An Overview of Electronic Music History

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The evolution of technology in the twentieth century had a huge impact on music. Holmes (2002) declared that music, as we know it today, would not exist without technology. In fact, a new music, called electronic music, evolved in the twentieth century parallel to this technological evolution.

This brief overview of electronic music history is divided into three sections: the early period, post war period, and the modern period.

The Early Period

The early period occurred from around 1900 through the early 1940s, and focuses on performing electronic musical instruments.

There were disagreements over when electronic music actually began. Holmes (2002) gave credit to the first electronic musical instrument to American Elisha Gray who invented the musical telegraph in 1874. Newquist (1989) and Shapiro (2000) acknowledged Thomas Edison’s recording of “Mary Had A Little Lamb” on the first phonograph player in 1877 as the dawn of electronic music. However, the majority
agree that electronic music began at the turn of the twentieth century with the invention of the Telharmonium by Thomas Cahill.

Thomas Cahill and the Telharmonium

Thomas Cahill was granted a patent in 1897 to build an electronic musical instrument and broadcast performances with telephone lines to restaurants, hotels, and private homes. His patent, "The Art of and Apparatus for Generating and Distributing Music Electronically" included the words "synthesizing" and "electrical music", foreshadowing the terms synthesizer and electronic music.

Immediately, Cahill began building an electronic instrument soon to be called the Telharmonium, and in 1901, he formed the New England Electric Music Company in Holyoke, Massachusetts. According to Chadabe (2000a) "In 1905, the New England Electric Music Company signed an agreement with the New York Telephone Company to lay special cables for the transmission of Telharmonium music throughout New York City." (p. 52)
In 1906, Cahill packed his 200-ton Tellharmonium in twelve railway boxcars and moved it to New York City. The first public performance was at the Telharmonic Hall, and the first broadcast was later that year to a restaurant thirteen blocks away. However, telephone conversations were interrupted by the music from the Telharmonium and therefore, the telephone company terminated its agreement. As a result, the Telharmonic Hall was closed and Cahill was forced to move the Tellharmonium back to Holyoke.

With the newly formed New York Cahill Telharmonic Company, Cahill made a second attempt when a franchise to lay cables for the Telharmonium by New York City was passed in 1911. However, the Telharmonium was no longer newsworthy and in 1914, Cahill declared bankruptcy.

After the Telharmonium, many other electronic instruments were built. These instruments benefited from the unique technology that vacuum tubes provided. Dobson (1998) declared the most important instruments were the theremin, the Trautonium, the Ondes Martenot, and the Hammond organ. The theremin and the Hammond organ will be further discussed.

Leon Theremin and the theremin

According to Robert Moog (1999), “the theremin was one
of the first electronic musical instruments" (p.18). Leon Theremin, an engineering student in Moscow, invented the theremin in 1920. It was sometimes referred to as the aetherophone.

An unusual looking instrument, the theremin was a box with two projecting antennas; one antenna extended from the top, while the other, in a loop shape, projected horizontally from the side. Waving one hand close to the vertical antenna controlled pitch, while moving the other hand in close proximity to the horizontal antenna controlled volume. Holmes (2002) stated that the theremin operated on a modulation principle called beat frequency oscillation.

According to Chadabe (2000a), “When he arrived in New York in December of 1927, Theremin was welcomed as a celebrity”. Chadabe continued, “Theremin stayed in New York for ten eventful years before returning to Russia.”

The theremin was featured on the Beach Boys hit, "Good Vibrations" and on Led Zeppelin's "Whole Lotta Love". In addition, it was featured in several movie soundtracks from 1940 to 1960, and in sci-fi television series, such as "Lost in Space" and the "Twilight Zone".
Laurens Hammond and the Hammond Organ

Laurens Hammond invented the Hammond organ in 1935. An ex-watchmaker and businessman, Hammond invented an electronic instrument to be mass produced and profitable. Being the first electronic instrument to be mass-produced, the Hammond organ was a commercial success with more than 5,000 sold before 1940.

The Hammond organ used the same principles as the Telharmonium; additive-synthesis through means of metal tone wheels. Crab (2005) stated that the Hammond organ had a unique drawbar system of additive timbre synthesis.

The Hammond organ has been used in everything from church choirs to daytime game shows and Chadabe (2000a) stated that the Hammond B-3 has achieved legendary status in the music world.

The Post War Period

The post war period was from the late 1940s to the late 1970s. There is evidence of parallel developments in electronic music. This period is broken down into five significant developments: the birth of the electronic music studio in Europe, the birth of the electronic music studio
in America, the birth of computer music, the birth of the synthesizer, and the development of the synthesizer in 1970s.

The Birth of the Electronic Music Studio in Europe

A technological advancement that had a significant impact on electronic music was the mass marketing of the magnetic tape recorder in 1948. Until this time, electronic music had mostly been a live performance medium. But now it had also become a composer’s medium. Imaginative composers began creating *Tape Music*, which referred to sounds that had been recorded on tape, then rearranged and organized into a complete composition. This initiated many tape techniques such as tape splicing, tape echo, tape delay, and tape looping.

Two European broadcasting networks, Radiodiffusion Television Francis (RTF) in Paris and Norwetdeutscher Rundfunk (NWDR) in Cologne, Germany, formed electronic music studios that used the tape recorder, but with different approaches. RTF called their approach *musique concrete* while NWDR called their approach *electronic music*.

In 1948, while working as an electro-acoustic engineer at the RTF, Pierre Schaeffer recorded various sounds from trains and organized them into a
short composition he named *Railroad Study*. To describe his technique, he coined the term *musique concrete*. Musique concrete was defined by Rhea (1988a) as “the manipulation and mixing of natural or ‘concrete’ sounds recorded with a microphone” (p. 1).

It should be noted that Pierre Schaffer used plastic discs, rather than magnetic tape, for *Railroad Study*. It wasn’t until 1951 when Pierre Schaffer and many others at RTF began to use the magnetic tape recorder and the aforementioned tape techniques.

The other aforementioned European electronic music studio that emerged at this time was the NWDR in Cologne, Germany. Differently than the composers at RTF, the composers at NWDR referred to their approach as electronic music meaning that pieces were produced from electronic sources rather than natural sources. Also differently from RTF, one particular person did not pioneer electronic music at NWDR. However, literature predominately mentions Karlheinz Stockhausen who came to NWDR in 1953 and became the studio’s director and principle composer.

The composers at NWDR initially used an additive synthesis approach with a single sine wave oscillator and a
four-track tape recorder. This laborious process was soon enhanced with electronic instruments such as the Monochord and the Melochord.

The Birth of the Electronic Music Studio in America


In 1956, RCA unveiled the new Mark I Electronic Music Synthesizer in New York. Constructed by Harry Olsen and Herbert Belar, it was 20 feet in length, reached from floor to ceiling, and data was entered via punched paper roll. Luening, Ussachevsky, and Princeton University professor Milton Babbitt, became interested in the RCA synthesizer and applied to the Rockefeller Foundation for a grant that to finance a new studio to house the synthesizer. In 1959, a grant for $175,000 was awarded for a joint studio between Columbia and Princeton. It became known as the Columbia-Princeton Electronic Music
Center at Columbia University and housed the improved, behemoth RCA Mark II Electronic Music Synthesizer. Over the next ten years, over sixty composers came to work there.

Luening (1968) stated the following:

The Columbia-Princeton Electronic Music Center was the first American electronic collaborative academic effort focusing on electronic music. We wanted to provide a center where composers could work and experiment without having to contend with the forces of commercialism. At the same time you could feed it to students and make the studio available for people to work in, to experiment on a high level. (p. 43)

Chadabe (1997) stated that the idea of Tape Music was so powerful that electronic music studios spread throughout the world. However, “because equipment was expensive and technical knowledge was necessary, most of the first studios were established at institutions where budgets and technicians were available” (p.52). By 1966, there were 560 known institutional and private studios in the world and an institution of some type sponsored approximately 40% of them.

*The Birth of Computer Music*
The first commercial computers were the UNIVAC in 1951 and IBM 701 in 1953. These large computers were mainframe machines. In 1957, Max Mathews, an engineer at Bell Telephone Laboratories in Murry Hill, New Jersey, demonstrated the first computer-generated sound. This was accomplished with his computer synthesis program, MUSIC I. Over the next several years, Max Mathews and his collaborators at Bell Labs released improved versions of Music I that were referred to as the Music N series. For example, a later version, Music V, was introduced in 1968.

Many significant developments grew from the research at Bell Labs. John Chowning, a graduate student at Stanford University, visited Bell Labs in 1963. Chowning returned to Stanford with MUSIC IV to establish a laboratory for computer music with David Poole. Chowning made a major breakthrough in 1971 when he developed a digital synthesis technique called FM (frequency modulation). FM was licensed by Yamaha in 1974 and was successfully used for commercial digital synthesizers in the 1980s.

By the end of the 1970s, MUSIC V programs were installed in many American universities. However, musicians had to know computer programming to compose computer music with these programs.
The Birth of the Synthesizer

Although the RCA Mark II Electronic Music Synthesizer was introduced in 1956, a majority described the first synthesizer appearing in the early 1960s parallel to the introduction of transistors and voltage-control.

Eisengrein (2004) defined the synthesizer as a transducer that translates electrical energy into sound. Differently, Holmes (2002) defined the synthesizer as a device that was designed to generate purely electronic sounds by analog or digital means. Rhea (1972) stated that most synthesizers are designed for subtractive synthesis; a type of synthesis that modifies complex waves with various types of filters.

The first synthesizers were analog modular systems that used voltage control. Three different men invented the synthesizer independently: Robert Moog in New York, Donald Buchla in San Francisco, and Paul Ketoff in Rome. However, a majority gave credit to Robert Moog. His invention was considered the most traditional because it had a keyboard resembling a traditional piano.

Moog began his construction of a synthesizer for the composer Herbert Deutsch. This synthesizer became a collection of separate modules (e.g. an
oscillator, filter, amplifier, envelope generator) that was connected with patch cords.

In Robert Moog’s (1999) own words:

The modular electronic music synthesizers of the 1960s made by companies such as Buchla, Moog, and others combined some of the tone production and control features of theremins and other early instruments with the sorts of sound generation and processing that were developed by the post-World War II tape composers. Using the technical principle of voltage-control, these large, telephone-switchboard-like instruments enabled musicians to shape and sequence sounds automatically and by purely electronic means. (p. 19)

The sound of Moog’s large modular synthesizers of the 1960s, was popularized by the 1968 release of Wendy Carlos’ Switched on Bach; an all-synthesizer album that became the top-selling classical music of all time. In addition, Kieth Emerson of the rock band Emerson, Lake and Palmer used a Moog modular synthesizer to perform a lead solo on the 1969 hit recording of Lucky Man.

Around 1970, there was an emerging commercial interest in electronic music. Previously, nearly all of Moog’s customers were composers from universities. However, the
musicians recording and performing with these instruments gradually shifted from academia to more mainstream musical genres. Because of this, the focus for synthesizer design moved from academic composer needs to commercial artist needs.

The Development of the Synthesizer in the 1970s

Advancements in technology during the post-war period had a tremendous impact on electronic music. The vacuum tube of the 1950s gave way to the transistor in the 1960s. The integrated circuit and microprocessor appeared in the 1970s. These technological achievements resulted in a decrease in size, cost and complexity for computers and synthesizers.

Demand from musicians led to a large number of companies with new simplified, portable synthesizers. In 1969, ARP Instruments was formed and released the modular Model 2500. Marketed to schools, it was a fraction of the size and cost of the large modular synthesizers that preceded it. But the first commercially portable synthesizer was Moog’s MiniMoog introduced in 1970. Unlike the modular synthesizers that came before, it did not require patch cables. Rhea explains
(1988b), “all the control voltage routings were accomplished with switches and knobs” (p.6).

These small, portable analog synthesizers still had two limitations. First, they were monophonic, meaning that only one note could be sounded at a time, and second, every time a different sound was desired, switches and knobs on the panel had to be painstakingly adjusted. These two problems were soon to disappear. The first polyphonic synthesizer, the Oberheim Four Voice, was introduced in 1975 allowing for multiple notes (chords) to sound simultaneously for the first time. Soon after, the first programmable monophonic synthesizer, the OB-1, was introduced in 1977 allowing different sounds, also known as patches, to be recalled from memory with the single push of a button. Finally, polyphony and programmability were combined in the first fully programmable polyphonic synthesizer in 1978 with the popular Sequential Circuits Prophet-5.

The Modern Period

The modern period occurred from about 1980 to about 2000. It is divided into four sections: the development of
digital instruments, the birth of the Musical Instrument Digital Interface (MIDI), the development of the personal computer hardware and software, and electronic dance music.

The Development of Digital Musical Instruments

By 1980, the introduction of the Synclavier and the Fairlight CMI signaled the dawn of a new era of all digital instruments. However, this impact was only felt at the high-end market. For example, a fully equipped Synclavier in the early 1980s cost more than $200,000. With state-of-the-art synthesis and sampling, they were only affordable by institutions and up-scale studios.

Following the introduction of the Synclavier and Fairlight CMI, digital instruments divided into two branches: synthesizers and samplers. Down the synthesizer branch, the Yamaha DX7, in 1983, was the first commercially viable digital synthesizer. Verderosa (2002) indicated its popularity, “The DX7 became the fastest selling and most popular synthesizer in history”. It was so popularity because it incorporated MIDI (Musical Instrument Digital Interface), sounded good, had 16-note polyphony, and was priced for less than $2,000. Gerrish (2001) stated that the DX7 was a pivotal shift from
analog to all-digital synthesizers. In addition, “The digital keyboard became an essential piece of gear for anyone interested in electronic music”. The DX7 used the aforementioned FM synthesis technique that John Chowning invented at Stanford University in 1971. FM and other techniques were used for digital synthesizers throughout the 1980s and 1990s. However, many people turned to samplers due to their ability to digitally record and playback any sound.

During this time, technology was advancing quickly and prices were dropping rapidly. In a five-year period, the price of a digital sampler dropped from $25,000 for a Fairlight CMI in 1979, to $10,000 for an E-mu Emulator in 1981, to less than $1,300 for an Ensoniq Mirage in 1984. By 1988, Ensoniq had sold 30,000 Mirage samplers. According to Kettlewel (2002), digital samplers had become one of the most significant tools for electronic music. They were able to replay a digitally stored sample (recording) whenever triggered by a note. In addition, samples could be edited with various techniques such as looping, pitch shifting, and crossfading. These editing techniques are analogous to the aforementioned tape editing techniques that were used
for musique concrete. Verderosa (2002) said that samplers allowed composers to playback more accurate representations of acoustic instruments.

The Birth of MIDI

By the late 1970s, the number of manufacturers for electronic music instruments had grown to include American companies such as Moog, Arp, E-mu, Sequential Circuits, Oberheim, and many Japanese companies such as Roland, Korg, Yamaha and Kawaii. However, on a control level, a product from one company could not communicate with another. Therefore, you had to buy products from the same company to ensure compatibility for communication.

During June of 1981, the idea of a standard for digital communication between electronic music devices was discussed between Ikutaro Kakehashi of Roland, Tom Oberheim of Oberheim, and Dave Smith of Sequential Circuits. In October, a meeting was arranged with representatives from Korg, Yamaha and Kawaii. Following, in November, Dave Smith proposed the Universal Synthesizer Interface (USI) at the Audio Engineering Society (AES) convention in New York. The name was changed to Musical Instrument Digital Interface (MIDI) while being further refined throughout 1982. In January 1983, MIDI was first demonstrated at the National
Association for Musical Merchants (NAMM) show when a Roland JP-6 synthesizer successfully communicated with a Sequential Circuits Prophet 600 synthesizer. Music could be heard coming from both synthesizer keyboards whenever a person played only one of them. In August of 1983, the MIDI 1.0 specification was published.

*The Personal Computer and Development of Software*

Webster (2002) stated that during this period, “we witness the growth of small, but powerful, personal computer systems” (p.39). Holmes (2002) added, “the personal computer has become an essential component of the electronic musician's equipment arsenal” (p.211). The first personal computers, such as the Apple II and the Commodore 64, appeared in the late 1970s and were adequate for some music applications. The IBM PC, which was introduced in 1981, were regarded by many sectors of the computing industry as little more than a tool for hobbyists. A turning point for music occurred with the introduction of the Macintosh.

In January of 1984 Apple Computer introduced the Macintosh computer. Its easy to use graphical interface was well suited for musical applications.
and therefore became the choice platform for musicians. Incorporating MIDI, music applications were being written for the Commodore 64, the Atari ST-series and the IBM PC, but the Macintosh became the leading platform.

The year 1985 saw a rapid growth in MIDI software developers. Introducing many different types of applications, the most common application was the MIDI sequencer. Modeled after a multi-track tape recorder, it allowed the recording and playback of MIDI information with MIDI devices such as an electronic keyboard. Leading companies for the MIDI sequencer were established at this time; Opcode Systems, Mark of the Unicorn and Steinberg. Other types of MIDI software introduced at this time included patch editors, music notation, auto-composers, automatic accompaniment, music theory and ear-training programs.

Having nothing to do with MIDI, the first digital audio programs appeared in 1985 as editor programs for samplers. The first serious digital audio program to be an alternative to a two-track tape recorder was Digidesign’s SoundTools introduced in 1988. Then in 1990, a milestone development occurred when Opcode combined MIDI sequencing and digital audio in the same environment. This started a new family of software that is still common today with
programs such as Digital Performer, Pro Tools, Cubase SX and Logic Pro.

The launch of Microsoft Windows 95 provided a Graphic User Interface (GUI) for the PC platform that met the essential requirements for modern personal computing. By the year 2000, Windows had a repertory of music software finally to rival that available for the Apple Macintosh. Both the Macintosh and IBM-type machines had become the dominant computers for music performance and education.

In 1996, Steinberg developed VST (Virtual Studio Technology) for the ability to add audio effects and processing as plug-ins to their digital audio sequencer, Cubase VST. This technology became a standard and in 1999, the release of VST 2.0 pioneered the development for software synthesizers and samplers. Russ (2004) stated that by the beginning of the 21st century, software was able to emulate synthesizers and samplers, and the comparatively low cost of software to hardware allowed many more people to explore sound design with synthesizers and samplers.

By 2000, it is clear that a world previously dominated by hardware products is fast becoming more supportive for computer-based systems offering facilities based on software rather than hardware.
Electronic Dance Music

This genre of music has spawned many new electronic music techniques such as turntableism and remixing. According to Verderosa (2002), the DJ was the driving force for this movement. It has birthed a plethora of electronic music sub-genres such as techno, house, electro, jungle, and breakbeat.

REFERENCES


