

Digital Technology

Rain D. Spann
Department of Electrical and Computer Engineering
Old Dominion University
 5115 Hampton Blvd.
 Norfolk, VA, 23529
 rspan004@odu.edu

Abstract—Introduction: Digital Art is a form of artwork produced by using digital technology. This digital medium has undergone several technological advancements since the 1990s and as technology advances it also moves forward.

Timeline: Since the 1940s all the way up to the 1990s, where digital art broke into the mainstream media, digital art has seen many technological developments that have helped shape it into the medium we see today. With technological development and cultural influence from movements in art history digital art has developed its own ideas and foundations.

Reception/Response: The resulting impact on Digital Art can be seen across several mediums. What was once seen as a peripheral has now been recognized by the mainstream art world. This has resulted in new ways for artists to showcase work, build careers using the technological advancements, and network with companies who have come to recognize the value of Digital Art.

Current Situation: Due to technology being used to build social media platforms and digital art markets, there has been a new development in the way artists who specialize in digital art sell that art. These platforms have introduced new ways for buyers to interact, experience, and buy digital art.

Conclusion: Digital Art began as a questionable medium but grew to become one of the leading forms. Over the last few decades it has steadily become one of the most popular mediums in mainstream culture and as technology continues to advance it only becomes more popular.

Index Terms- Digital Art, Technology, Computer, Engineering, EAT, ZKM, Dada, Fluxus, Conceptual, Media

I. INTRODUCTION

D

igital Art is an extensive and broad medium of art that has took the art world by storm since its break into the mainstream in the late 20th century. There are many questions pertaining to its origins and what how it has exactly come to be a respectable form of art next to the traditional mediums such as oil paint on canvas. With many questions surrounding its origins and how it exactly came to be, there are many answers that can be found if one simply analyzes the rise of the computer and technology in general. You see, Digital Art has

its origins rooted in the development of technology, more specifically the development of the computer. As read in “Digital Art: Third Edition”, the history of computer art or digital art is “inextricably linked to the military-industrial complex and to the research centres...” [1] Now, even though the first evidence of computers can be seen as early as the mid-1940s, they were not utilized in the practice of computer art until the 1960s and did not have a breakthrough until the 1990s. According to Christian Paul in Digital Art: The Third Edition, the breakthrough took “...up to sixty years...” (pg.7 line 5) of development [2]. This breakthrough into mainstream media can be credited to the many technological developments that preceded it. These technological developments were rapid and not only led to the rise of computer art, but also the increasing rate of urbanization.

These sudden rises led to more affordable technology. As more and more people began to gain access to computer technology and the various programs that would later be used to create digital art, this new medium started to find its way out of the peripheral and into the passenger seat. With the newly found popularity of the digital art medium came more acceptance, understanding, and generally more open arms. This new embracement would then lead to more organized exhibitions of digital art in major galleries and on major platforms. One of these is the piece “The Legible City (Amsterdam), Jeffrey Show, 1990 [3]. As Digital Art began to gain popularity, it began to evolve. It went from computer art to multimedia art, to cyber art, and so on. This evolution would eventually lead to the categorization of digital art. Different sub-mediums and forms of the original medium would slowly, but surely, begin to emerge and develop unique distinctions based on language, technological evolution, and historical evolution.

II. TIMELINE

The history of Digital Art starts with the development of the computer. As mentioned in the introduction, the medium known as “Digital Art” has been shaped largely by the history of scientific development and the history of technological development. This development had much to do with the military and research environments. The history of the computer can be traced back to 1945 when an article, entitled: “As We May Think”, was written by scientist Vannevar Bush and published by the Atlantic Monthly [3]. In this article, Bush described a device called the Memex [4]. The Memex, as read in “Digital Art: Third Edition” was a desk with translucent screens that would allow users to browse documents and create their own trail through a body of documentation [5]. This innovation was just an idea, but it highlighted documentation via books, periodicals, images, etc. All of which would come to be vital in a modern “trail” that we call “the internet”. A year later, the world’s first digital computer was presented by the University of Pennsylvania. The innovation was known as ENIAC (Electrical Numerical Integrator and Computer) and it took up the space of a whole room. Fast forward five years later and the first commercially available computer has been patented. This computer was not

only important for the advancement of individual accessibility, but also important in the jump that Digital Art was soon to take. This new commercially available computer was now built with the capability to process numerical data and textual data. With the newly found capabilities of the computer, one can see how this single moment of mass manufacturing was preceded by years of study in the 1940s. Not only did the preceding years lead to the computer, it also led to the creation of a new study called “cybernetics”.

Cybernetics was coined by American scientist Norbert Wiener (1894-1964). Wiener, as mentioned in *Digital Art: The Third Edition*, based the terminology based on the idea for “comparative study of the different communication and control systems, such as the computer and the human brain” (pg. 9 lines 15-20) [6]. This ideology would go on to form the foundation of the concept known as the “man-machine” symbiosis. This new concept would then go on to influence the exploration of many digital artists. After this newly found development, the 1960s came. This decade served as one of the most important time periods in the history of digital technology. During this time period many foundations for ideas that we see in today’s technology and artistic exploration were laid.

In 1961, Vannevar Bush’s ideas were taken to a new level by the American scientist Theodor Nelson. During this time period, “hypertext” and “hypermedia” were coined to represent “a space of writing and reading where texts, images, and sounds could be electronically interconnected and linked by anyone contributing to a networked ‘docuverse’” (pg. 10 lines 3-6) [7]. This “docuverse” points in the direction of linked webpages over a global network, which would not be fully developed until the 1990s. As mentioned prior in the introduction, the 1990s is also when Digital Art saw its rise to mainstream media and garnered the most attention.

From 1964 through 1969, we see many more strides made in the field of digital technology. During this time period, there are developments in the actual equipment by numerous scientist and research teams as well as many executions by Artist of all kind. These advancements would go on to influence many exhibitions and ideas that we see in modern society. Artists and Scientists alike were all aiding in the development of new ideas and executing these ideas as well.

One of the major accomplishments was made by the RAND corporation, the leading “think tank”, during the Cold War. It was the groundwork of a communication network called ARPA. Towards the end of the decade (1969) ARPA was met by its predecessor, “ARPANET”. It was created by the leading institutions: (1) University of California in Los Angeles, (2) University of California in Santa Barbara, (3) Stanford Research Institute, and (4) University of Utah.

Before the ARPANET was created, however, there was yet another addition to computer technology. Ivan Sutherland created the information space and “interface”. Douglass Engelbart introduces the idea of bitmapping, windows, and direct manipulation through a mouse. The addition of the mouse would prove to be useful for the Digital Artists to come in the near future. It was not until the 1970s came about that

Englebart and his colleague Ivan Sutherland would create the GUI (Graphic User Interface).

Now, with the development of computers, you have the tools necessary to create new digital art and lay down the foundation for many forms of digital art to come afterwards. But where did the Artists gain inspiration from? Where did the ideologies that led to the new mediums’ rise come from? The answers can be found in three of the previous art movements from history. These art movements are, as mentioned in *Digital Art: The Third Edition*: Dada, Fluxus, and conceptual art [8]. The parts of these movements that can be seen in Digital Art are the concepts, events, audience participation, and the emphasis on formal instructions.

Dadaist:

Dadaist poetry utilized random variations of words and lines combined with formal instructions to create poetry that was based on both random, yet controlled, subject matter. This can be compared to digital art, as the algorithms that were used as the basis would be utilized to form the basis of software that was used to create digital art in the early development of the medium. Artist such as Marcel Duchamp and Laszlo Moholy-Nagy would experiment with virtual interaction (*Digital Art: Third Edition*, pg. 13 (lines 5-9) [9]). These experiments, such as Duchamp’s Rotary Glass Plates, invited the user to stand by the display and look until they saw the effect that the artist wanted them to see.

Fluxus Group:

The international Fluxus Group was comprised of artists, musicians, and performers. This group based much of its execution on precise instruction (*Digital Art: Third Edition*, pg. 13 (lines 34-35) [10]). Audience participation combined with events that would eventually lead to the many interactive events created by computer artworks in the future. This group saw to it that there was a certain “randomness” incorporated into the basis of their artistic presentations. The presentations would go on to influence other artists in other genres such as John Cage, who described the construction of music as “its divisibility into successive parts”. Another Artist by the name of Grahame Weinbren stated that the “digital revolution is a revolution of random access”. Yet another allusion to computers (RAM).

Conceptual Art:

As the industrial age started to make its way and urbanization increased everyone started to become more interested in technology and art. Artists were amongst these people and efforts were made to further develop a bridge to connect the engineer and the artist. One of the first engineers to start this was Billy Kluver in 1966 with the development of the EAT (Experiments in Art and Technology) [*Digital Art: Third Edition* (lines 7-9, pg. 16)] [11]. This foundation was created to develop an effective relationship between engineer and artist. For a decade, artist such as Andy Warhol, Robert Rauschenberg, Jean Tinguely, John Cage, and Jasper Johns presented shows via performances in New York and other major presentations across the world.

Over the next few years we would see artist start to utilize the developments of the computer, various forms of media,

and the groups that rose to bridge the gap between engineering and artistry to create new forms of digital art. These new technologies such as video and satellites were utilized to begin experimenting with live performances and networks. This new idea of execution is a foreshadowing of the new platforms of streaming in present day.

III: Reception/Response

As Digital Art started to become more widely spread it was met with both criticism and applause. In some cases, people were critical of the new medium and whether or not it should serve as yet another form of “picture production” or if it should be used for more instrumental usage (ie. Schematics, enhanced imagery of machinery, etc.) As mentioned at the end of the ‘Timeline’ portion of this report, one of the first foundations to forge a collaborative relationship with artists was the ETA. Once again, this company collaborated with many of the world’s most iconic artists of the time. These artists included Andy Warhol and more of his stature. Another foundation that support the rising new media was the Bell Labs, which has now- according to.....- became a greenhouse for artistic expression. Now, not only was the new form of art accepted by foundations, but also by major corporations such as Pepsi Cola. For example, as mentioned in the book *Digital Art: The Third Edition*, one of the major early show cases of digital art was the Pepsi-Cola pavilion at the world expo ’70 in Osaka Japan [12].

Besides major corporations and foundations supporting digital art, there was also an embracing of the media from galleries who held large scale exhibitions all over the world. In 1968, an exhibition entitled “Cybernetic Screen Display” was held at the Institute of Contemporary Art in London. This exhibition showcased new ideas that translated digital art in new ways via plotter graphics, light and sound environments, and sensing robots. Now, although these forms were displayed in large scale shows, some were criticized for their “clankiness and overall technical approaches” [13]. This simply meant that the works were seen as more technical than artistic in the traditional sense. Some people simply thought that Digital Art should embody a balance of the conjunction itself rather than just rely on the foundation it was built on: technology.

Not only were these large-scale shows held in traditional gallery settings, they were also held via telecast. These shows shown via telecast were presented with the help of international satellites. One of the first of these telecasts that were shown reached twenty-five countries. Not only were the telecast promoted and shown on an international scale, they were shown nationally as well, from east coast to west coast. One example of this coast to coast broadcast was a collaborative effort between artists who held a fifteen-hour, two-way, interactive satellite transmission between New York and San Francisco.

Now, with the support of corporations, foundations, and even galleries all over the world, it comes to no surprise that the inhabitants of the artist community would eventually come to venture into the world of digital art. One example of these inhabitants is an art historian by the name of Jack Burnham.

Burnham was an art historian and critic who, according to the Third Edition, explored a ‘systems approach’ to art in the novel “Systems aesthetics’ and Real Time Systems” [14]. As well as exploring his ideology, Burnham also curated an exhibition called “Software” at the Jewish Museum of Modern Art in New York in the year 1970. This is still two decades until digital art breaks through into the mainstream. This exhibition showcased many works that served as early foundations to artworks in the future. One of these works was an early prototype of Theodore Nelson’s hyper text system: Xanadu.

As well as several different sources that put digital art on a pedestal to display as an introduction to the general public, you can also see how the practices that digital it introduced were adopted by other genres of art. One of these other genres was dance. Dance embraced digital art by utilizing its practice of transmission via satellite. One can see this as performers on the Atlantic and Pacific coasts would hold some of the first interactive satellite dance performances. Another one of these genres was literature. One example of this can be seen in the novel “Necromancer” in 1989 [14]. In this novel, written by William Gibson, the author coins the term “cyberspace”. This phrase was directly influenced by the earlier works of digital artists and the terminology that was used to describe the world where bits and bytes were located in.

Fast forward to the 1990s when digital art showed signs of breaking through the mainstream art world. Around this time, the new media is still being exhibited all around the world in media centres and museums. These museums include NTT’s Intercommunication Center (ICC) in Tokyo and the ZKM Center for Culture and Media in Karlsruhe, Germany [Digital Art: Third Edition (pg. 23)] [15]. Although, digital art was breaking through and keeping some of the positive foothold it had in the art world, there was some new criticism. As all things new, you can not expect there to just be positive reviews. There are bound to be opinions that will challenge the legitimacy of that which is new. Whether it is visual art, ideas, or writing. There will always be two sides. Digital Art, in its newly positioned seat in the art world, was challenged mostly because of the characteristics that differentiated it from traditional art. These included many, but the main three were how the new art was to be presented, preserved, and collected. This was mainly due to the fact that since digital art was not traditional art and required many things to be properly presented it put more responsibility on the gallery in its part of upkeep and presentation.

As opposed to traditional forms of art, digital art required a larger audience. This was mainly because it was new and something that people were not familiar with right away. Another people were not familiar with digital art installations right away was because the installations did not reveal its content at a single glance. Another thing that made it difficult to showcase digital art was how much it cost to display. You see, with traditional art, the gallery would display the art and that would be the end of it. But, with digital art, not only did the gallery have to install the initial show case, they would also have to adhere to consistent maintenance of the piece.

One of the most important problems that galleries faced when it came to the showing of digital works of art was how they would price and sell it. With traditional art, the pricing was based on originality and the fact that it was a one of one art piece. With digital art, however, since it ran off the compilation of a specific code the display was not a one of one piece. You see, if the code could be copied and compiled, the piece could be displayed anywhere that could compile the code. Yet another issue that arose from digital art was the problem that came with collecting. When art is collected and preserved by the collector, that collector wants the art to retain its original stature. This expectation would be fine under normal circumstances, but since digital art is built on an everchanging foundation this expectation can't be upheld. As the foundation of digital art, its code, changes the art itself has to be updated so that it will be able to run programs at new speeds. These updates would be made towards hardware/software, operating systems, increasing screen resolutions, and upgrades of web browsers.

There have been many more reasons as to why people stand somewhat against digital art. For example, in the book "Computers in Art, Design and Animation", the author says "Computer graphics as art must be able to say something relevant about the world [16].

IV: Current Situation

Today digital art has immersed itself into the world of mainstream art and mainstream media itself. Since the 1990s until now there have been many developments in the technological field that digital artists have used to build their medium. One of these technological developments is the introduction of social media. Social media are websites or applications that enable users to create and share content or to participate in social networking. Due to social media being accessible to more people than ever before, Artists have been able to build followings and attention. Before social media the only way to gain attention or a following was with the help of a gallery. An artist was not able to build their career without leaving the comfort of their own home.

Today, however, Artists can create a name for themselves by using social media and the tools that it provides. In short, the international reach that social media has given Artist an advance. It gives Artist a chance to reach more people in a day then they could if they it did not exist. In the Seattle Times, an article compares the way people experience and share art to the way people share and experience their lives, food, and friendships.

As I mentioned before, social media has given artist the ability to reach more people than ever before. As said by Catharina Manchanda, the SAM (Seattle Museum of Art) curator, "Social media can be an incredible tool for generating excitement about an exhibition if it captivates people's imagination" [17]. She then goes on to say that the way social media can be utilized in promotion is different as compared to other museum-led communications since it can capture the experience in a way that is more appealing to viewers.

Another instance of how social media has the influence and

capability to influence the attention on an art event is articulated by Ingrid Langston, who says "If a friend is saying, 'You have to go see this exhibition, it's amazing,' that's more compelling to me than a billboard..." [18].

Not only has social media given artists who create traditional art a way to promote via digital means, it has also given artists who work in primarily digital mediums to display their art in a way that helps them more. As mentioned before in the "Reception/Response" section, one of the problems that both digital artist and galleries were presented with when it came to digital art installations was maintenance. Well since digital artist now had a platform of their own and did not have to depend on galleries, they no longer faced these problems. Using social media these artists are now able to display their work and reach people who might be interested.

Due to the success of social media, new platforms began to be developed to help digital artist as well. One of these platforms is called R.A.R.E. Art Labs. R.A.R.E Art Labs or simple "R.A.R.E." for short is a digital marketplace that specializes in limited-edition digital art [19]. The company was founded in 2017 by John Zettler (CEO), Kevin Trinh (Creative Director), Matt Russo (Chief Blockchain Engineer). The company is currently based in Richmond, VA. Together, these founders have built a successful company that specializes in the selling of, what they call, rare digital art.

What is rare digital art? Rare digital art is but a deviation of regular digital art: any creation that can be converted to a computer file (images, sound, videos, and code). What makes this digital art rare is how the R.A.R.E. Network utilizes the IPFS (Inter-Planetary File System) to make the digital art permanent and scarce [20]. Now, the IPFS hash is embedded within an Ethereum smart contract. This smart contract mints cryptographic Art Tokens, which each represent ownership of 1 print of the rare digital art.

Now, this puts ownership into an entirely new perspective since there are no physical prints. According to the R.A.R.E faq page, Art Tokens are like numbered prints of the artist's work. But, unlike physical prints that can be physically counted, digital prints can be accounted for by examining the Ethereum blockchain.

Since its establishment in 2017, R.A.R.E. Art Labs has built its platform to showcase hundreds of art pieces from artists all around the world. Not only has R.A.R.E. established itself in the digital market, it has also utilized the art community in Richmond, VA to showcase talent and build its following. One of these showcases took place earlier this year where R.A.R.E. used a local gallery to display work from some of the first artist to display on the R.A.R.E. Art Labs platform.

With the rise of digital platforms such as social media websites like Instagram, Facebook, and Twitter Artists have been given a new way to display their work. Not only have they been provided a new way to display work, they have been given a new way to generate sells and attention for themselves too. Not only are there ways to show case art on platforms with international attention, there have also been newly established platforms developed by art enthusiast to help

elevate digital art too. These platforms have established new means of sharing art, experiencing art, and selling art.

Although, there are newly established ways to display work, the medium is still being displayed in galleries all around the world. As mentioned in Section 3:

Reception/Response, ZKM Center for Culture and Media in Karlsruhe, Germany was one on of the galleries that helped elevate digital art to its current position in mainstream media. The ZKM has remained one of the many galleries involved in boosting the scene of digital art and has been mentioned by new article, *Medium*, as one of the 18 Museums boosting the scene of digital art.

As said in the article, the ZKM is often referred to as the “Electronic or Digital Art Bauhaus” (Bauhaus referring to the German art school that was famous for the approach to design that it publicized and taught) [21]. According to *Medium*, the ZKM captures the development of all media relevant to the digital age. This includes paintings, photography, video, performances, installations, and even time-based creations. One of the many people that are credited with its display of work is curator Peter Weibel. Due to his work, the ZKM has been provided with some of the earliest and most relevant exhibitions of digital art.

These exhibitions include works like net condition (1999), Ctrl [Space], Rhetorics of Surveillance from Bentham to Big Brother (2001 -2002), and many more.

V: Conclusion

In Conclusion, digital art has gone through many developments and change throughout its history. Some of these developments are seen as great and some are seen as not so great. Either way, they have helped shape digital art into the medium we see it as is today. As well as many technological developments, there have been many developments in the mediums’ foundation. These developments were influenced by historic art movements such as Dadaism, Fluxus Art, and Conceptual Art. With these movements having a huge influence on how digital artist approached their medium, the art world saw its rising influence on how other forms of art such as dance presented itself. Now, with its strong foundation built from the 1940s up until the 1990s, digital art has become a leading medium with new technological updates such as social media. New ways to discover, buy, sell, and even create digital art are being invented everyday and as history has shown us, digital art is here to stay.

John Lansdown & Rae A. Earnshaw, *Computers in Art, Design and Animation*, Copyright 1989 by Springer-Verlag New York, Inc.

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