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Chapter

Diginalysis: The Man-Machine Collaboration in Music Analysis

Ikenna Emmanuel Onwuegbuna

Abstract

The digital technology of the twenty-first century has put man and machine in the center stage where electronic generation, production and manipulation of the musical sound are the norm. The dynamics of the century have made time more elusive and patience more diminutive. Time and patience are vital for any form of successful exercise in music analysis. The intricacies of applying logic to resolve complex musical structures, facts, propositions, and concepts into their elements demand more than technical know-how; they demand a lot of time and patience. With the continued fleeing of time and patience, mechanical accuracy in music analysis would need a full-blown computer-driven "diginalysis." However, inherent limitations of the computer in music analysis, such as decoding the composer's ideologies, necessitate human-machine collaboration. An in-depth descriptive survey has shown that this effective collaboration between man and machine will collapse time and energy by providing immediate feedback, technical accuracy and dependable results.

Keywords: music, analysis, digital, collaboration, computer, software

1. Introduction

Analysis is considered the resolution, by application of logic, of complex structures, facts, propositions and concepts into their elements. By extension, it is the tracing of things to their source and the resolution of knowledge into its original principles, the discovery of general principles underlying concrete phenomena. Music analysis, therefore, is the dissection of the musical composition to separate the component parts of the whole in order to take a proper examination of the nature, function, connotations, compatibility, complementary and unitary contributions of these components. This exercise will, among other things, offer the analyst a chance for proper appraisal of the effects of different compositional and performance techniques on the consumers of the musical product. It will also ensure personal and institutional in-depth studies of the composition. In the words of Achinivu,

> *Through analysis, the various elements of musical architecture become less technical and less dry to music students. Conversely, by their application of the knowledge they have of musical elements and concepts in the analysis of a piece of music, they obtain greater insights into and understanding of musical design and content of form.*

In the recent applications of the theory of observational learning, terms such as *mastery learning*, *teaching machines*, *programmed instruction*, *computer-based training* (CBT), *computer-aided instruction* (CAI) and *audiovisual education* have found their place in the center stage of the twenty-first century educational procedures.

Sidney Leavitt Pressey had, in the 1920s, designed the first set of teaching machines, which provided immediate feedback for multiple-choice tests. In using the machine, the learners had the advantage of correcting their errors immediately. This immediate feedback system enabled the learners to work at the test items until their answers were correct. Improving on the efforts of Pressey, B. F. Skinner, in 1954—exploring the possibilities of his operant conditioning, developed his own version of teaching machine that became known as *programmed instruction*. The basis of Skinner's programming includes simple principles, namely, presentation of information in small steps called frames, immediate confirmation of the learner's response, active responding to induce sustained activity, self-pacing and dual evaluation of learner's progress by both learner and teacher [1–4].

The application of the programmed-learning theory in analyzing music in the twenty-first century, obviously, engages the computer as an inseparable aid. The elements and items for analysis are codified and, thereby, reduced to icons which are packaged in music software (programmed). The programme then becomes the model to be observed and interacted with by the analyst, in a multimedia of presentation. Sociocultural, ideological and historical issues in music—through a human and machine collaboration—can equally, and easily, be reduced into electronic forms for analysis in the same interactive manner as in musical issues [5].

2. Approaches to music analysis

In trying to dissect music, to separate the component parts of the whole in order to take a proper examination of the nature, function, connotations, compatibility, complementary and unitary contributions of these components, the scholar has already embarked on an analytical assignment that would stretch his/her studies into other disciplines than music. Such studies, whether carried out by an individual or a team, would demand the application of knowledge from at least such academic disciplines as sociology, history, anthropology, semiology, linguistics, economics and philosophy. Because of these interpretative demands, there is a need to engage with music analysis from various approaches.

2.1 Musical approach

Certain elements are globally accepted as intrinsic commonalities in the phenomenon of sound. Such elements as rhythm, pitch, timbre and duration when consciously or subconsciously manipulated distinguish the musical sound from the rest. Analyzing music along the lines of its sonic elements, exposing the inherent stylistic features, conventions and idioms is basically in the domain of systematic musicology. This approach tends to describe 'the over-all structure of a piece of music, and ... the interrelationships of its various sections. In most cases, indeed, it is the fitting of this structure into a preconceived mode' [6].

For instance, 'form', as a basic element in music, refers to the structural make-up of a musical composition. It exposes the basic shape of the composition that gives it its distinctive character. Musical form, as one of the characteristic elements of music, is the bases of the systematic and coherent arrangement of the structural design of a musical composition. Apel, therefore, expresses the fact that:

> *Music, like all art, is not a chaotic conglomeration of sounds, but…it consists of sounds arranged in orderly manner according to numerous obvious principles as well as to a still greater number of subtle and hidden relationships which evade formulation. In this meaning, form is so essential to music that it is difficult to imagine a procedure by which it could be avoided [7].*

The musical approach to analysis exposes the stylistic features of the piece, the conventions and the exceptions in the application of those features by the composer and the performers of the piece. In this approach, the analyst is trying to appreciate the composer's application of expressive variables in music—like tonality, rhythm, form, tempo, metre, timbre, intensity and texture.

2.2 Sociocultural approach

In the sociocultural approach, music is considered not just as a sonic material but also a symbolical representation of entities, deities, communities, age-grades, generations, classes, races, norms and societies. Analysis under this approach must expose and explain the determinate associations that are implied in the musical expression and the functionality of music in society.

The sociocultural issues in music—especially the 'popular' genre—are implicated more in the processes and negotiated decisions that lead to the creation and consumption of the musical product, than in the textual pronouncements that make up the lyrics of the song, those belong to the ideological angle of the piece. Other sociocultural-related issues in popular music include recording/performance contracts, copyright protection, signing on a record label, publicity, promotion, marketing, publishing, artiste-patron agreements, collaborations, public performance and broadcasting rights and hiring the services of an entertainment law attorney.

2.3 Ideological approach

Personal opinions held by individual composers and other stakeholders in the musical enterprise, expressed in the textual materials and the musical product, form the bulk of the ideological stance of the music. These opinions could be philosophical, religious, spiritual, political, interpersonal relationships and the total world-view of the composers, which are perceptible, not just in the lyrics but also in the CD sleeves, video clips, interviews, press releases, personality image of the artistes and their style of usage of metalanguage and polyglottism.

2.4 Historical approach

In the historical approach, the analyst embarks on a retrospective study of schemata of music and how they have developed over time. He/she studies the major stylistic features that characterize each particular period and relate them to parallel developments in other forms of the arts and sciences of the same period, and how each individual composer has interpreted the dominating music of his/her own time. In addition, she/he exposes the practices that marked the points of transition from one era to the different practices of another era, thereby establishing the trends that distinguish one period from another.

3. Computer-aided music analysis

The computer technology which saw its modest beginnings in the 1960s and, within a decade of its development, succeeded in turning the world into a global

village, has its impact felt in music production. From the introduction and advancement of music synthesizers and other complementary devices, the once dominating analogue audio recording devices have progressively and dexterously been replaced by digital equivalents [8]. The introduction of computer technology, therefore, started a radical turning point in audio production. This turning point has finally eclipsed the analogue system of recording, giving way to the more efficient, real-time and almost real-life digital system [9–11].

An audio recording in which the raw sounds emanating from the initial sources are represented by the spacing between pulses (bits) rather than by waves, thereby making the sounds less susceptible to degradation, is known as digital recording. In digital recording, computer programmes are used to manipulate the audio data stored in the form of alphanumeric codes. This manipulation is done through mathematical processes [8, 10, 12]. The process involves 'the description of a sound waveform as sequence of numbers representing the instantaneous amplitudes of the wave over small successive intervals of time' [9]. Some of the advantages of the digital technique, according to Salt (as cited in [13]), are:

> *In digital recording systems, many of the distortions are removed because the continuously varying sound signal is transformed into a digital signal (a sequence of binary values, or a series of bits), by a process called quantizing or quantization, as soon as it is captured. This enables the stored sound data to be checked and processed so that it can, in theory, be reproduced exactly as it was recorded.*

The basic advantage of digital storage of the musical sound is the ease of processing, manipulation and analyzing of the data. This flexibility of the digital data has made it a nearly effortless task to create sound effects, enhance quality and ease editing of the recorded sound. This flexibility makes it possible for the analyst to not only engage but also interact with the digitized items. However, the challenge lies in the reversibility of such digitized items.

The creative and production processes involve computer synthesis in digital recording—starting from the generation of audio samples from analogue sources to conversion to digital equivalents through series of voltage steps, electronic means of creating, filtering and modifying sound—mediated via special interfaces such as effects boxes, tone generators, MIDI, drumulator, vocoder and keyboard sampler.

Through the use digital audio software such as Cakewalk, Cubase, Sonar, Nuendo, Adobe Audition and Fruity Loops, among others, audio projects ranging from sampling, sequencing, quantizing, voicing, boosting, compressing, mixing, recording, re-mixing, etc. are successfully delivered. Music analysis is greatly favored by the instant generation of notated music scores by these audio production music software.

In the application of the computer as the analytical tool, the musical elements are codified and, thereby, reduced to icons which are packaged in music software (programmed). The programme then becomes the model to be observed and interacted with by the analyst, in a multimedia of presentation. The reduction of the elements into electronic forms is the major duty of the computer programmers. The analyst, working with professional computer programmers who are adepts in computer programming language, reduces the issues and elements in music into icons for which the options for digitized items are only a click away.

In analyzing the musical elements of tonality, rhythm, form, tempo, metre, timbre, intensity, texture, vocal/performance techniques and orchestration, among others, the items are reduced to icons backed up with motion pictures, simulations, musical examples, sound clips, diagrams, graphs and charts, all of which are activated as soon as the right icon is clicked at. By engaging the computer programmes,

any analyst can dissect a piece of music by selecting and clicking at the right icons to access and interact with the compositional rationalizations of the music composer.

Sociocultural, ideological and historical issues in music can equally, and easily, be reduced to electronic forms for analysis in the same interactive manner as in musical issues. In this multimedia formats, computer-aided music analysis encourages interactive relationships between the analyst and the models through the use of images (still and motion), animations, speeches, sounds, figures and, mostly, music. It is advantageous that the analyst can quickly access information, get immediate feedback, move at his/her own pace, monitor his/her progress, motivate him/herself and learn independently [14–17].

In this era of digital technology, the prospects of computer-aided music analysis have inspired computer programmers to create many programmes with different capabilities and limitations. Some of the programmes are the Digital Alternative Representation of the Musical Score (DARMS), Humdrum, Finale, Sibelius, Lemon and Studio 4. Others with some specialization in audio analysis include Fourier, SoundEdit, AudioSculpt, SARA and Lemur [18–20].

4. The collaboration

Sociocultural issues in music are implicated more in the processes and negotiated decisions that lead to the creation and consumption of the musical product than in the textual pronouncements that make up the lyrics of the song. Here music is considered not just as a sonic material but also a symbolical representation of entities, deities, communities, age-grades, generations, classes, races, norms and societies. Analysis must expose and explain the determinate associations that are implied in the musical expression. The functionality of music in society becomes the main focus of the analyst. Is the purpose for music-making self-fulfilling or group-fulfilling? Is it to train, to communicate, to enlighten, to worship, to praise, to heal, to supplicate, to mourn, to mock, to invoke, to curse, to defy, to survive or what? And what social events are they linked with?

Whether on a live stage or an electronic stage, one observes that the emotions expressed by music performers are not always felt by the artistes; sometimes they are feigned to create a contingent, a utilitarian or an esthetic value. The simulated emotions are constructively packaged by the producers to disguise the commercial intent, thereby succeeding in presenting the art as necessary, useful or entertaining in itself.

The stochastic nature of the foregoing makes it difficult for the computer to detect or decode the creative intent of the composers of such musical phenomena and activities. This limitation also applies to the subject matter encoded in CD sleeves, video clips, interviews, press releases, personality image of the artistes and their style of usage of metalanguage and polyglottism.

The foregoing makes the human-machine collaboration imperative. While the computer analyzes the machine-modifiable music notations, simulations, animations and icons, the rest of the variables that are largely psychological, sociological and philosophical are humanly analyzed to make up for the limitations of the machine. This model of collaboration therefore bestrides the music domain and other related disciplines including visual arts, architecture, design and film-making and editing.

5. Conclusion

The chapter has proposed the effective collaboration of human and the machine in analyzing music—especially in this twenty-first century where the computer

age has expanded the frontiers of the audiovisual creativity—via the system of computer-aided music analysis.

Resources for the composition and performance of electronic music have recently been broadened considerably through the introduction and use of the Musical Instrument Digital Interface (MIDI). The MIDI, as a remarkable system, enables composers to manage quantities of complex information and allow computers, synthesizers, sound modules, drum machines and other electronic devices from many manufacturers to communicate with each other. Originally of interest only to a few so-called serious composers, today MIDI-based systems, are used to analyze and teach music, write and perform film scores, create rhythm tracks for popular music and provide music for computer games. Also with the MIDI, the numbers of ways in which the electronic synthesizer may serve composers seem limited only by the boundaries of human initiative and perception [21, 22].

Music, bestriding art and science, affects a zone where emotion intersects with processes taking place at a corporeal level and is capable of producing tactile, sensuous and involuntary reactions. The musical sound has the ability to change the emotional and physical states of people and could equally alter one in many ways, depending on the composer's manipulation of musical elements and the producer's manipulation of post-production sonic enhancements [23].

By acknowledging this protean nature of music, the chapter has identified the limitations of a single mode of analysis and therefore recommends the dual mode of man-machine collaboration in 'diginalysis'. In this effective collaboration, the computer analyzes the machine-modifiable music notations, simulations, animations and icons, while the human handles the psychological, sociological and philosophical elements of music. While the utilitarian value of this effective collaboration collapse time and energy by providing immediate feedback, technical accuracy and dependable results, the contingent will benefit other related disciplines including visual arts, architecture, design and film-making and editing.

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