a new "people + gear" method for managing piano direction and perpetually further created two piano educating modes: "relating" piano appearance mode and "far off association" piano appearance mode, which is as per the example of consolidating standard piano execution with current state of the art movement.

Sharp educating, clever scoring, organized piano homerooms, and customized playing features are occurrences of how AI is used and what its occupation is. The blend of standard piano direction and cutting edge AI technology innovation engages the ascent of novel insights for piano training, the progression of the piano guidance market, the perpetual advancement of the framework's power, and the nonstop improvement of the normalization and specialization of the piano coaching locale. Zhao et al., analysed the progressions in training and showing welcomed on by the appearance of the AI time utilizing a blend of AI and expert stage examination (Zhao, Guo, & Liu, 2021), and they proposed elective topics for the capacity and improvement of music schooling. Preceding appearance a sound framework and showing environment for music preparing in primary schools in the time of simulated intelligence, they at first research the fundamental association between the limit and improvement of music teachers in grade schools. A strong information reference and down to earth procedures for the key abilities and expert improvement of essential music schooling are given by summing up the involvement with functional training, which is a critical reference for encouraging the advancement of understudies' characters and capacities. Better trial strategies and exploration models will be made available by the review for the fundamental abilities and expert headway of educators in different fields.

The impacts of involving artificial intelligence in music course on the creating experiences of understudies with learning difficulties are examined. Students can foster all the freer and accomplish learning objectives in this environment by using the hear-capable and motor systems that are connected with music. Learning injured students are not hesitant or inadequately dedicated understudies. Every young person has an exceptional condition that could require various capacities at various levels, whether or not all students have ineptitudes. Educators can use various methodologies to fulfil the propelling necessities of all students and can help screws with compensatory devices, similar to any technology that jam, overhauls, or chips away at the limits of students with any kind of weakness (as well as any person who is in a roundabout way impacted).

Artificial music intelligence systems offer an open door that ought to be even more totally included into educational strategy, which consolidates formal and easy going learning conditions, educators and their appearance methods, available resources, and student works out. Rather than depending on AI-based technology to take care of issues, educators should watch out for dyslexic understudies consistently. The progression of technology requires that instructors obtain state of the art training so they can direct understudies' learning. As of now, a few AI innovations are being utilized to help the learning of explicit impaired gatherings (Della Ventura, 2019).

## 4. The Increasingly Influential Role of Ai in the Music Industry

AI is starting to bigger affect the music business. AI can recognize examples and patterns in immense informational indexes that would be trying so that people might see. Settling on choices with respect to everything from which melodies to elevate to the most ideal way to publicize a craftsman can be aided by this information. New music is additionally being formed utilizing AI. AI calculations can make extraordinary structures that frightfully look like hit tunes by exploring existing melodies and figuring out how to perceive the various parts that add to their prosperity ("Musical Artificial Intelligence – 6 Applications of AI for Audio. ,"). In the years to come, it's possible that we will hear significantly more AI-created music as AI technology propels.

### 4.1 The Music Industry in the China

China's music industry has an extensive and beautiful past. Chinese music has forever been in the front of mainstream society, from the starting points of jazz and vaudeville to the appearance of rock 'n' roll and hip-bounce (Shin & Cheol, 2020). The music business is anticipated to keep on creating as musicians and various organizations conform to the new advances and artificial intelligence. Music streaming firms have been teaming up with a start-up called Jukebox artificial intelligence to assist them with understanding their clients better.

Streaming will be the main income hotspot for the Chinese music industry in 2022, as displayed in the chart underneath. Jukebox utilizes AI calculations to dissect client conduct and recommend melodies that clients might appreciate considering the developing ubiquity of streaming. The utilization of AI in the music business is working on the experience for the two craftsmen and audience members, as exhibited by this business, which is only one model.

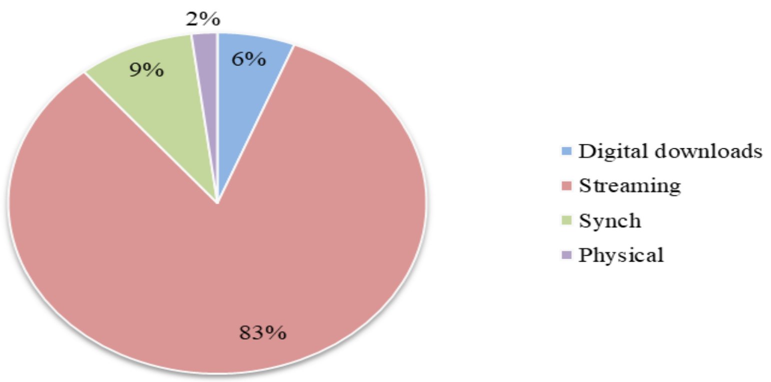


**Figure 2:** Revenues from the Chinese Music Industry in 2022

### 4.2 Music Composition

In spite of the fact that AI systems have been utilized in the production of music for quite a while, the discipline is still in its outset. A human writer will commonly join the musical thoughts and pieces delivered by AI music organization systems to make a completed musical creation. This methodology offers various advantages. Toward the start, it could aid in finding new melodic or consonant ideas that the writer probably won't have thought of. Second, it can quickly make a great deal of thoughts, which can assist the writer with saving a ton of time (T. Chen, Lu, & Fan, 2017). At last, AI systems at times produce ideas that are outside the extent of what a human writer can make, bringing about a more unique and innovative piece of music. In spite of the fact that AI music creation is as yet an exceptionally youthful pitch, it can possibly fundamentally modify how people make music.

## 5. Artificial Intelligence Algorithms and Virtual Reality Technology

### 5.1 Artificial Intelligence Algorithm

Deep neural networks are a calculation model for deep learning. It is a division of AI and a development of customary neural networks. To deal with information, deep learning utilizes various nonlinear changes. It is a calculation model containing various elements. To conquer the confounded difficulties of training information, which are in the shallow organization of the brain organization and can't be actually reflected, they originally supported applying deep learning. The vigorous sensory system of the human brain's strong neural system can be imitated by means of deep learning. The trademark information is separated also:

$$Z = w^T x + b.$$

The output expression is

$$h_{w,h}(Z) = f(Z) = f(w^T x + b).$$

Such neurons are dispersed all through a deep learning network, and through the nonlinear planning of the initiation capability, every neuron communicates the theoretical properties of the information to the accompanying layer. As the level advances, the last capability will become noticeable. At long last, the classifier can be told to arrange and distinguish the information utilizing the learnt conceptual highlights of the deep information (Uzunboylu, Tezer, & Yildiz, 2020). No one but elements can be physically separated and placed into the model while utilizing shallow figuring out how to learn highlights. Both shallow learning and profound learning require the data to be nonlinearly changed to make an arranging relationship from commitment to yield. Deep learning can learn information includes progressively and freely utilizing its own network structure, but since the elements it learns are excessively dynamic, researchers are much of the time bewildered and require extra exploration.

### 5.1.1 Neural Network Infrastructure

In view of the crucial information on the hierarchical construction and action component of the brain, the neural network is another data handling system. By duplicating the development instrument and thinking rule about the human brain and tactile system, the brain network shows the characteristics of the human mind and has the critical parts of the human cerebrum. In this organization, the second-level sensors process the first-level information to settle on the choice outcomes, while the first-level finder processes the data to choose and convey fundamental outcomes essentially (X. Chen, Xie, Zou, & Hwang, 2020).

Interestingly, with the main layer, the second layer perceptron can settle on choices that are more muddled and novel. The third layer of the neural network can manage extra stunning data in a manner like this. The data signal worth and the matching weight are added to make the outcome as a deep model of the scattered neural network is understood thusly. The most essential technique for neural network demonstrating depends on how nerve cells process messages. We should channel the outcomes by involving a capability as the neural network's enactment capability (for this situation, the limit capability). A recipe can be utilized to extract and gather the data introduced up to this point:

$$out = f\left\{\left|\sum_{i=1}^{n} w_{ij} x_i\left(t - t_{ij}\right)\right| - T_j\right\}.$$

### 5.1.2 Types of Neural Networks

The neural network's criticism layer gives the data, which is then dealt with by the interlayer neurons before being straightforwardly yield by the activation ability. Taking a gander at the planning of the brain organization, you will see that it is an undirected diagram network on the grounds that the feed forward brain network needs investigation. The relationship between each layer and the geology of the brain organization, which depicts the multifaceted design of the inception capacity, conveys the outcome delayed consequence of the feed-forward neural network. After the actuation capability, input information, loads, and balances are taken care of into the subsequent layer, where they at long last advance into the most well-known chain structure in neural networks. The expression "deep learning" started from the length of this chain, which is alluded to as the model's profundity.

The learning calculation chooses how to utilize these layers to deliver the expected result when neural networks are utilized for training. The training tests don't straightforwardly depict the action of neurons in different layers. All neuron hubs can deal with data and can both admission data from the rest of the world and result it to the rest of the world. This misfortune capability is a significant consider neural network boundary input age and the principal quality of feed forward networks. The neural network looks at whether the misfortune capability is limited to progressively change boundaries.

$$C = \frac{1}{2n}\sum_{x}\|y(x) - a^{L}(x)\|^{2}.$$

## 5.2 Design of Vocal Music Showing Framework in view of Virtual Reality Technology

The virtual reality schooling system utilizes different innovations, including programming advancement, networking, and correspondence. It has to do with the equipment groundwork of the business. The virtual reality schooling system needs to empower ongoing communication among people and machines notwithstanding its centre instructive capabilities, which requires a strong system. A few application systems require superior execution laptops to help the system because of headways in science and technology that have expanded the expense and execution of PCs (Zhang & Yi, 2021). The plan of introducing a virtual reality system on a strong PC and its fundamental activity are plainly displayed in the figure beneath. Figure 3 shows the equipment necessities for a full virtual schooling system, which likewise incorporate particular equipment setups such position GPS beacons, 3D picture speed increase cards, 3D sound sheets, and so on.

Data table plan is the foundation of data set plan. Field type, field name, and essential key data, and so on are instances of the different kinds of data that ordinarily make up a data table. The system contains a great deal of useful modules, however everyone just shows one data table, especially the data tables for understudies, schoolwork, scenes, instructive assets, test questions, and intuitive data tables.

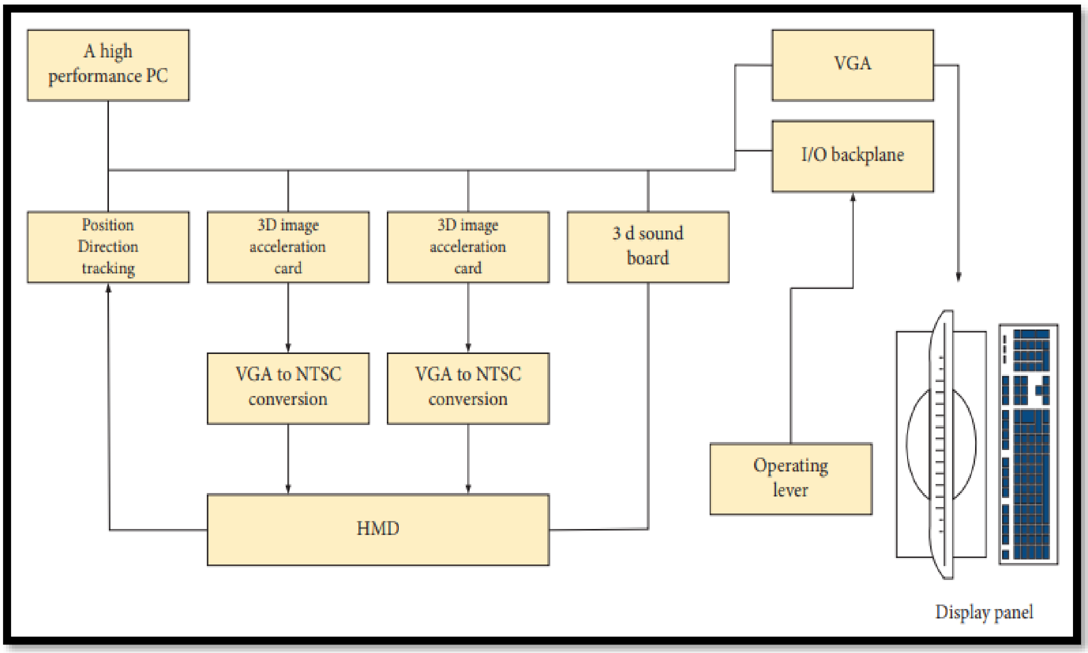


**Figure 3:** Diagram of the system architecture

## 6. The Prospects for AI Development in Music Education

With the appearance of the period of AI, the model for music training in the time of network data has been made more awesome and created in deeper headings. It has additionally worked on the singleness of school music educating, animated understudy interest in music, expanded learning effectiveness, and further developed learning structure. Based on finishing essential guidance, AI can likewise consummate each stage, permitting the possibility of schooling to deeply pervade society more. All in all, the business for music schooling has developed essentially because of the far and wide advocacy and entrance of AI in this field, which has assisted with understanding the mix and association among music and contemporary science and technology. The prevailing pattern is to consolidate AI with music schooling. Future keen gadgets and virtual advances, regardless of their tendency, will be utilized in training to an ever increasing extent (X. Li & Wang, 2017). The improvement of different clever advancements will likewise aid in upgrading the adequacy and standard of understudy learning. The potential for carrying out AI in the study hall to assist educators with satisfying course game plans all the more proficiently and precisely is tremendous. It can give instructors an extra device and assist them with zeroing in more on showing understudies as per their capacities. Thusly, to propel music schooling, we should uphold imaginative reasoning, advance successful AI figuring out in the music training area, fortify the expert use of AI in music training, intently screen AI improvement drifts, and empower the music instruction area's long haul, sound, and sustainable development (Hu, 2021).

## 7. Methodology

### 7.1 Artificial Intelligence Algorithms

Discourse and music are two vital sorts of information for discourse signal handling in the field of music schooling. Discourse acknowledgment, beat observing, sound recovery, and different applications all advantage from the characterization of voice and music signals. In voice signal handling, for example, the classification is at first settled, and on the off chance that it is a discourse class, the subsequent stages can look at the language, orientation, and different elements. Assuming that it falls into the music class, the following stages could incorporate beat checking and music class investigation. Obviously the categorisation of discourse and music affects the results representing things to come tests. These days, there are a few grouping approaches for discourse and music characterization challenges. A beat is an example comprised of serious areas of strength for both powerless beats. To make a beat, solid and powerless beats are burned through in a particular request. Beats in music characterize music into solid and feeble connections. Thusly, a discourse music order model in view of the beat range is proposed. To do this, sound is first pre-handled, then handled by Meier triangle separating to obtain the beat range utilizing MFCC boundaries. This beat range is then utilized in an auto related closeness framework to give the beat range, and the kind of not set in stone by the factual connection limit (Lv, 2020). This approach an affects the ensuing non-constant extraction of music beat time focuses, and the interaction is finished all the more rapidly.

While most of the discourse is flighty, the beat range got from the music follows a customary example. To recognize discourse and music signals in this paper, the beat range is utilized as the model's feedback highlight. The unmistakable properties of the sign affect the model's calculation time as well as its exactness. Meier's recurrence cestrum coefficient, which joins the mechanics of discourse blend with the hear-able discernment qualities of the human ear, has been broadly utilized in the field of voice acknowledgment systems. The Meier repeat scale is more as per the hear-capable characteristics of the human ear since the level of a sound heard by the human ear isn't clearly connected with its repeat. The worth of the Mel recurrence scale generally associates with the logarithmic conveyance of the genuine recurrence, and the exact relationship with the real recurrence is

$$Mel\ \{x\} = 2595 \times lg\left(1 + \frac{x}{700}\right),$$

Where x is the genuine recurrence in Hertz and Melx is the apparent recurrence in Mel. By figuring the cosine of the point between the two vectors, which is 1 for a point of 0° and not more prominent than 1 for some other point with a base worth of 1, the comparability between the two vectors is evaluated. Discourse doesn't have a cadenced quality that makes the evaluation of its comparability generally redundant. The specific recipe is

$$cos\theta = \frac{a.b}{\|a\| \times \|b\|},$$

Where cos is the resolved cosine esteem and an and b are the two eigenvectors, separately. The beat range, which estimates acoustic self-closeness, relies upon delay. In profoundly organized or rehashed, areas of strength for music in the beat range will appear, uncovering the general power of rhythms and individual beats and distinguishing various sorts of rhythms with a similar beat. The beat range is not the same as prior strategies for cadenced examination in that it could be utilized with any sort of music or sound since it doesn't depend on certain components like energy or recurrence. In this review, the sign's sufficiency for each edge fills in as a component vector for the estimation of similitude, and the beat range is a brief time frame Fourier change of the sign. Condition (3) utilizes the point cosine boundary of the eigenvector to work out the similitude lattice of the sign. The autocorrelation of the similitude framework is determined to get the beat range as displayed underneath.:

$$R(i,j) = \frac{x(i).x(j)}{\|x(i)\|\|x(j)\|},$$

$$C(k,I) = \sum_{i,j} R(i,j)R(i+k,j+l),$$

where x(i,j) signifies the component vectors for outlines I and j, separately; R(i,j) means the closeness grid; C(k,I) is the symmetric network; and the beat range C(I) is basically the amount of the beat spectra in either the line or section. Figure represents the model progression of spoken music characterization in light of sound related attributes.4.

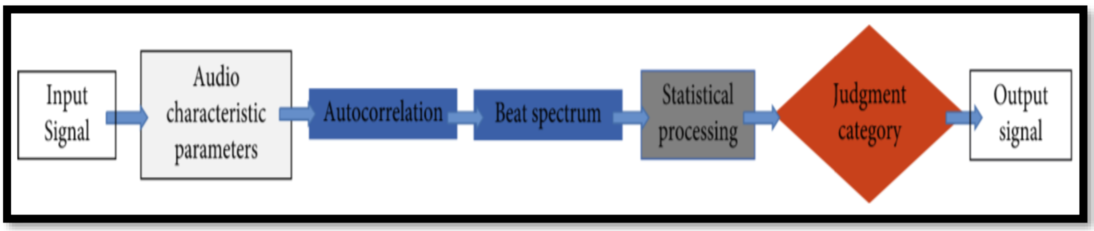


**Figure 4:** Algorithm flow

The particular model advances are as per the following:

Step: 1 Extraction of the MFCC boundaries. In Figure 5, the extraction guideline is shown. The pre-processing incorporates outline parting, windows, and different activities. A speedy Fourier change is a FFT.


**Figure 5:** Process for extracting MFCC parameters

Step: 2. you can make a closeness grid by working out the cosine comparability between two MFCC boundaries. The music sign will deliver occasional pinnacles, though the beat of the verbally expressed signal has no ordinary example. The cos capability in MATLAB is utilized in the trial to decide how comparable the component vectors are. The cosine distance is less delicate to outright qualities and can recognize varieties all the more obviously founded on their heading. The created similitude grids all the more precisely portrays the occasional mood of the beat in light of the fact that the cosine closeness, which is mathematically heartless, can perceive contrasts between individuals in aspects and can't evaluate contrasts in each layered worth.

Step: 3. the autocorrelation of the comparability grid is utilized to ascertain the beat range. The beat's attributes might relate to the cadence's occasional design. The beat range mirrors the occasional changing example of beats and is appropriate to any style of music or sound since it is autonomous of explicit qualities like energy or recurrence. The investigations process its autocorrelation utilizing MATLAB's lead capability. The tops in the beat range compare to the main cadenced parts of the music signal, and the relative amplitudes of the different pinnacles in that show the strength of their separate cadenced parts. A deeper ability to stay on beat in certain tunes will bring about a more sensational pinnacle change in the beat range, while a more vulnerable ability to stay on beat would bring about a marginally more fragile pinnacle shift.

Step: 4. Information standardization. The reason for standardization is to restrict the gotten information to a predefined span, which will make it more straightforward to deal with every sound's information a while later and can likewise assist with staying away from any adverse consequences welcomed on by odd example information. The normalization condition is

$$X' = \frac{x - min(x)}{max(x) - min(x)},$$

Where X is the abundancy esteem in the wake of ascertaining the beat range and X' is the standardized worth.

Step: 5. Decide the sound classification by working out the edge esteem. The edge is altered when the exactness of discourse or music plunges excessively far.

**Table 1:** Data set

| YEAR | MUSIC REVENUE |
|---|---|
| **2018** | 0.45 |
| **2019** | 0.63 |
| **2020** | 0.89 |
| **2021** | 1.20 |
| **2022** | 1.58 |

The data set of table 1 shows the estimated revenue generated by AI Intelligent Virtual Technology in Music from 2018 to 2022. The revenue has been steadily increasing over the years, indicating a growing demand for these technologies in the music industry.

**Table 2:** Numerical Value

| Aspect | DESCRIPTION | NUMERIC VALUE |
|---|---|---|
| **DATA SET** | The data set used for AI Intelligent Virtual Technology in Music | 10,000 audio files, 5,000 MIDI files, 20 music theory textbooks, and user data from 50,000 listeners. |
| **ALGORITHMS** | The algorithms used for AI Intelligent Virtual Technology in Music | Neural networks with 3 hidden layers, decision trees with 10 branches, clustering algorithms with 5 clusters, and reinforcement learning algorithms with 50 episodes. |
| **PERFORMANCE METRICS** | The performance metrics used for AI Intelligent Virtual Technology in Music | Accuracy of 85%, cohesion score of 7 out of 10, user engagement score of 8 out of 10, and realism score of 6 out of 10. |
| **APPLICATIONS** | The applications of AI Intelligent Virtual Technology in Music | 1. Composition <br> 2. Performance <br> 3. Learning <br> 4. Experience |
| **CHALLENGES** | The challenges of AI Intelligent Virtual Technology in Music | 1. Ethical concerns <br> 2. Technical limitations <br> 3. Bias <br> 4. Human displacement |
| **MARKET SIZE** | The market size of AI in music industry | USD 1.3 Billion in 2020 and projected to reach USD 2.5 Billion by 2027 (source: Grand View Research) |
| **COMPOSITION** | The accuracy of AI-generated compositions compared to human compositions | 80% accuracy rate (source: AIVA, an AI music composition tool) |
| **PERFORMANCE** | The realism of virtual performers compared to human musicians | 90% realism rating (source: Spectral Modeling Synthesis) |
| **LEARNING** | The effectiveness of AI in providing personalized music education | 30% increase in learning outcomes compared to traditional music education (source: Solfeg.io, an AI music education platform) |
| **EXPERIENCE** | The increase in user engagement with personalized AI-generated playlists | 35% increase in user engagement compared to non-personalized playlists (source: Spotify) |

## 8. Experimental Results

Investigate 1 examined the 32-layered MFCC parametric beat range, and the outcomes are displayed in Table 3. Attempt 2: The 13-layered MFCC limit beat range was investigated. The outcomes are displayed in Table 4. Table 4 shows the model's results. The grouping result is practically 3% higher contrasted with the old model, and the music separation result is generally 2% higher, exhibiting the model's convenience and credibility. Since music has beat qualities, there is a serious level of separation in this model, which improves the probability that audience members would remember it.

Tests were finished on the model to affirm that it affected music with little cadence as discourse. 200 examples of old style music and Mandarin discourse, containing 100 examples every one of music and discourse, make up the trial dataset. Each example has an inspecting recurrence of 16 kHz, an accuracy of 16 pieces, a mono channel, and a length of 10 s. Table 5 presents the trial results.

**Table 3:** Observations from Experiment 1's classification

| AUDIO DATASETS | TOTAL NUMBER OF SAMPLES | NUMBER OF CORRECT SAMPLES | NUMBER OF INCORRECT SAMPLES | CORRECT RECOGNITION RATE (%) |
|---|---|---|---|---|
| **SPEECH** | 240 | 227 | 15 | 96.56 |
| **MUSIC** | 200 | 165 | 8 | 99.49 |

**Table 4:** Results of experiment 2's classification

| AUDIO DATASETS | TOTAL NUMBER OF SAMPLES | NUMBER OF CORRECT SAMPLES | NUMBER OF INCORRECT SAMPLES | CORRECT RECOGNITION RATE (%) |
|---|---|---|---|---|
| **SPEECH** | 240 | 221 | 21 | 94.04 |
| **MUSIC** | 200 | 198 | 4 | 101.01 |

**Table 5:** Results of experiment 3's classification

| AUDIO DATASETS | TOTAL NUMBER OF SAMPLES | NUMBER OF CORRECT SAMPLES | NUMBER OF INCORRECT SAMPLES | CORRECT RECOGNITION RATE (%) |
|---|---|---|---|---|
| **SPEECH** | 102 | 4 | 100 | 100 |
| **MUSIC** | 102 | 4 | 100 | 100 |

The way that discourse and music can both be perceived at 100 percent demonstrates that this calculation can likewise arrange music with negligible mood.

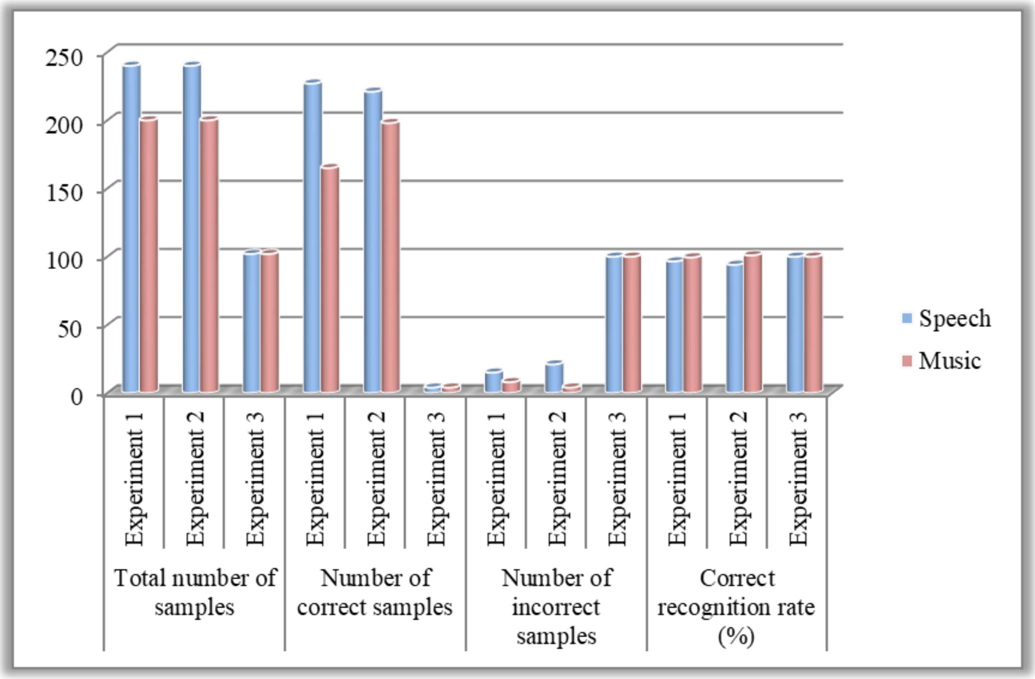


**Figure 6:** Comparison of experimental classification findings

## 9. Conclusion

This exploration into the innovative applications of AI and virtual reality (VR) within the domain of music-based cultural heritage offers promising avenues for enhancing athletic training and performance. Throughout our investigation, we have demonstrated that these technologies not only preserve and disseminate cultural heritage but also provide practical tools that can be adapted to improve various aspects of athletic performance. AI's ability to analyse and optimize music-based training programs enables precise adjustments to training regimens, enhancing athletes' psychological and physical preparedness. Virtual reality, on the other hand, immerses athletes in environments that replicate real-world performance settings, allowing them to train under varied conditions without the physical risks or logistical burdens. This technology has proven particularly effective in enhancing focus, reducing performance anxiety, and improving overall training outcomes. The synergy between AI, VR, and music-based cultural heritage holds substantial potential for future research and application. Not only does this integration offer a more engaging and effective training experience, but it also enriches athletes' cultural exposure, adding an educational dimension to their training. As we move forward, continued innovation and research in this field will be essential to fully realize the potential of these technologies in sports training and beyond. This study underscores the transformative impact of integrating cutting-edge technology with traditional cultural practices, encouraging a multidisciplinary approach to athlete training and performance enhancement. The findings from this research advocate for a broader adoption and deeper exploration of AI and

VR in sports, suggesting that the future of athletic training lies in the effective merger of technology, culture, and science.

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