

Player piano

A **player piano** (also known as **pianola**) is a self-playing piano, containing a pneumatic or electro-mechanical mechanism that operates the piano action via programmed music recorded on perforated paper, or in rare instances, metallic rolls, with more modern implementations using MIDI. The rise of the player piano grew with the rise of the mass-produced piano for the home in the late 19th and early 20th century.^[1] Sales peaked in 1924, then declined as the improvement in phonograph recordings due to electrical recording methods developed in the mid-1920s. The advent of electrical amplification in home music reproduction via radio in the same period helped cause their eventual decline in popularity, and the stock market crash of 1929 virtually wiped out production.



A restored pneumatic player piano

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Steinway reproducing piano from 1920. Harold Bauer playing Saint-Saëns' Piano Concerto No. 2 in G minor, Op. 22, excerpt of 3rd movement. Duo-Art recording 5973-4

Predecessors

The idea of automatic musical devices can be traced back many centuries, and the use of pinned barrels to operate percussion mechanisms (such as striking bells in a clock) was perfected long before the invention of the piano. These devices were later extended to operate musical boxes, which contain a set of tuned metal teeth plucked by the player mechanism.

An early musical instrument to be automated was the organ, which is comparatively easy to operate automatically. The power for the notes is provided by air from a bellows system, and the organist or player device only has to operate a valve to control the available air. The playing task is ideally performed by a pinned barrel, and the art of barrel organs was well advanced by the mid-18th century.

The piano is a complex instrument, requiring each note to be struck with a different force to control the dynamics of the performance. The entire force required to sound the note must be given by the performer hitting the keys. It proved to be difficult for a player device to combine a variable percussive force and a controlled note duration. Barrels do not provide a percussive force, but a relatively gentle

switching motion.

Early barrel pianos moved the hammer back and forwards continuously as the operator turned the handle, but the hammers did not strike the strings until moved slightly forwards by a pin in the barrel. The hammers hit repeatedly until the pin was removed. This played the note, but at a fixed dynamic and with a tremolo action quite unlike a pianist.

The development of the player piano was the gradual overcoming of the various difficulties of controlled percussive striking and note duration. The earliest practical piano playing device was probably the Forneaux Pianista, which used compressed air to inflate a bellows when the barrel pin opened a valve. This bellows struck the piano key and so played the note.

The acceleration of developments leading to the pneumatic 'player' device started in the 1840s and began to reach some recognizable device in the 1870s. The start of the player period can probably be seen as the Centennial Exposition of 1876 in Philadelphia, USA. At this exhibition were a number of automatic player devices, including the Pianista, that contained the elements which would lead to the player.

The earliest description of a piano playing device using perforated paper rolls was Claude Seytre's French patent of 1842. The concept was sound, but the device described was impractical in the way it read the roll and operated the piano.

In 1847, Alexander Bain described a device that used a paper roll as a 'travelling valve' that allowed air to flow through the reeds of a reed organ. Simple reed and pipe organs using this sort of system are still being produced. However, the air flow is not sufficient to drive a piano mechanism. In 1848 Charles Dawson of England described a more complex travelling valve device which added little to Bain's.

Hunt & Bradish of the US, 1849, used a roll read by sprung fingers, the springs being strong enough to operate the piano mechanism directly. This device applied the entire playing strength to the paper, so would have shredded it rapidly, and the device would have had to be as wide as the piano keyboard.

In 1851, Pape, England, submitted a patent that recognized the need to remove the playing force from the paper, using light springs to read the roll and activate a more robust device which plays the note—a mechanical amplifier.

The first device to address the practical requirement of operating a piano mechanism was Forneaux's, of 1863. This recognized that a hard strike was needed to throw the hammer towards the keys. It used a traditional barrel, but tripped a pneumatic device that inflated bellows rapidly to operate the note. In 1871 a perforated cardboard book was substituted for the barrel, but it was still read using sprung fingers. This device entered manufacture, and is generally regarded as the first practical player device. It was exhibited in Philadelphia in 1876.

Van Dusen's American patent of 1867 was the first to describe a pneumatic striker operated by a roll. It was probably based on the work of John McTammany.

A leap in thought occurred in the 1873 patent of the Schmoele brothers. They described a 'double valve' system that acted as a pneumatic amplifier, reading the roll electrically and operating the pneumatics with an electromagnet. They also exhibited at Philadelphia. With some modification, and pneumatic reading of the roll, this would become the final player piano some 20 years later, although the Schmoele brothers never benefited from it.

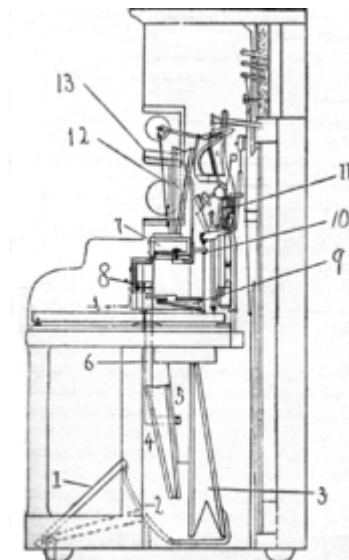
In 1876, John McTammany exhibited a working player in Philadelphia that used a paper roll read using sprung fingers whose slight movement triggered a mechanical player device. This operated a reed organ. McTammany had been experimenting since the mid-1860s, and went on to be one of the key names in the early player industry. He claimed to be the inventor of the 'player', but not the 'player piano'—an important distinction.

As of 1876, in Philadelphia, three working devices were exhibited that between them contained almost all the components that the final player piano would require. However, it was to be 20 years before all these aspects were combined. Surprisingly, the missing component was the pneumatic reading of the roll. This was in all probability due to the lack of suitably flexible airtight material to translate the air flow into the mechanical movement needed to trigger the player device.

The mechanism that finally came into widespread use in the 20th century was all-pneumatic, with foot-operated bellows providing a source of vacuum needed to operate a pneumatic motor driving the take-up spool while each small inrush of air through a hole in the paper roll was amplified in two pneumatic stages (the so-called double valve mechanism) to sufficient strength to strike a loud note.^[2]

Development

1900–1910



The mechanism of a player piano.

1. Pedal. 2. Pedal connection. 3. Exhauster (one only shown). 4. Reservoir; high tension (low-tension reservoir not shown.) 5. Exhaust trunk. 6. Exhaust tube to motor. 7. Air space above primary valves. 8. Secondary valves. 9. Striking pneumatic. 10. Connection from pneumatic to action of piano. 11. Piano action. 12. Pneumatic motor. 13. Trackerboard (music roll passes over trackerboard).

The Pianola was advertised in one of the highest-profile campaigns ever, making unprecedented use of full-page color advertisements. It cost \$250 (equivalent to \$7,500 in 2018). Other, cheaper makes were launched. A standard 65-note format evolved, with 11¼-inch-wide (290 mm) rolls and holes spaced 6 to the inch, although several player manufacturers used their own form of roll incompatible with other makes.

Huge sums were spent: by 1903, the Aeolian Company had more than 9,000 roll titles in their catalog, adding 200 titles per month. Many companies' catalogs ran to thousands of rolls, mainly of light, religious or classical music. Ragtime music did feature, but not commonly: in this period, the player was being sold on its artistic capabilities to rich buyers.

The pioneer of this decade was Melville Clark, who introduced two key ideas: the full-scale roll which could play every note on the piano keyboard, and the internal player as standard. Both ideas were ridiculed by his competitors as unnecessary or impractical, but Clark rapidly won both battles.

By the end of the decade, the piano player device was obsolete, as was the 65-note format. This was a major catastrophe for many small manufacturers, who had spent all their capital on setting up 65-note player operations, and the result was rapid consolidation in the industry.

A new full-scale roll format, playing all 88 notes, was agreed at an industry conference in Buffalo in 1908, the so-called Buffalo Convention. This kept the 11¼-inch roll, but now had smaller holes spaced at 9 to the inch. Any player made anywhere in the world could now play any make of roll. Understanding the need for compatibility was the defining moment of the player industry. The consensus was key to avoiding a costly format war, which plagued almost every other form of entertainment media that followed roll music.

While the player piano matured in America, a young inventor in Germany, Edwin Welte, was working on a player which controlled all the aspects of the performance automatically, so that his machine would play back a recorded performance exactly as if the original pianist was sitting at the piano keyboard. This device, the Welte-Mignon, was launched in 1904. It created new marketing opportunities, as manufacturers could now get the foremost pianists and composers of the day to record their performances on a piano roll, allowing owners of player

pianos to experience such a performance in their own homes on their own instruments, exactly as the original pianist had played it.

From the early days, manufacturers sought to create mechanisms which would pick out the melody of a musical composition over the background of the rest of the music in the same manner as a live pianist. The true player piano was designed to be a fully interactive musical experience rather than merely an automatic instrument, and hence they are fitted with interactive control levers intended for the "player pianist" or "pianolist" to create a music performance to their own taste. The player piano would provide aspiring pianists and music lovers with the technical dexterity they lacked while permitting them to control the musical performance interactively as if they were an accomplished pianist.

Aeolian introduced Metrostyle in 1901 and the Themodist in 1904, the latter being an invention "bringing out the melody clearly above the accompaniment."^[3] With sales growing rapidly, and the instruments themselves relatively mature, this decade saw a wider variety of rolls become available. Two major advances were the introduction of the **hand-played roll**, both classical and popular, and the **word roll**.

- **Hand-played rolls** introduced musical phrasing into the rolls, so that player pianists did not have to introduce it through the use of tempo controls – something that few owners ever felt much inclination to do.
- **Word rolls**, a significant 1916 innovation, featured printed lyrics in the margins,^[4] making it simple to use players to accompany singing in the home, a very popular activity in the years before radio and acceptable disc recordings became available.

The other major advance was the arrival of major commercial rivals for the Welte-Mignon: the Ampico and the Duo-Art systems, both launched around 1914. When World War I came in 1914 and German patents were seized in the US, these two companies were left to compete with each other. In England, Aeolian had a huge factory and sales network, so easily outsold the Ampico. It is estimated that perhaps 5% of players sold were reproducing pianos.

In America by the end of the decade, the new 'jazz age' and the rise of the fox-trot confirmed the player piano as the instrument of popular music, with classical music increasingly relegated to the reproducing piano. Most American roll companies stopped offering large classical catalogs before 1920, and abandoned 'instrumental' rolls (those without words) within a few years.

Things were somewhat different in England, where the Aeolian Company continued to promote classical material to a receptive public. Word rolls never became the norm in England, always being charged at a 20% premium over non-word rolls. As a result, post-World War I American and British roll collections look very different.

1950–present

During the early 1950s, a number of collectors began to rescue player pianos and all the other instruments of the 1920s and earlier. Amongst them was Frank Holland, who formed his collection while working in Canada. On returning to England he located a number of like-minded enthusiasts and started to hold meetings at his house in west London. In 1959 this was formalized as 'The Player Piano Group'. By the early 1960s, Frank Holland had formed the British Piano Museum (now the Musical Museum) in Brentford.

In America, another collector was Harvey Roehl, who was so enthused by the players that in 1961 he published a book called *Player Piano Treasury*. This sold by the tens of thousands, and was followed by books on how to rebuild and restore these instruments. Harvey Roehl's Vestal Press was a major driving force in raising awareness of the player piano within the general population.

Other societies worldwide were formed to preserve and study all aspects of mechanical music, such as the Musical Box Society International (MBSI) and the Automatic Musical Instruments Collector's Association (AMICA^[5]) in the USA.



A player piano performing

In 1961, Max Kortlander died of a heart attack, and QRS was run by his wife until she sold the company to Ramsi Tick in 1966, in whom it found another stalwart champion whose business philosophy was not so much profit as to limit losses. QRS's presence ensured that owners of newly awakened players could purchase rolls of the latest titles, so ensuring that the instrument remained current, not just a historical curiosity.

So great was the revival that in the 1960s, production of player pianos started again. Aeolian revived the Pianola, albeit this time in a small spinet piano suited to post-war housing. Other manufacturers followed, and production has continued intermittently ever since. QRS today offer a traditional player piano in their Story and Clark piano.

In recent years, there has been greater focus on full rebuilding as original instruments finally stop working. Early enthusiasts could often get by with limited patching, but the repair requirements have slowly risen, although even to this day it is possible to find original 1920s instruments that still work after a fashion – a tribute to their quality, and an indication of their continued popularity.

Types

While there are many minor differences between manufacturers, a player piano is a piano that contains a manually controlled pneumatically operating piano player mechanism. It is intended that the operator manually manipulates the control levers in order to produce a musical performance. Various aids to the human operator were developed:

Split stack control

These instruments (the vast majority of all player pianos) have the pneumatic player mechanism divided into two approximately equal halves. The operator can lower the volume of either half of the keyboard independently of the other in order to create musical effects.

Theme control

These instruments have peripheral pneumatic hardware systems fitted which, when used in conjunction with special music rolls, are able to highlight those notes in the score which are intended to be accented away from those whose volume it is desired to subdue. Basic theme pianos subdue all notes and release full power to only those notes which are aligned with special music roll "theme" perforations. Subtler systems (such as Hupfeld's "Solodant" and Aeolian's "Themodist") have a graduated theme control where the background subdued level and the foreground melody level are both controllable. The nature of the mechanism is such that where a chord occurs notes to be emphasised have to be advanced slightly away from their neighbors in order for the mechanism to identify them.

Isolated theme

The hardware of these pianos is able to pick out the melody notes away from their background accompaniment within the entire range of the keyboard without the necessity for breaking up chords i.e. a software workaround. Manufacturers of these systems were the UK "Dalian" and "Kastonome" and the US "Solo Carola".

Expression player

The hardware of these pianos is able to generate a broad general musical dynamic from roll coding. The pneumatic stack operates at fixed pre-set tension levels depending on the coding giving a general effect of musical dynamics. Examples of this system are "Recordo" and "Empeco"

Reproducing pianos

These are fully automated versions of the player piano requiring no human manual control in order to produce the illusion of a live musical performance. This is achieved by the utilization of music rolls where tempo mapping is fully incorporated into the music rolls i.e. the note lengths of a live performance have been captured. The volume dynamics are created by peripheral



Steinway Welte-Mignon
reproducing piano (1919)

pneumatic expression accessories under control of system-specific music roll coding. This obviates the need for human manipulation of the manual dynamic control levers. Typically an electric motor provides power to remove the human operator from the necessity to provide motive power by treading. Most reproducing pianos are capable of manual over-ride operation, and many are constructed for dual functionality both as regular player pianos and also as reproducing pianos. Numerous companies made these utilizing different technology. The first successful instrument was called the "Mignon" launched by Welte in 1904.

Music rolls

Music rolls for pneumatic player pianos, often known as piano rolls, consist of a continuous sheet of paper rolled on to a spool. The spool fits into the player piano spool box whereupon the free end of the music sheet is hooked onto the take-up spool which will unwind the roll at an even pace across the reading mechanism (the "tracker bar") The music score to be played is programmed onto the paper by means of perforations. Different player systems have different perforation sizes, channel layouts and spool fittings though the majority conform to one or two predominant formats latterly adopted as the industry standard.



A player piano roll being played

Music is programmed via a number of methods.

1. the music is marked out on master stencil on a purely metronomic basis direct from the printed sheet music with the player-pianists being left to create their own music performance
2. the music stencil is created metronomically via a piano-keyboard operated punch machine
3. a live performance is played onto a special piano connected to an electronically operated marking mechanism, and a physical stencil is produced from this live output, either as-is or after some general regularisation of tempo where necessary
4. modern computer software and MIDI software can be used to create piano roll stencils for operating modern-day perforating machines and create new titles.

The player piano sold globally in its heyday, and music rolls were manufactured extensively in the US, as well as most European countries, South America, Australia and New Zealand. A large number of titles from all manufacturers survive to this day, and rolls still turn up regularly in large quantities.

It was reported that the last remaining mass producer of piano rolls in the world, QRS Music, temporarily halted production of the rolls on December 31, 2008.^[6] However, QRS Music still list themselves as the only roll manufacturer remaining, and claim to have 45,000 titles available with "new titles being added on a regular basis".^[7]

Preservation and restoration

Roll scanning has made significant advances in recent years, applying technology to possibly the most obvious yet hardest of all conservation and preservation topics, the replication of aging and disintegrating piano rolls.

Roll scanning is the process of reading a music roll into a computerized form that can be used for any purpose, such as cutting new rolls or operating old or new instruments directly. This uses the same technology as domestic flatbed scanners, hence the term roll scanner. The ubiquity of computers makes scanning fundamental to the preservation of rolls of all types, as well as providing the basis for secondary activities such as operating instruments directly. Roll master re-creation is the process of understanding how the roll was originally manufactured so that errors arising from the scanning are removed, and the computer works to the same accuracy as the original perforators in the roll factory. This allows exact replica rolls to be made, and maximizes the accuracy of any secondary activity.

Replication of the original master from which a perforated paper roll was created is the highest aim of roll scanning. Roll masters are not literally replicated, because they were originally large cardboard rolls, but re-created in a computerized form. The rationale is that starting with the master in this form, anything can be done with the music – cut new rolls, operate player pianos fitted with electronic valves, or simulate a performance for playing on modern instruments – all without introducing any errors.

This is the case because virtually all rolls were punched in fixed rows, where punches will occur only in one row or the next, but never in between: the roll is effectively a digital storage medium. Scanning simply counts the distance from the start of the roll to each note event, giving an analogue, and hence inaccurate, representation of the roll. If instead the rows are counted, the result is an exact representation of the original roll – a perfect digital copy. This can be done by applying knowledge about the original roll's creation to the scan.

Once the master computerized copy has been recreated, all of the information in the roll is retained, and anything done after this can be done with the accuracy of the original roll. When using the analogue version, all its timing errors are carried through to whatever is done with it. This is particularly true when making recut rolls, where imposing the punch-row spacing of the perforator over the (different) row spacing of the original roll causes surprisingly obvious and audible errors. However, even analogue uses of the scan, such as operating instruments directly, benefits from the recreated master because of the way it removes timing errors from the basic scan, and in so doing allows the accuracy of the scanner itself to be calibrated.

Roll scanning itself is not of major significance – it simply adds optical technology to the pneumatic, electrical and mechanical technologies previously used to extract data from perforated paper. The ability to store the extracted data on electronic media marked the start of the modern era of scanning, but did little more than act as a substitute for the paper roll. The most familiar such system is the Marantz Pianocorder, but at least two systems were produced, by Wayne Stahnke and Peter Phillips, to operate pneumatic pianos.

From having the performance in "streaming" form on a tape to extracting the note events into a list in a computer is a fairly small step. Such computerisation of the scanned data adds the ability to edit and manipulate it. The key advance is the manipulation that converts the analogue scan data to a replica of the perforation master.

The first serious and sustained roll master replication exercise was probably that of Wayne Stahnke, who described his by-then completed methods in the *Mechanical Music Digest* in March 1996, and used them to practical advantage in his Rachmaninoff-Bösendorfer CDs. He started with a pneumatic roll reader (from the mid-1970s, for the IMI Cassette Converter system and later projects) and later moved to an optical system. He has been offering commercial scanning and roll master re-creation since the mid-1990s.

Within UK Player Piano Group circles, the topic of recreating roll masters was already well established by 1996. Rex Lawson had raised the topic as part of his work developing a perforation-level roll editor software suite for his Perforetur rolls, and the topic was publicly discussed in the PPG bulletin during winter 1994/5 when Lawson explained precisely why rolls should be copied punch-for-punch, digitally.

Richard Stibbons started his roll-scanning attempts in the mid-1990s, and described his progress in PPG article “The PC Pianola” in December 1995. Soon afterwards he adopted the master replication idea, described very thoroughly in September 2000. This led directly to the launch of the Rollscanners group in February 2001.

The aim of this group has been to focus and publicise scanning efforts worldwide, encouraging sharing of progress and knowledge, a radical shift from the earlier essentially private attempts.

Modern implementations

Later developments of the **reproducing piano** include the use of magnetic tape and floppy disks, rather than piano rolls, to record and play back the music; and, in the case of one instrument made by Bösendorfer, computer assisted playback.

In 1982, Yamaha Corporation introduced the "Piano Player", which was the first mass-produced, commercially available reproducing piano that was capable of digitally capturing and reproducing a piano performance using floppy disk as a storage medium.^[8] The Piano Player was replaced in 1987 by the Yamaha Disklavier and since 1998, the Disklavier PRO models are capable of capturing and reproducing "high-resolution" piano performances of up to 1024 velocity levels and 256 increments of positional pedaling using Yamaha's proprietary XP (Extended Precision) MIDI specification.^[9]

Almost all modern player pianos use MIDI to interface with computer equipment. Most modern player pianos come with an electronic device that can record and playback MIDI files on floppy disks and/or CD-ROMs, and a MIDI interface that enables computers to drive the piano directly for more advanced operations. The MIDI files can trigger electromagnetic devices called solenoids, which use electric current to drive small mechanical pistons mounted to the key action inside the piano. Live performance or computer generated music can be recorded in MIDI file format for accurate reproduction later on such instruments. MIDI files containing converted antique piano-rolls can be purchased on the Internet.

As of 2006, several player piano conversion kits are available (PianoDisc, Pianomation, etc.), allowing the owners of normal pianos to convert them into computer controlled instruments. The conversion process usually involves cutting open the bottom of the piano to install mechanical parts under the keyboard, although one organization—Logos Foundation—has manufactured a portable, external kit. A new player piano conversion kit was introduced in 2007-08 by Wayne Stahnke, the inventor of the Bösendorfer SE reproducing system, called the "LX".

Steinway now manufactures a player piano based on Wayne Stahnke's Live Performance LX system. Live Performance Model LX, was sold to Steinway in 2014 and re-branded as Spirio. In contrast to other piano brands, a recording option is not available in Steinway Spirio pianos.^[10]



Player and control unit of Yamaha Disklavier Mark III



Sequencer control unit of Yamaha Disklavier Mark III

Comparison to electric pianos

A player piano is neither an electric piano, electronic piano, nor a digital piano. The distinction between these instruments lies in the way sounds are produced. A player piano is an acoustic piano where the sound is produced by hammer strikes on the piano strings. Electrical or electronic components are limited to moving the keys or hammers mimicking the actions of a person; no sound is produced from electrically amplified audio.

See also

- Mechanical organ
- Punched tape
- Virtual piano
- Circus Galop*, a piano piece specifically designed for the player piano
- Conlon Nancarrow, a significant composer for the player piano

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External links

- The Pianola Forum (<http://pianola.fr.yuku.com/>) The Pianola Forum
 - The Pianola Institute (<http://www.pianola.org/>) London, England
 - The Musical Museum (<http://www.musicalmuseum.co.uk/>) in London, England
 - The Music House Museum (<http://www.musichouse.org/>) in Traverse City, Michigan, USA
 - The Player Piano Group (<http://www.playerpianogroup.org.uk/>) England
 - Upright Player Piano, Weber / Aeolian Co. Ltd., Hayes ca. 1927, Andrzej Szwalbe Collection, Ostromecko Palace near Bydgoszcz, Poland (<http://www.fortepian.instrumenty.edu.pl/en/pianos/show/piano/37>)
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