Virtual Reality Environment:
Between Artistic Display and 3D Formation

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Abstract

Recently, virtual reality (VR) has been widely used in many different fields, including art, entertainment, education, training, etc. The rapid and massive development of digital technology has been directly reflected in the arts, as the art world today witnesses virtual reality technology, augmented reality, and mixed reality. And extended reality. Digital technology has contributed to enriching the creative atmosphere for the artist and has provided more tools that helped him implement his innovative ideas, and his tools have become in the hands of artists. Not only to simulate reality but to transcend it. Several artists have recently moved to push the boundaries of three–dimensional digital art by taking advantage of the use of virtual reality in their works. Thus, virtual reality has provided the audience with a unique experience, which is watching a work of art in an animated image, three dimensions, and has enabled the viewer to interact with it more deeply than being a static work. The research will discuss the vital role that virtual reality plays in artistic display and 3D formation, and the extent of its effectiveness in achieving sustainability.

Keywords: *Virtual Reality (VR); 3D formation; digital art; digital technology; sustainability.*

Introduction

The rapid development of 3D digital art today is closely related to the strong technological innovation behind it. Hence, the integration of new technology and 3D art is an inevitable trend, and how to apply virtual reality technology to artistic performance has attracted the attention and interest of many artists (Shi 2022: 1). Virtual reality technology has contributed as an auxiliary tool for conveying the idea and philosophy of the artist in his three–dimensional formations of movement and a specific scene to the audience more clearly, as in traditional art, the artist expressed movement in his artwork in a static way.

I wonder if this technology was available when the famous Egyptian sculptor Mahmoud Mukhtar sculpted his statue "Khamseen", how would he have used it to form this statue? This statue was inspired by ancient Egyptian art, and we can see one of the famous Egyptian positions of the foot preceding the other to express the movement and walk forward. "Khamseen" statue represents a walking woman, taking a big step forward, but she looks as if she is resisting the Khamseen wind in the opposite direction of her walking, also

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her dress is tight on her body and flies behind her. Of course, the artist has succeeded in expressing the idea of movement and wind, even though his statue is just a block.

Virtual reality not only breaks through the boundaries between time and space but also attracts more viewers because it is closer to life and more interesting in daily life. The recent development of VR sculpting software and the rapid advancement of VR technology have led to the increasing development of the community practising 3D sculpting in VR. In recent decades, with the boom of virtual reality (VR), artificial intelligence (AI), augmented reality (AR), 3D printing and more, all of these technologies have impacted the art world and its market in many ways. Digital art can reach audiences on a sensory level that many traditional arts cannot access. For example, virtual reality can transport viewers to other worlds or include a new point of view. The creative process has always been a common factor between both art and science. Innovative cooperation between the scientist and the artist has continued to contribute to creating a new creative vision for society (Wright & Linney 2006: 1). The VR experience is multi–layered; It is a visual and audio experience, and the artwork creates spaces between the representational and theatrical, the limited and the multi–dimensional, the abstract and the real. This is for people to visit and experience, and the multiple scenes point to a variety of places in our reality that are limited to visiting for various reasons, which reveals humans' relationship with the larger world. It pushes the boundaries of landscape art by putting the natural environment and human environmental interventions into dialogue through immersive virtual reality, and it attempts to embody a specific concept amid a virtually constructed world. The pursuit of digital tools that best emulate the real thing lowers barriers to entry and expands the possibilities for artistic exploration while continuing to reap the benefits of digital art that has made it so prevalent today.

The artist's creative process begins with his idea and artistic style, and this is what distinguishes an artist from others at all levels. There is no doubt that the artist's ability to use his materials and tools with high professionalism and craftsmanship is what transfers his ideas, expressions, and experiences into his physical artistic work to go out to his audience (Abdoh 2024: 476). 3D digital formations have become essential elements in industries such as virtual reality, gaming, animation, and more as technology evolves. The ability to create detailed, lifelike digital models has paved the way for a variety of uses, from animated films to making video game characters (Sahu 2024, 887). With time, the idea of digital art has become increasingly familiar to many societies that recognise it through interest in technologies such as blockchain, augmented reality, virtual reality, and others. Even if a person is not tech–savvy, they hear about it on the news and social media, and there are a lot of talented artists who use digital tools as their primary tools of creativity.

Therefore, anyone can find what they like in this new world of digitally produced art, in whatever way of display it. One of the famous virtual reality artists is "Giant Swan", who creates virtual 3D surrealist art. He combines surreal elements and modern icons with sculpture. Swan uses virtual reality to track his movements and create three–dimensional models; this is his visual language to speak to people naturally, and his artistic works reflect his desire for human communication with the audience through interaction with his artworks in virtual reality (Abdoh 2023: 112).

1. Virtual reality between display and 3D formation

There is no doubt that virtual reality has proven to be highly successful as a means of displaying both traditional and digital arts in virtual spaces. It was also a solution that went beyond the stage of success to the stage of excellence in displaying 3D art and enabled the viewer to turn around in virtual environments and see all sides of the artwork as if the viewer were actually in front of it. It cannot be denied that displaying 3D art in the virtual reality world enables the audience to watch and interact with the piece of art with a feeling completely different from watching it through screens, which still cannot reach the same feeling as watching the piece of art in real. One of the most successful experiments now is when we talk about holding an art exhibition or having a museum in another country that provides virtual reality technology to transfer the experience of visiting and viewing in three dimensions, just as we are in the place without the need to travel distances, as VR technology and virtual aesthetics can improve the rich and interactive simulation effect (Chen 2015: 1–3).

In addition, 3D modelling in virtual reality is the intersection and merging of technology and art and holds great potential to revolutionise creative expression and the world of digital design. Between 2000 and 2024, the field of 3D formation software underwent a major digital transformation, evolving from traditional, primitive tools to advanced platforms that reshaped art design. In the early 2000s, basic 3D rendering tools enabled experimentation with digital media, providing an initial sense of the medium's potential. However, the real leap forward occurred in the 2000s, which was marked by the incorporation of advanced functionality and the introduction of virtual reality (VR) sculpting tools. This timing witnessed a major shift as 3D sculpting tools advanced to provide engaging and precise display capabilities. This era laid the foundation for a revolutionary artistic period between 2010 and 2024. Artificial Intelligence (AI) has played a pivotal role in the process of generating creative ideas. The experience of formation with virtual reality has also reached unprecedented levels of success, allowing artists to delve into a virtual world that simulates the spontaneity and fluidity of 3D formation. This digital revolution has reshaped the paths of artistic work, opened the doors to new

creative methods, and caused a high level of democratisation of art by making sculpting tools accessible to a larger audience. This influence extended beyond the world of art, such as character design and production of assets in animation and games (Sahu 2024: 886).

2. Virtual reality in the art field inside and outside Egypt

Implementing virtual reality systems in higher education institutions may be difficult from a technological and economic standpoint. There is no doubt that technology is extremely important in providing many benefits. Many believe that over the coming years, technological developments and available and accessible platforms will contribute to the implementation of 3D formation tools in virtual reality in art studies. Still, it is necessary to ensure that they are used correctly and with their high–quality professional capabilities (Vukovic et al. 2021: 4– 5). Despite the spread of virtual reality technology across various fields of the arts and heritage, including display and three–dimensional formation through interactive control gloves and virtual reality glasses, there is a limitation in its use in Egypt, whether in education or the arts. The reason for this is due to several factors, the most important of which is the high cost of virtual reality equipment and technologies, which makes them unavailable to many artists and artistic institutions. In addition to the infrastructure that does not enable some people to access strong Internet service and the limited investment and support for emerging technologies such as virtual reality, compared to countries that are more technologically, economically and scientifically advanced.

2.1. To what extent does the public accept the integration of technology with the arts?

In addition to all of the above, one of the most critical factors affecting the spread of virtual reality in Egypt is the extent of the public's acceptance of virtual art. There are questionnaires for eighty–six artists, university professors, curators, and art historians, from Australia, Canada, China, Egypt, Germany, Italy, Japan, the Netherlands, Portugal, Russia, Switzerland, Turkey, and the United States, the United States of America and the United Kingdom, to answer the extent of the public's acceptance of the idea of the integration of technology with the arts. and the answer was 30% "yes," 16% "no," and 54% "not yet" (Figure 1). The last group, which received the most significant percentage of answers, believes that the societies that are still against digital technology are more in countries that do not have high–quality digital technology in their daily lives or around them (developing countries) and that the people who are still against digital technology are the oldest and least aware of the changes and requirements of the twenty–first century. In addition to these factors, it is very important to add the role of education in the extent

to which we accept digital technologies in the field of art (Abdoh 2022: 5; Abdoh 2025: 35). The global virtual reality market size is expected to be raised from less than twelve billion US dollars in 2022 to more than twenty–two billion US dollars by 2025 in both the enterprise and consumer sectors, including the increasing development of virtual reality and the virtual reality gaming industry is expected to benefit from the expected growth (AR&VR–United States 2024, VR Hardware– Egypt 2024).


The extent to which the public accepts the idea of integrating technology with the arts

- YES
- NOT YET
- NO
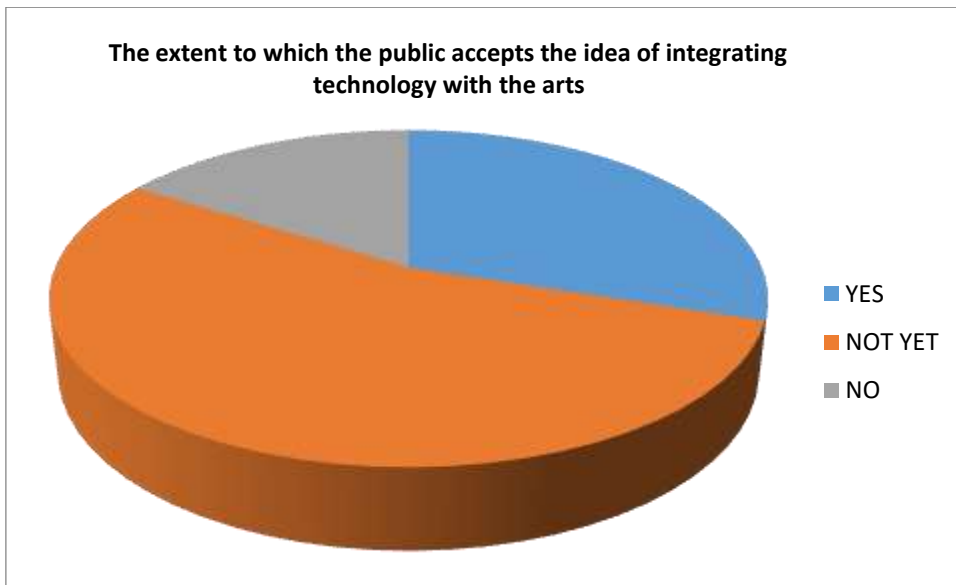
(Figure 1) Answers show a response rate of 30% "yes", 16% "no", 54% not yet.

2.2 Statistical data on digital markets and consumer behaviour

According to the study presented by Statista, which provides statistical data on digital markets and consumer behaviour, revenues in the virtual reality devices market in Egypt are expected to reach 20.6 million US dollars in 2024 and 32.5 million US dollars by 2029. Also, the users' rate will reach 0.3% by 2029, while revenues in the virtual reality market are expected to reach 10.9 billion US dollars in 2024 in the United States of America. The expected market size will reach 16.4 billion US dollars by 2029, meaning that the user penetration rate will reach 85.8% by 2029 (AR&VR–United States. Statista 2024, Virtual reality (VR) – statistics & facts 2024) (see: Figure 2), which shows a graph of the rise in virtual reality market revenues for consumers and institutions around the world from 2021 to 2026 in billions of US dollars, confirms the increasing demand for this technology and its success on a global level (Virtual reality (VR) market revenue worldwide from 2023 to 2028, 2023). The previous numbers indicate huge differences between the rate of spread of virtual reality

in Egypt, as a developing country, and the United States of America, as a developed country.
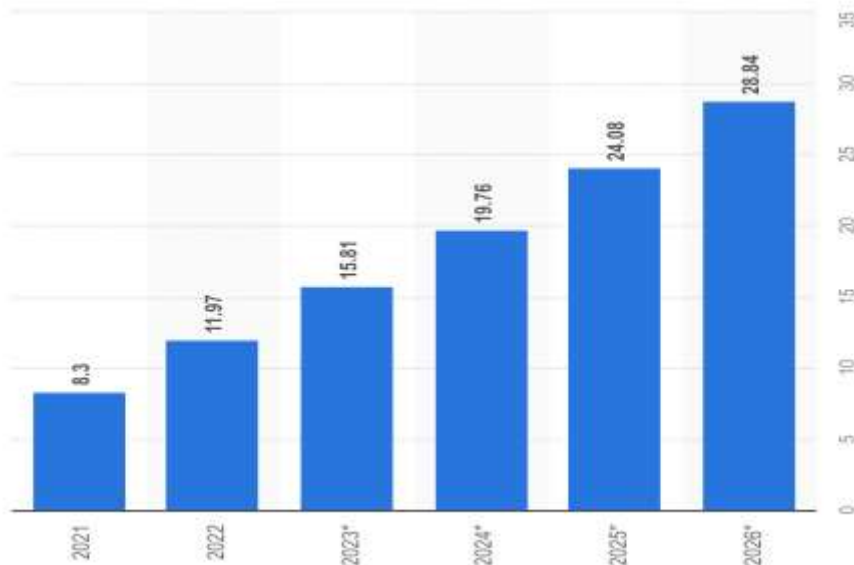
(Figure 2) Worldwide Consumer and institutional Virtual Reality market revenue from 2021 to 2026, (Virtual reality (VR) market revenue worldwide from 2023 to 2028, 2023).

3. The importance of virtual reality in our world today

Recent research has demonstrated, with scientific evidence, increased interest in the study of applying virtual reality in higher education institutions (Vukovic et al. 2021: 1). Digital technology has endless advanced capabilities, and it can summarise all existing new media technologies, including films, video clips, etc. The development of network technology has expanded the scope of activities of artists from real life to virtual reality, and Interactive art has been further promoted and increased in popularity, and this has enabled anyone to engage with art in some way. With time, many modelling techniques and systems are being developed more and more (Wong & Lau, & Ma, 2000: 155). Virtual reality provides a new creative space, especially for sculptors, compared to other types of art, through formation and displaying directly in the virtual space, without using 3D printing or formation using computer programs. Virtual reality is not used to simulate reality, but rather to transcend it. So, sculpture achieves freedom of creativity through virtual reality technology (Shi, 2022: 1– 2).

Virtual reality technology also gives a more realistic feeling and builds a more vivid and ideal world than the real world. Therefore, displaying art in a virtual reality environment not only crosses the boundaries between time and

space but also attracts more viewers because it is closer to real life. Also, the concept of artistic design has gradually changed from simply focusing on the experience brought by the visual senses to a more interactive model of the multiple sensory effects to enable the viewer is able to interpret the content of the design and artwork when viewing it. The concept of artistic design has gradually changed from simply focusing on the experience brought by the visual senses to a more interactive model of the multiple sensory effects, so that the viewer can interpret the content of the design and the artwork when viewing it. Nowadays, the display methods for various exhibitions change year after year. We have witnessed a change from traditional static display to dynamic display, and from static graphic display to multimedia technology. Virtual reality uses the best way of transmitting information, which many people tend to use, especially new generations, and it is considered a main link when some institutions hold their exhibitions virtually. Integrating virtual reality into the creation process of art contributes significantly to the development of the artistic movement at present and in the future as well, and enables designers to look at their work from a new perspective and new ideas that contribute to enhancing the artistic sense of design products and avoiding presentation and design problems to develop the artistic creativity industry (Ye & Juan, 2021: 2–3).

4. Virtual reality between art and entertainment
It is worth noting that it has been proven historically that artists adapt the creative process to the nature of the materials they use, and many artists have been classified as influential leaders in the field of art because of how they deal with materials. Likewise, digital artists adapt their thinking to the foundations and rules of modern technological programs and devices, and digital shaping is a popular channel for 3D creativity through software (Moo–Young & Hogue, & Szkudlarek, 2021: 1). 3D modelling and digital formation techniques have been developed for several decades, and these technologies in the digital age have led to tremendous progress and have become of great importance in recent years (Tang & Ho, 2020: 61). Digital sculpting has always been associated with video, gaming, and animation production, and during 2020–2021, when the NFT art market and 3D printers expanded, digital sculpting gained wide acceptance. In addition, teaching digital sculpture and 3D modelling has a history of more than fifteen years in various universities as part of digital art studies, interactive and graphic design studies, multimedia, game art, and other diverse interdisciplinary studies (Vukovic, Damjanov, Petkovic, 2021: 1). Because of the integration of computer programs with the arts, the forms of creativity and artistic presentation have become more diversified, and virtual reality works to expand the scope of the visual experience. The integration of many art fields such as architecture, painting,

sculpture and other artistic styles with virtual reality has become an inevitable trend, and the integration of 3D formation and virtual reality has become not only an artistic demand, but also a demand for consumers. In virtual reality, 3D artworks are no longer static, but rather alive and capable of movement, such as rotating, zooming, or merging and separating and This has led to interaction between artists and consumers, and VR provides the audience with more space for imagination. In addition, consumers not only seek visual stimulation but also want to add other sensory stimulation, such as hearing, which can also be achieved through virtual reality (Shi, 2022: 4). Integrating 3D formation with virtual reality has resulted in providing a virtual environment for games and entertainment, especially since digital 3D formation has always played a fundamental role in the production of animation films, videos, and games that are now displayed in virtual environments.

5. Does virtual reality help achieve sustainability?
One of the biggest challenges facing our planet is climate change, and the carbon footprint aims to calculate the total amount of greenhouse gases throughout the life cycle of a process or product (Allen and Pentland, 2011: 1). Measuring sustainability depends on measuring carbon footprint emissions, which is considered a vital indicator of climate and environmental changes (Wandana et al., 2021: 73). Virtual reality art, augmented reality art, extended reality, and digital art have become closely linked to blockchain technology, as this technology ensures transparent transactions of digital art without an intermediary in the process of selling the artwork, and artists can also track the ownership of their artwork. Although this technology is still emerging, it has proven effective in the ability to make progress on sustainable development goals in the environmental, social and economic sectors (Abdoh, 2022: 4). Achieving sustainability in the arts of virtual reality, augmented reality, extended reality, and digital art comes through not consuming many materials and raw materials in the process of creating artistic work, which are difficult to recycle as waste causes environmental damage. In addition to artistic practices such as art exhibitions, events, and auctions, which many countries have begun to hold in a virtual environment to achieve sustainability, several artistic practices hurt the environment, including holding exhibitions and international art events that cause the generation of carbon emissions from During the transportation of artworks using air freight and wrapping the artworks in plastic and other materials that are harmful to the environment and produce waste such as publications and others, in addition to the energy used in galleries and exhibition halls, this does not deny that virtual reality leads to the consumption of a large amount of power, but, the use of virtual reality technology in formation and display still achieves sustainability compared to traditional methods.

6. Virtual reality in the field of art: advantages and disadvantages

The contribution of digital technologies has promoted change and transformation in 3D formation and production methods, which means a shift from physical to digital and virtual. Digital technology has played a vital role in modernising production, reducing production time, simplifying the creation process, and offering new horizons for traditional sculpture in the digital age (Chen& Zhang, 2023:2, 12). Virtual reality allows artists to create three–dimensional spaces, which has led to a change in the traditional artistic model. The emergence of virtual reality shaping tools has been one of the most important distinguishing characteristics of the current era, and this technology enables the artist to communicate with their creative work in a tangible interaction in a three–dimensional virtual world that has never happened before. Forming in virtual reality allows the use of virtual materials that are very similar to the feeling of formation using physical materials. This is also reflected in the viewer's feeling of presence in the workplace and its environment and allows the artist's physical gestures to be transferred smoothly into the digital space (Sahu, 2024: 889–892). There is no doubt that virtual environments have revolutionised product design and thus bridge the digital gap (Kuester, et. al, 1999: 92). Virtual artworks also enable viewers to see and evaluate the artwork from three–dimensional angles and to interact with the design. The feeling of distance emanating from the protective barrier in the exhibition hall disappears due to the fear of damage to the display elements, and art exhibitions in virtual reality can break the restrictions of screen, place and time. All the above make the human value of digital display reflect well (Ye& Juan, 2021: 3). It is worth noting that many institutions have begun to provide study via the Internet and have adopted virtual reality as one of the most important e–learning systems in higher education institutions, while physical learning continues to exist as the prevailing education model in art colleges (Vukovic, Damjanov, Petkovic, 2021: 1). In addition to all the previous advantages of using virtual reality in the field of art, there is the possibility of achieving sustainability and reducing carbon emissions that cause an increase in global warming.

However, VR integration has presented challenges such as compatibility and learning issues (Sahu, 2024: 886). As we mentioned previously, the high cost of virtual reality equipment and technologies makes them inaccessible to many artists and artistic institutions. Therefore, the problem of not making this technology available, especially in poor countries, leads to a lack of the teaching and learning process for advanced modern technologies such as virtual reality and the transformation of these countries into consumer countries and not producers of the modern technologies and their programs, in addition to the difficulty of achieving fair competition

between virtual reality artists in developing and developed countries, who have all the capabilities and support that help them top in this field and on an international level in a way that is difficult to compete with.

Conclusions and recommendations:
Digital technology has become an increasingly important medium in our world today, and art will continue to move into digital spaces and virtual worlds as there continues to be a connection between the physical and virtual world, which will be provided through augmented reality and virtual reality devices developed by Apple and Google and their partners over the years and till now. The future of art cannot be imagined without integrating digital technology and new technologies with it, as digital technology reflects the features of the era in which we live. There is no doubt that society's acceptance of the idea of integrating technology with art depends on many important factors, such as the availability of digital technology in their daily lives and dealing with it, in addition to economic, cultural, educational, and infrastructure factors. There's no doubt that this integration and the virtual reality technology help in achieving sustainability and reducing carbon emissions in both displaying and forming three–dimensional objects. Virtual reality devices are gaining popularity in Egypt in the field of games and entertainment, but only for the classes that can afford them because they are expensive. There is no doubt that the market of virtual reality devices in Egypt is growing in the field of entertainment as a consumer market, but the size of the market is very small compared to the markets of developed and economically rich countries such as the United States of America. The researcher recommends the necessity of taking advantage of virtual reality in three–dimensional display and formation, and emphasising the importance of increasing institutional support to ensure diversity in the artistic scene, to include digital and virtual arts and other contemporary trends in addition to traditional arts.

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