



## A brief study on Computer aided (CAD) art design using artificial intelligence and Generative Adversarial Network (GAN) models

Qingqing Hu<sup>1\*</sup>

1293

Address: <sup>1\*</sup>Faculty of Humanities and Arts, Macau University of Science and Technology, Macau, China

<sup>1\*</sup>E-mail : 2109853vad20004@student.must.edu.mo

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

### Abstract

The influence of the Internet on human production and living has never been greater because to the advancement of computer and network technology. Network media, or new media, came into the historical stage, and both its technological and communication modes offer many advantages. A new technology called computer system aided arts and crafts designs frees staff from laborious and complex work by incorporating artificial intelligence technology into these designs. A media form known as "digital media art" was created using digital technology. Images have endless scalability thanks to the leap in capabilities given by digital technology. In the digital age, "interaction" has emerged as the most all-encompassing term to characterize an artistic medium. CAD technology is used to design various essential models from basic human needs to commercial products. It has been demonstrated that engineers can also benefit from CAD. It is possible to perform CAD using the four attributes of history, features, parameterization, and high-level restrictions. The model's individual features can be examined in the building history so that a specific section, rather than the entire model, can be worked on. The numerous modeling elements' sizes, shapes, and other characteristics can be determined by parameters and constraints.

**Keywords:** Computer aided design (CAD), Artificial intelligence (AI), Generative Adversarial Network (GAN)

DOI Number: 10.14704/NQ.2022.20.13.NQ88162

NeuroQuantology2022;20(13): 1293-1299

### Introduction

The influence of the Internet on human production and living has never been greater because to the advancement of computer and network technology. Network media, or new media, came into the historical stage, and both its technological and communication modes offer many advantages. Any era's media creation has deep social roots, thus society must constantly advance and expand communication technologies. The system of the database management also an essential component of numerous computer-aided systems since it is commonly required for the

operation of enormous amounts of information and data. But more advanced commercial database management solutions frequently fall short of their requirements. A new technology called computer system aided arts and crafts designs frees staff from laborious and complex work by incorporating artificial intelligence technology into these designs. Let traditional arts and crafts design increase job productivity while enhancing the quality of the art goods. The level and effectiveness of art and art design have advanced more than ever before thanks to the ongoing development of computer technology, the introduction of artificial



intelligence, and other factors. (Rootbernstein, 2015).

Electronic computers are utilising more hardware and software for image processing at a rate of 40% each year, or doubling every two years. The amount of labour that needs to be done twice is significantly reduced, the design process is sped up, new ideas are brought to light, and the quality of the finished product is improved when artists use a collaborating CAD system as an additional tool. Development of artificial intelligence (AI) technology, CAD art has gradually increasing day by day. Each year, a significant number of CAD art works are designed (Gatt & Karppenen, 2014; Petersen, 2016). Repetition on a flat surface, which is widely encountered in ancient artefacts, is a characteristic of many arts and crafts.

Using a few basic graphic building blocks, the compositional rule, and the automatic generation technique of interlocking images, you can make some useful arts and crafts on conventional colour (or black and white) TVs or computer colour monitors (graphic, for silk stretch, flower cloth, straw, batik, carpet, and other design use). The automatic synthesis of joint money graphics allows for the automatic interlocking and duplication of mosaic images without the need for drying or overlapping, as well as the cutting of materials such as leather, wood, and metal without stamping, cutting, or other processing. Additionally, it can be used to create wallpaper, art floors, floor tiles, and other surfaces. (Petersen, 2016).

A technology known as computer-aided technology uses computers as tools to aid humans in completing activities in particular application areas, such as theories, methods, and technologies, such as product design, production, and testing. It encompasses a

number of disciplines, including CAD (computer aided design), CAM (computer aided manufacturing), and CAI (computer aided intelligence). The word "auxiliary" highlights the importance of people in the system, and the user and the computer work together to create a close-knit human-machine system. This paper gives a basic idea of a CAD design by analysing the theories and supporting artificial intelligence, along with Generative Adversarial Network (GAN) models in art design.

#### **Objectives of the study**

1. To study the different computer aided art design
2. To study the advantages of computer aided art design

#### **Methodology**

For the study of different computer aided art design, we have followed Marri *et al.*, 1998; Vegte, 2002; Deng & Chen, 2021; Ye & Li, 2022 and Liu & Yang, 2022.

#### **Different computer aided art design**

##### **Computer Technology**

**Computer-Aided Technology:** A key aspect of the design is the use of computer-aided technologies (Oklobdija & Popseku, 2017; Johansson & Oden, 2018). The first is computer-aided design's parametric design. After input of settings, it can help with altering and transforming different shapes. Second, computer-aided design technologies are continually improving. Examples include automatic design software and automatic drawing.

**Overview of IRT theory:** In psychology, mental attributes that constrain people's behaviour are referred to as mental attributes. IRT employs tests to look for the psychological characteristics, commonly referred to as latent traits or skills, of the subject being evaluated. It provides qualities based on some very strong assumptions. Given that it uses the project as the primary test unit, it is referred to as the IRT



in comparison to the CTT (Vanga & Sloka, 2020). IRT is founded on robust assumptions when compared to traditional measurement theory as following:

(1) The unidimensionality assumption of ability: The ability variable is taken to be one-dimensional and have a scale-like representation. As a result, it is possible to compare the abilities of different subjects which is known as the latent trait space (LTS) dimension.

(2) Local independence assumption: The test-taker responses are thus statistically unrelated to one another. The participants' responses to one question did not affect how they responded to subsequent inquiries. The combined probability of the correct response for all things is calculated as the product of the probability of the correct response for each item.

(3) Project characteristic curve assumption: A monotonically growing function can be used to illustrate the connection between an object's ability and the correct rate at which it should be used for a particular item. The two most common types of models are the logical model and the normal model.

(4) Other assumptions besides speed tests are also given, such as assumptions of correct knowledge. It should be emphasised that the test subject's intellect, personality, power level, test anxiety, and other measurement conditions are also important factors affecting how they respond to the test items. In addition, there are the test's capabilities and qualities. Therefore, one-dimensionality is not strictly speaking one-dimensional.

**Digital media art design:** "Digital media art is a new interdisciplinary field that grows together from traditional art and industry, information technology and other scientific fields" (Ncube, 2020 and Sadilkova, 2021). As a result, there are no limitations to the field of digital media art

instruction. Its inborn absorption has significant effects on society as well as being mirrored in schools. Only when issues arise can students use social resources to find solutions. It carries out instruction and learning, places students at the centre, actively shapes their personalities, and fosters their understanding of contemporary art as well as their inventiveness. As a long-standing compound course, the emergence of digital media art education courses coincides with a momentous development in information technology. More and more types of digital art are emerging, including network art, 4D digital art, virtual reality, etc. (Arrieta & Berdasco, 2020). It is a holistic type of artistic expression that includes imaginative thinking, an appreciation of art, the ability to critique art, and practical operation skills. It ranges from graphical designs to the 3-dimensional designs, from edge to content.

### **The basic concept of art design (AD) and art design education (ADE).**

Art design (Obukoadata *et al.*, 2020) is from the emphasis on practicality and comfort from the angles of technology, economy, society, and culture. It adheres to the laws of beauty, uses particular materials and crafting methods, and employs particular artistic techniques. Additionally, its goals and plans are translated into inventive activities that result in useful goods with distinct uses with some interactions and significance.

Education in art and design involves fundamental theory and understanding of these subjects. Additionally, it blends professional training in design, creation, education, research, production, and management in order to cultivate a certain level of inventive qualities and many sustainable developmental possibilities.

### **Overview of Digital Media Technology Digital Media**



The extent of the digital media industry, which uses cutting-edge technologies including graphics of computer, network technologies, multi-media, and digital technologies to support the production of digital cultural goods and services for society, is depicted in Figure 4. The production, communications, and market processing for the media house, cinema, television channel, entertainments and advertising agencies and other related industries now depend heavily on digital media technologies.

A media form known as "digital media art" was created using digital technology (Penkowska, 2020). All areas of contemporary art are covered by digitalized a technology, which uses computers as a fundamental tool in above mentioned areas.

Images have endless scalability thanks to the leap in capabilities given by digital technology. In the digital age, "interaction" has emerged as the most all-encompassing term to characterise an artistic medium. The contact with the tool is used by the artist to develop and inspire new works of art for their own personal tool. Or it affects the interaction of the art's listeners by taking part in a predetermined procedure. Additionally, it can alter itself automatically in response to viewer inputs or easy actions.

#### **Characteristics of Digital Media Art (DMA)**

(1) Public acceptance of media, popular culture is where digital media art originated because it is a development of traditional art. With the developing information age's, rapid development in the in the present century, the distribution of DMA can play a special role and reach every corner of every home and society. Only a few instances of how it is significantly influencing and depending on our life and aesthetic tastes include the Internet, TVs, and computers, which are rapidly changing our way of life. Digital media artists create a wide range of artistic works and visual works for cultural

expression with the help of the hugely used DMA tools in order to satisfy the public's needs for entertainment and aesthetic preferences. It is clear that people are becoming more and more interested in art.

#### **Diversified performance**

Digital media art exhibits a diversity of artistic styles due to the 21st century's rapid development of digital information technology. This comprises works of art created with digital technology as well as traditional art that has been turned into digital art.

#### **Creation efficiency**

The filming has become more tolerant and convenient because to the continued advancement of high-tech technology. The development of 3D film and television technologies, the digitalization of film photography and broadcasting systems, and visual rendering have all become simpler in recent years. Future digital movies will take a significant step in this direction, and their actual implementation will have a significant impact on how movies are produced and shown, as well as on how well they sound (Mekvabidze, 2020 and Burinskas & Burinskas, 2020).

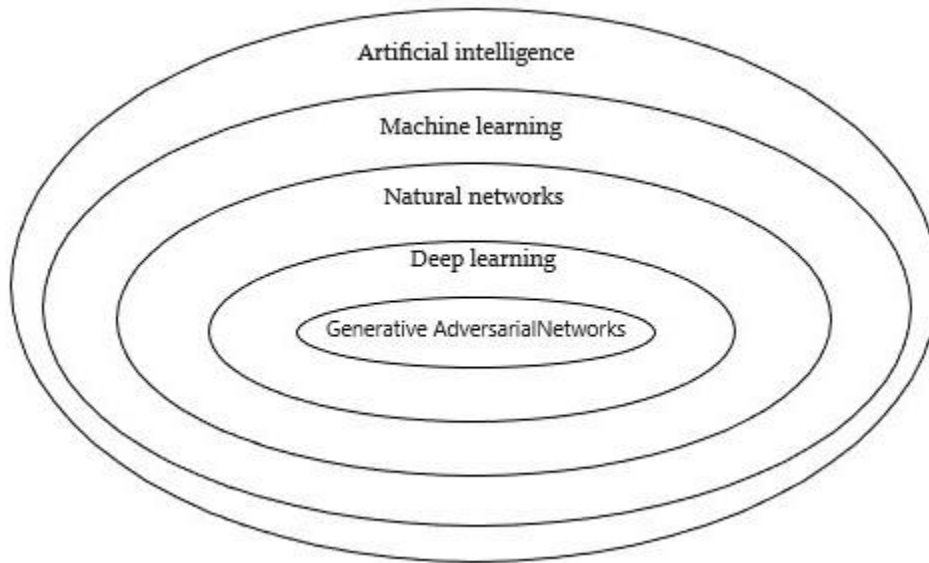
#### **Deep Learning (DL)**

The knowledge gained through these learning processes is highly helpful for comprehending many sorts of information's. Giving machines the ability to study, understand, and recognize data like words, pictures, and noises is their ultimate goal. DL is a sophisticated artificial intelligence technology that performs better in recognition than prior equivalent technologies. The connections between generative adversarial networks in deep learning, neural networks and machine learning (Orben & Przybylski, 2020) are shown in Figure 1. Machine learning, in its simplest form, is the system of gaining knowledge from the collected data. It derives conclusions and predictions from newly discovered facts through gathering,

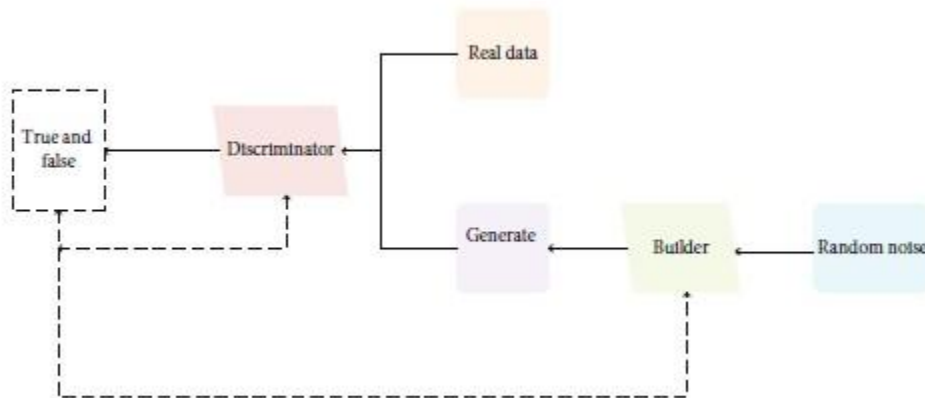


analysing, and understanding. Through the two phases of feature engineering and data preparation, the machine learning method identifies patterns in existing information's and uses these designs to calculate new data. Machine learning algorithms are at the heart of this procedure. A computer learning some of its

data and predicting other data to make decisions is known as machine learning. The process is akin to how learning in real life leads to experience. Machine learning's deep learning technique also uses generative adversarial network models.



**Figure 1:** Concept related to the design  
**Overview of Generative Adversarial Network (GAN) models**



**Figure 2:** Generalize structure of GAN model

Figure 2 depicts the fundamental network models topology of Generative Adversarial Networks (GAN) (Rahman, 2019). The generation techniques of creating GAN images may broadly divide into 3 sub-classes: i) direct method, ii) iterative method and ii) hierarchical method. This is based on the number of

generative & classification models of various created adversarial network models.

**i) Direct method:** The discrete generator model and the generator model, both of which are used in the direct approach, are intimately related to one another. This category includes the majority of the original GAN models





“GAN”, “DCGAN”, “Improved- GAN”, “InfoGAN”, “f-GAN”, and “GANINT-CLS”. The implementation of this model is simpler than the other two.

**ii) Iterative approach:** The iterative method is a procedure that goes from rough to detailed, and its core involves using a generator with the same goal and structure to make images.

**iii) Hierarchical techniques:** The fundamental principle of the hierarchical technique is to split a picture into its foreground and background, complete the model with several discriminators and generators, and assign various duties to each generator. The tasks that have been accomplished have various purposes.

### Advantages of CAD art

Computer-aided design (CAD) is used by engineers and designers as one of the many tools. Professional users and the system analyst employed in a variety of ways. CAD is utilized as combinations as integrated models, such as: including CAD (computer aided design), CAM (computer aided manufacturing), and CAI (computer aided intelligence), Photorealistic motion simulation and rendering, making use of product data management to regulate document updates (PDM)

Additionally, the picture simulations that are commonly required when compiling environmental impact studies are precisely created using CAD. In these simulations, photos of existing environments are overlaid with computer-aided drawings of planned buildings to show what that site will look like if the proposed amenities are allowed to be developed. To study shadow studies and probable view corridor interference, CAD is frequently employed (Burke & Sinclair, 2015).

It has been demonstrated that engineers can also benefit from CAD. It is possible to perform CAD using the four attributes of history, features, parameterization, and high-level

restrictions. The model's individual features can be examined in the building history so that a specific section, rather than the entire model, can be worked on. The numerous modeling elements' sizes, shapes, and other characteristics can be determined by parameters and constraints.

### Conclusion

CAD technology is used to design various essential models from basic human needs to commercial products (Herron, 2010). CAD is primarily used for the detailed engineering of three dimensional models or two dimensional design of any physical components. The design of products like jewellery, furniture, appliances, etc. can also use it. Furthermore, a lot of CAD programmes now have advanced stages and some are already deployed in the market which aid engineers in constructing their art and drawing more clearly. Time scale data is incorporated for the management of project in a sort of virtual simulation for construction engineering called 4D BIM. With having benefits like low cost design and a significantly shorter time period, computer aided design has emerged as particularly prominent machinery within the context of CAD technologies.

### References

- Arrieta-Castillo, C., & Berdasco-Gancedo, Y. (2020). Brexit and female leadership in Spanish digital media from a linguistic perspective. The case of Theresa May's decline.
- Burinskas, A., & Burinskienė, A. (2020). Application of Gordon's growth model for the transport sector of Lithuania. *Journal of logistics, informatics and service science*, 31-41.
- Burke, S., & Sinclair, R. (2015). Computer-aided design (CAD) and computer-aided manufacturing (CAM) of apparel and other textile products. In *Textiles and Fashion* (pp. 671-703). Woodhead Publishing.
- Deng, J., & Chen, X. (2021). Research on artificial intelligence interaction in computer-



aided arts and crafts. *Mobile Information Systems, 2021*.

Gatt, I., & Karppinen, S. (2014). An enquiry into primary student teachers' confidence, feelings and attitudes towards teaching arts and crafts in Finland and Malta during initial teacher training. *International Journal of Art & Design Education, 33*(1), 75-87.

Herron, J. (2010). 3D Model-Based Design: Setting the Definitions Straight. *MCADcafe*. <http://www10.mcadcafe.com/nbc/articles/2/867959/3D-Model-Based-Design-Setting-Definitions-Straight>.

Johansson, B., & Odén, T. (2018). Struggling for the upper hand: News sources and crisis communication in a digital media environment. *Journalism Studies, 19*(10), 1489-1506.

Liu, F., & Yang, K. (2021). Exploration on the teaching mode of contemporary art computer aided design centered on creativity. *Comput.-Aided Des. Appl, 19*, 105-116.

Marri, H. B., Gunasekaran, A., & Grieve, R. J. (1998). Computer-aided process planning: a state of art. *The International Journal of Advanced Manufacturing Technology, 14*(4), 261-268.

Mekvabidze, R. (2020). From business modeling to business management: an exploratory study of the optimal decision making on the modern university level. *Journal of Logistics, Informatics and Service Science, 7*(1), 67-86.

Ncube, L. (2020). African language digital media and communication: edited by Abiodun Salawu, New York, Routledge, 2019, 236 pp., \$49.45 (hardback), ISBN 978-0-81535-954-8.

Obukoadata, P. R., Uduma, N. E., Eneokon, P., & Ulam, J. (2020). Deploying digital media as innovations in marketing government policies and enhancing civic engagement among vulnerable youths in Calabar. *Media Watch, 11*(2), 296-309.

Oklobdžija, S. D., & Popesku, J. R. (2017). The link between digital media and making travel choices. *Marketing, 48*(2), 75-85.

Orben, A., & Przybylski, A. K. (2020). Reply to: Underestimating digital media harm. *Nature Human Behaviour, 4*(4), 349-351.

Penkowska, G. (2020). Visual communication in the age of digital media. *Problemy Opiekuńczo-Wychowawcze, 592*, 29-36.

Petersen, T. (1981). Computer-aided indexing in the arts: the case for a thesaurus of art terms. *Art Libraries Journal, 6*(3), 6-11.

Rahman, A. (2019). Challenges in privately joint-ventured project: a case study. *Journal of Logistics, Informatics and Service Science, 6*(2), 90-107.

Root-Bernstein, R. (2015). Arts and crafts as adjuncts to STEM education to foster creativity in gifted and talented students. *Asia Pacific Education Review, 16*(2), 203-212.

Schneider, T., & Rea, N. (2018). Has artificial intelligence given us the next great art movement? Experts say slow down, the 'field is in its infancy.'. *Artnet News*.

van der Vegte, W. F. W., & Horváth, I. (2002). Consideration and modeling of use processes in computer-aided conceptual design: a state of the art review. *Journal of Integrated Design and Process Science, 6*(2), 25-59.

Vanaga, R., & Sloka, B. (2020). Financial and capital market commission financing: aspects and challenges. *Journal of Logistics, Informatics and Service Science, 7*(1), 17-30.

Ye, W., & Li, Y. (2022). Performance Characteristics of Digital Media Art Design Relying on Computer Technology. *Mobile Information Systems, 2022*.

Ye, W., & Li, Y. (2022). Performance Characteristics of Digital Media Art Design Relying on Computer Technology. *Mobile Information Systems, 2022*.

