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Research on innovation and application of 5G using artificial intelligence-based image and speech recognition technologies

Hu Fan

Hubei University of Technology Engineering and Technology College, 430068, China

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ABSTRACT

Many sectors have been fundamentally altered by the entrance of the 5G era due to the rapid advancement of information technology and computer technology. A fresh wave of digital media art (DMA) creation and invention has taken place in the current context. DMA is a brand-new field of study that brings together art and digital technology in a powerful way. It is a modern, multidisciplinary, and versatile art topic that is merged with other art themes. Humans used to be the primary means of creating digital media like animation. The labor of creating media content from raw sources is progressively being replaced by computers with advancements in artificial intelligence (AI) technology. Virtual reality (VR) technology's popularity has rapidly spread beyond the computer area to other parts of life, and it has also evolved into a new approach to DMA. Art will surely be highly influenced in the AI age, but we must also recognize the new developments brought to art by technical advancement in the 5G and AI. Hence, in this work, we examine the properties of virtual reality technology as well as the two most widely utilized approaches, artificial intelligence-based image recognition technology (AI-IRT) and artificial intelligence-based speech recognition technology (AI-SRT). We investigate and practice them in detail. We also compared these technologies to conventional teaching methods and discovered that visuals and pictures were considerably more responsive and enlightening to students than traditional teaching methods.

1. Introduction

Digital media art (DMA) is an innovative fusion of art and technology. The phrase "digital art (DA)" refers to artwork created or exhibited solely via the use of digital technology. Graphic designers, photographers, videographers, animators, game designers, and many more types of digital media artists contribute to our ability to perceive the world around us. Simulating human intellect in computers that are built to think and behave like humans are referred to as AI. Any machine that exhibits human-like features, such as the capacity to learn and solve problems, may also be referred to as an intelligent machine. Raw digital media technology has begun to be widely disseminated and exploited as information technology has progressed through time. With the effective integration of digital media technology's application display design, rich three-dimensional spatial design, innovation, and change are produced. It has become more popular in China and other countries to use digital media design as the driving force behind the design of displays. A new information technology product's life is given a fresh lease of life thanks to the creation of a new business display (Cao, 2020). The information age has been accelerated by the rapid rise of the social economy. Designing for the digital age has been a boon to the field's development and progress. Advances in digital media technology have the potential to enhance the originality of artistic expression and spur the creation of new works of visual art. Creative design is intrinsically tied to current visual works. Digital media and its visual field can be improved if aesthetic design thinking is incorporated (Wang and Zhang, 2020). In addition to adjusting to the big data trend, digital media technology also plays a vital role in providing essential social development. The need for cinema and television works is growing as people's quality of life improves. By improving conventional film and television creation, technicians support the optimization & improvement of film and television works, thereby meeting

E-mail address: hufan12021@163.com
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people's requirements and maximizing digital media technology development (Jiang et al., 2022). Fig. 1 shows the outlook of DMA.

DM technology may make abstract knowledge comprehensible, manageable, and engaging. AI is a newer sort of computer technology. AI creates depending on its traits. Nowadays, with the fast growth of digital media technology, the widespread use of AI technology may greatly optimize digital media technology consumption. AI may allow a machine to think like a person, which is required for digital media innovation. Character design is a major use of AI in digital media. Designing using AI may help designers create rapidly and in batches. AI is particularly beneficial in online game creation (Liang, 2020). Information is transformed by digital technology so that it may be identified, processed, stored, analyzed, and sent by computers. Other digital technology benefits from the 5 G technology's environmental assistance. It is specifically designed for the Internet of Things (IoT) and mobile Internet. It's now the most important link in the Internet of Everything. New digital technologies are driven by the rapid development of 5G (Lin, 2022). Techniques based on artificial intelligence-based image recognition technology (AI-IRT) and artificial intelligence-based speech recognition technology (AI-SRT) is utilized in our investigation into the innovation brought about by 5G technologies.

2. Related works

Multiple odontogenic keratocysts are frequent in many of these disorders, according to Mody and Bhoosreddy (1995). An odonotogenic keratocyst was found in a 12-year-old girl. Using fine-grained data, Ahmed and Ali (2021) shows how tailored medication may identify specific deviations from normal. Engineers used 'Digital Twins' to analyze the philosophical and moral implications of these rapidly changing, data-driven healthcare solutions. As a whole, the artifacts' were digitally connected and constantly shown. Depending on the data format and, the interpretation given to it, moral differences may be recognized. Digital twins are examined in terms of their ethical and societal ramifications. Healthcare has grown more reliant on data. It has the potential to be a social equalizer because of the successful solutions it gives to improve societal equality. According to the author (Shahabaz and Afzal, 2021), allergic rhinitis would be a worldwide epidemic for a long time to come. Many of Taiwan's healthcare institutions prescribe traditional Chinese or Chinese-Western drugs. Allergy rhinitis was the most often treated

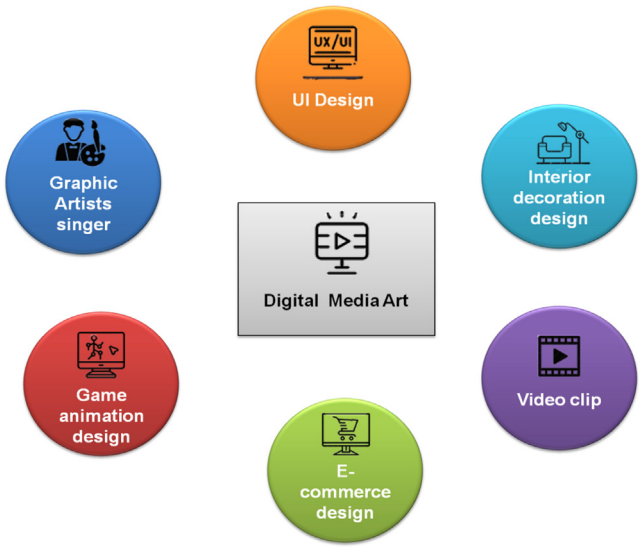

Fig. 1. Outlook of DMA.

respiratory illness in traditional Chinese medicine outpatient clinics. HDR brachytherapy is mentioned in Li (2022) as a way to reduce radiation and allow for outpatient treatment and quicker testing times. A single-stepping source might improve dosage dispersion even further by varying delay at each dwell location in turn. HDR brachytherapy treatments must be performed accurately since the shorter processing intervals do not allow for any error checking, and errors might cause harm to people. For rural locations, Momohshaibu et al. (2022) the author presented a technique and technology for residential sewage treatment. The author (Lin, 2020) identified "physicochemical" and "organochlorine pesticides" in samples collected from specified vegetable fields in Zamfara State, Nigeria. To evaluate both testing methodology and test outcomes, QuEChERS with GC–MS was used. In Chen et al. (2022) because of the advances in science and technology, new types of art have been created as well as a fresh spark between technology and art. Meanwhile, the integration of AI and art design has also shattered the pattern of conventional art, which provides art with a bold vision. It's mind-boggling to see how far AI can go. The evolution of art and AI will be tightly intertwined in the future as people's perceptions of beauty shift. In Ye and Liang (2021) students' painting abilities, the effectiveness of their art-learning activities, and their capacity to identify colors may all be improved by incorporating an AI-assisted learning system into K–12 classes. As a consequence, students' work has improved in terms of relevance and usefulness, as well as creativity and originality. Students in the experimental group that received the children's ability training method performed better as painters than students in the control group. In Xu et al. (2019) the innovative experience of design, and the aspects of digital media art, such as audience, application scenarios, and digital technology, are covered. To begin, the paper will examine digital media art's use of experience design as a technique, as well as the impact of this type of innovation on the medium's aesthetics. It represents the DMA from a variety of perspectives, including the experience innovation theory and the marvels of immersive encounters. In Yang (2021), DMA and AI technology are compatible, boosting and extending their respective professions. Virtual reality art is organized and aesthetic aspects are determined by digital media. DMA is still art, but it is not traditional art, and people need to adjust their appreciation. Many digital media artists are used to working with computer data processing equipment. As a result of these procedures, the AI application of virtual reality technology has improved. Also discussed are the technological advantages of AI for making DMA via interactive virtual education. In Liu (2020), Designers must create and develop visual communication design appropriately within the framework of digital media art to maximize the design effect. It examines how visual communication design has evolved in the digital media age, explains its unique traits, and makes specific recommendations for new inventive countermeasures. In Ren (2016), To stay up with the rapid growth of modern technology, animation, and television design-related companies need to include digital media technologies in their creative processes. By harnessing the benefits of digital media technology during this process, China's animation industry will be injected with new life, resulting in the long-term growth of China's animation industry. In Degand (2019), Digital media art (DMA) is examined in animation design, and a peek into the future of DMA is provided. Digital media arts appear to have a positive impact on animation design in a variety of ways, including the temporal features of the scene, express style, content transfer, and the intended function. In addition, it contributes to the growth of the animation industry as a whole. In Whatmough et al. (2019), the next era of art is dominated by digital media art. Integrating it into the world of animation may both showcase the distinct appeal of DMA and encourage traditional animation design to undergo reform and innovation. Animation

design for DMA has a bright future because of advances in network information technology and computer technology. Digital media animation may advance much further if its animation elements are fully explored and used flexibly. The animation business has benefited greatly from the innovative use of digital media art, which incorporates aspects from a wide range of disciplines to create a distinctive style. In Fang (2010), the use of animation control technology in DMA is the subject of this article. It is possible to acquire more vibrant creative resources via the Internet in the context of Internet technology. Animation control technology, which is based on the Internet, allows a 3D model to be generated with more accurate data. As a result of this, design in DMA can also benefit. Digital media animation control technology is explored in this research and found to have a high degree of practicality as well as significant artistic possibilities for advancement.

2.1. Problem statement

With a greater focus on creativity comes a lack of knowledge of technology, especially social media sites. Even though recent work has substantially improved the state-of-the-art, creating visuals from a description remains difficult. Cross-media search, which uses text queries to get annotated pictures, is a potential new method for finding images from large image libraries. However, cross-media search remains difficult, particularly when expressiveness and manageability are taken into consideration. AI methods to improve the automation of narration & plotting technology in interactive entertainment, particularly in the context of audio signals for the speech recognition-based internet age, but also in the context of audio-visual signals in gaming. To seed a machine learning system, AI techniques often need big input datasets. However, we must also build ways that can function with sparse input, such as a single designer or engineer explaining his goals to an algorithm. There aren't enough tools to make narrative movies using gaming engines. By analyzing the limitation of the previous study, we propose artificial intelligence-based image recognition technology (AI-IRT) and artificial intelligence-based speech recognition technology (AI-SRT) techniques to overcome this issue.

3. Proposed methodology

In this phase, we examine the innovation and application of DMA based on AI and 5 g. The data is collected and it is divided into three groups. Group 1 provides DMA creation based on image recognition technology, group 2 provides DMA creation based on speech recognition technology and group 3 provides DMA creation based on traditional teaching methods. The analysis of variance (ANOVA) method is used for statistical analysis. Fig. 2 indicates the overall methodology used.

A. Data collection

A total of 150 people responded to the survey, including 87 pupils in the lower intermediate and 63 in the upper intermediate. The questionnaire was given to both sets of students during a break in class or during free hours. It is envisaged that the survey findings would represent students' views on the communicative teaching approach's implementation and effectiveness in teaching and learning (Panciroli et al., 2018).

B. Virtual reality technology based on AI & 5G

It allows people to communicate and interact with gadgets in a virtual world. It's a computer simulation. It creates virtual environments using a computer. An interactive three-dimensional view of the device is provided by this simulation environment, which may be manipulated by the user. It is capable of generating a virtual reality that can be experienced by users. Many approaches can be used to carry out interactions. The most common is to use a human-controlled scope. The atmosphere is fully virtualized. The ideal virtual reality system would mimic human perception, achieve high simulation, and fully immerse the user in the created virtual world. The virtual reality realm created by VR technology also enhances the viewing experience of artworks. Artists using virtual reality technology may utilize their creativity to create settings that were before impossible to create. The conceivable experience is achieved, allowing digital media artists to "access" the designed art environment. Immersive art allows audiences to engage with the artwork. Fig. 3 shows three properties of virtual reality.

The triangle of virtual reality technology is formed by the imagination. As compared to other technologies, virtual reality technology has three distinct characteristics. The term "interaction" in the context of virtual reality refers to the establishment of a relationship between the virtual representation and its users. In computer-mediated data exchange, it indicates the client's ability to participate. The virtual world may sometimes seem more bright and lifelike than what most people can describe using their memories and memories from their imaginations. Virtual reality technology is increasingly applied in different sectors, and its three properties are developing. additional outcomes. Mobility is the ability of users to control virtual systems in the virtual environment by performing real-world actions or procedures and receiving feedback from the scenes and surroundings. Everything's physical characteristics in the actual world can be presented convincingly in the virtual realm.

i. Group 1-DMA creation based on image recognition technology

The identification of complicated pictures in human image recognition systems is often accomplished via many layers of information processing. The basic elements of a familiar picture are mastered, so it is recognized as a unit. A block is a full unit made up of discrete pieces of material that are viewed concurrently. Written materials may be recognized as blocks of units such as strokes or radicals of a Chinese character, or words or phrases that commonly occur together.

a. visual design

In the use of intelligent picture identification, numerous elements such as structural composition, color ratio, and shooting backdrop are required. Currently, most three-dimensional video technologies involve clever picture recognition technology. The aesthetic impact of the picture is achieved via a succession of image processing. Color adjusting and processing may also immediately excite the viewer's sensory adventure and grasp the picture's emotion, image, & significance. The written content is communicated via vibrant graphics & videos, making it simpler for people to grasp the information and emotions to be conveyed. Fig. 4 shows the benefits of visual design.

b. Animation

A motion visual is an animation. Animation transforms a motionless picture into a moving, logical image. In animation, each frame has a pause duration of 25 frames. Animation is aesthetic, and some animations are educative, helping youngsters develop their ideals. Some animations have many effects. For example, Pixar animation is creative and powerful. While the narrative itself

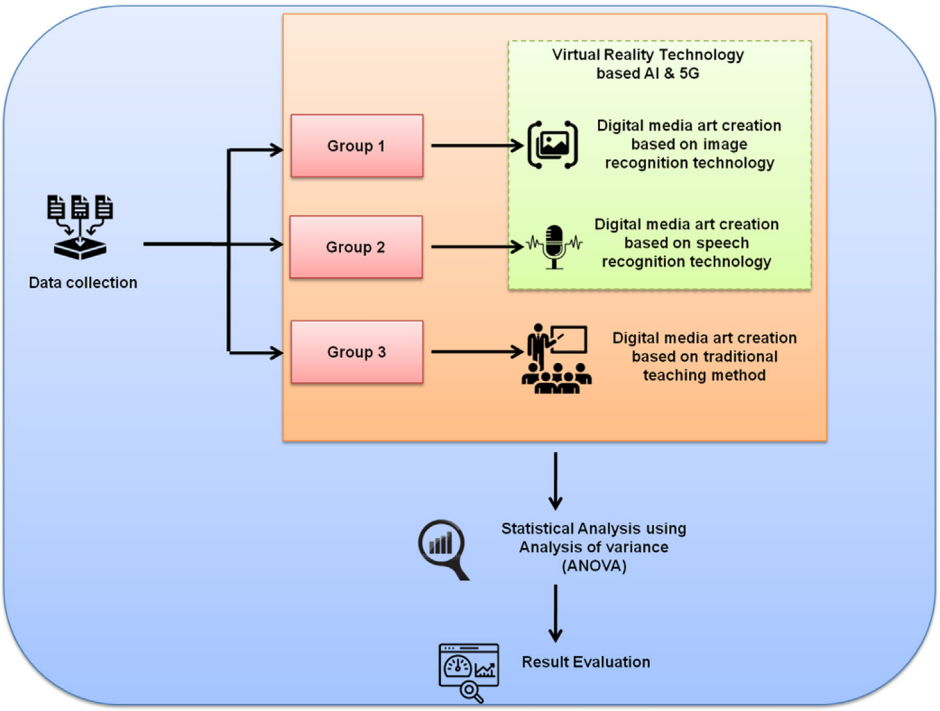

Fig. 2. Overall methodology used.

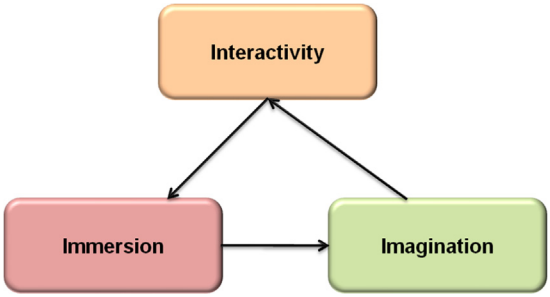

Fig. 3. Features of VR technology.

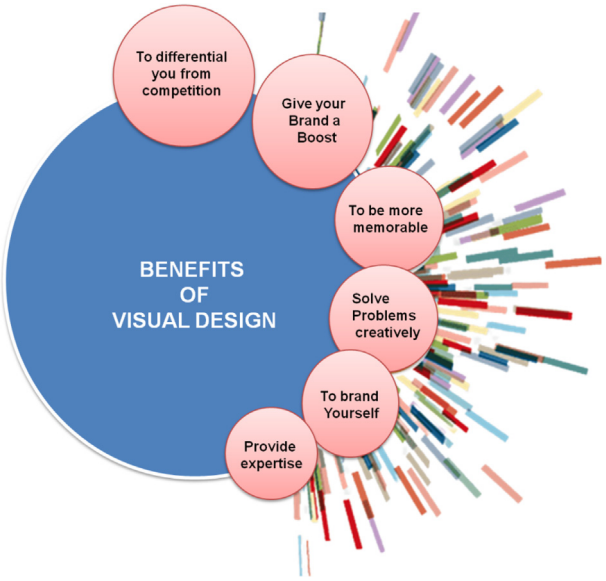

Fig. 4. Benefits of Visual design.

is appealing, the images provided are equally appealing and may completely fulfill people's spiritual demands.

ii. Group 2 – DMA creation based on speech recognition technology

Smart gadgets will be able to recognize human speech with the help of speech recognition technologies. AI, languages, mathematician stats, audio, and psychology all have a role in the field of digital signal processing (DSP). Speech recognition technology may be used by individuals to control and convey information using just their voices. Speech recognition software creates words as quickly as they are uttered, which is generally quicker than typing. This technology may be used for automated customer care, speech translation, command control, & voice verification codes. Computer-intelligent voice recognition is widely used in digital media art. The most often utilized feature is voice interplay, which enables people to connect with computers using natural or machine-produced voices. Tone synthesis converts text to sound. Making sounds using synthesizers is called synthesis. The computer generates radio signals, which are subsequently transformed to sound waves via equipment & speaker. The induction sound shell interactive gadget is one of several digital media works of art. You may combine the enigmatic black acrylic base plate and the traditional tungsten light to form English letters and numerals. The light and audio styles change depending on the size of the sound shell. Fig. 5 shows the general operation in speech recognition technology.

iii. Group 3-DMA creation based on traditional teaching method

Passive learning may be performed via virtual teaching. Distance learning allows students to absorb material at their own pace. Seminars or online tests may convey the information. Recognize the learning environment that encourages new knowledge development. For example, contextual learning, experiential learning, cooperative learning, problem-oriented learning, etc., may all

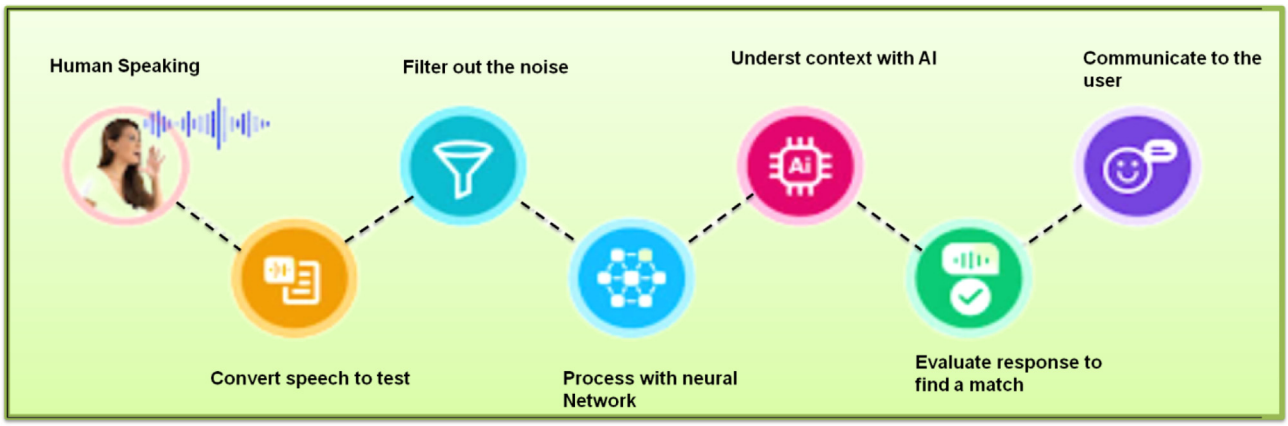

Fig. 5. General operation in speech recognition technology.

be utilized to teach virtual reality. Contextual learning is a theory that analyses how individuals gain professional talents and include apprenticeship research into how acceptable external involvement leads to participation in a community of inquiry. Experiential learning is the process of comprehending through doing something, and it is more accurately described as acquiring knowledge while doing something. By exposing students to a diversity of opinions, cooperative learning promotes higher-order thinking, verbal presentation, personality, and leadership capacity. Problem-Based Learning is a teaching approach in which students are taught concepts and procedures via the use of complex real-world problems rather than just interpreting data and ideas. Virtual reality technology has just recently entered the area of education, and it has yet to have a significant impact in regular classrooms. Virtual reality's two properties, "immersion" and "interaction," may be used to imitate various learning settings. These many technologies are not mutually exclusive in practice but may be used in the same virtual learning environment. Fig. 6 depicts the advantages of VR in education.

C. Statistical analysis using analysis of variance (ANOVA)

After the survey, the questionnaire was evaluated using statistical tools. In this research, we used Analysis of variance (ANOVA) as statistical tools.

a. ANOVA test

Analysis of variance, or ANOVA, is a quantitative method for the further testing of reported variability data that can be divided into various components. When there are three or more data sets, a one-way ANOVA was employed to investigate the association between variables. F-statistics are commonly used in ANOVA since they show how many times the null model's average sums of squared are greater than the whole model. The parameters are calculated using the least-squares approach, with all variances being identical. This may be expressed as:

$$I = PV_{between}/PV_{error} \tag{1}$$

where

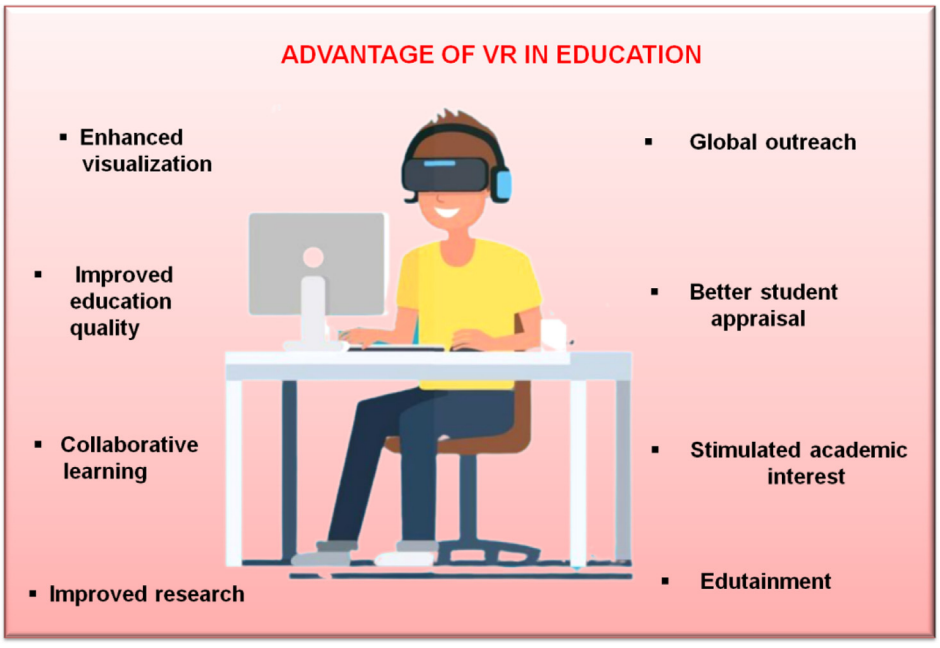

Fig. 6. Advantage of VR in education.

$$PV_{between} = \frac{\sum_{l=1}^{j} p_l \left(\bar{A}_l - \bar{A}\right)^2}{j-1} \tag{2}$$

and

$$PV_{error} = \frac{\sum_{l=1}^{j}\sum_{m=1}^{p_l} \left(A_{lm} - \bar{A}_l\right)^2}{Q-j} \tag{3}$$

The Welch-test-statistic is defined as.

$$Z = \frac{\sum_{l=1}^{j} z_k \left[\left(\bar{A}_l - \tilde{A}\right)^2/(j-1)\right]}{1 + \frac{2(j-2)}{j^2-1}\sum_{l=1}^{j}\left[(1-z_k/x)^2/(q_l-1)\right]} \tag{4}$$

where $Z_k = \frac{p}{v_1^2}$, w = $\sum_{l=1}^{j} Z_l$ and $A = \frac{1}{w}\sum_{l=1}^{j} Z_l A_l$ is defined as:

$$i = \frac{j^2-1}{3\sum_{l=1}^{j}\left[(1-z_k/x)^2/(q_l-1)\right]} \tag{5}$$

The Brown-Forsythe-test-statistic is defined as:

$$I^* = \frac{\sum_{l=1}^{j} q_l \left(\bar{A}_l - \bar{A}\right)^2}{\sum_{l=1}^{j}(1-q_l/Q)V_l^2} \tag{6}$$

When L_o is factual the allocation of I^* is appropriate by a central I distribution with degrees of freedom i − 1 and h, where h is defined as.

$$1/i = \sum_{l=1}^{j} f_l^2/(q_l-1), \quad f_l = \frac{(1-q_l/Q)V_l^2}{\sum_{k=1}^{i}(1-q_l/Q)V_l^2} \tag{7}$$

To calculate the generalized r-value, the generalized r-value is now computed as r = 1 − t, where s is the sample size.

$$t = H\left(K_{j-1,Q-j}\left(\frac{Q-j}{j-1}\tilde{v}_e\left(\frac{q_1 v_1^2}{E_1E_2,\cdots,E_{j-1}}, \frac{q_2 v_2^2}{E_1E_2,\cdots,E_{j-1}}, \frac{q_3 v_3^2}{(1-E_2)E_3,\cdots,E_{j-1}}, \cdots \frac{q_1 v_j^2}{(1-E_{j-1})}\right)\right)\right) \tag{8}$$

The prediction is calculated about separate Beta stochastic processes in an H-distribution having i − J, W − j dof.

$$E_m\ Beta\left(\sum_{l=1}^{m}\frac{(q_l-1)}{2}, \frac{q_{m+1}-1}{2}\right), \quad m = 1,2,\cdots,j-1 \tag{9}$$

The r-value is calculated by numerically integrating the anticipated value in the r-value formula about the Beta random variables.

4. Result and discussion

In this paper, we examine the innovation and application of DMA based on AI and 5G. The parameters are the mean score, implementation cost, student evaluation, and efficiency. The existing methods are augmented reality, cloud computing, holographic projection technology, Internet of things.

i. Mean score

The sum of all the values in a set divided by the total number of values in the set yields the mean value. And, given the random nature of sampling, it is possible to extrapolate its predicted value throughout the sample space. The following Fig. 7 represents the Mean score.

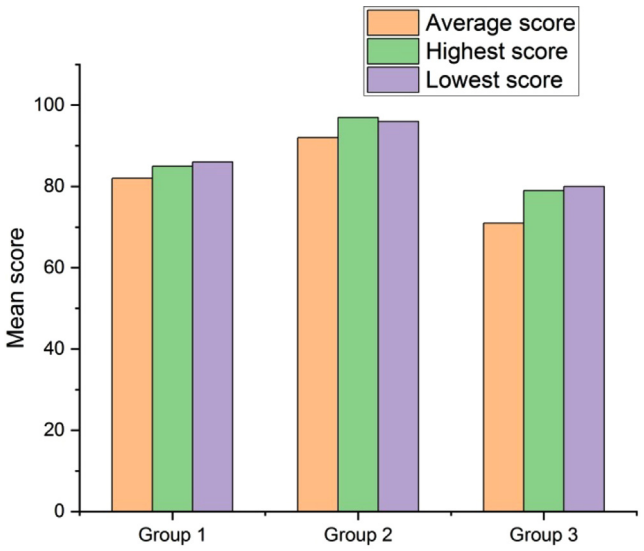

Fig. 7. Comparison of score for three groups.

When compared to group 3, the scores of groups 1 and group 2 including their average score, highest score, and lowest score, are significantly higher than group 3. (Group 1: DMA creation based on image recognition technology, Group 2: DMA creation based on speech recognition technology, Group 3: DMA creation based on traditional teaching method).

ii. Student's evaluation of the experimental group

The evaluation of educational strategies such as innovation, novelty, enjoyment, exploration, immersion, ease of operation, improvement your grades, and continuing to learn is greater in groups 1 and 2 compared to group 3, which shows that groups 1 and 2 are more effective than group 3. The following Fig. 8 represents the student's evaluation of the experimental group.

iii. Implementation cost

The sum of all or a portion of the real total costs to install or implement measures that result in completed units is called imple-

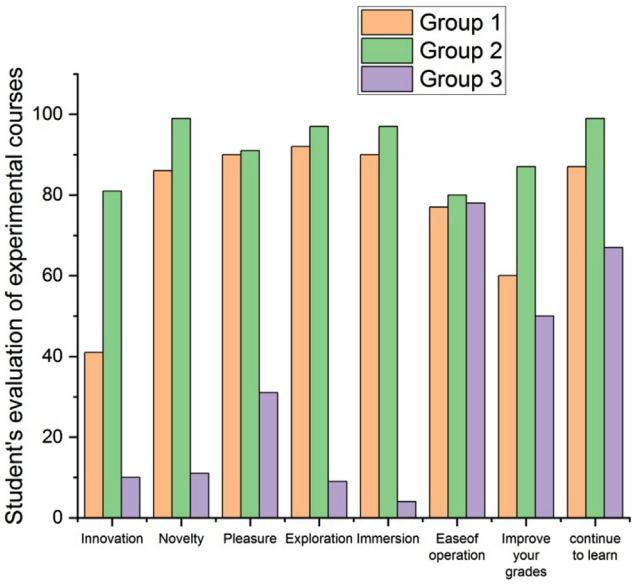

Fig. 8. Student's evaluation of experimental group.

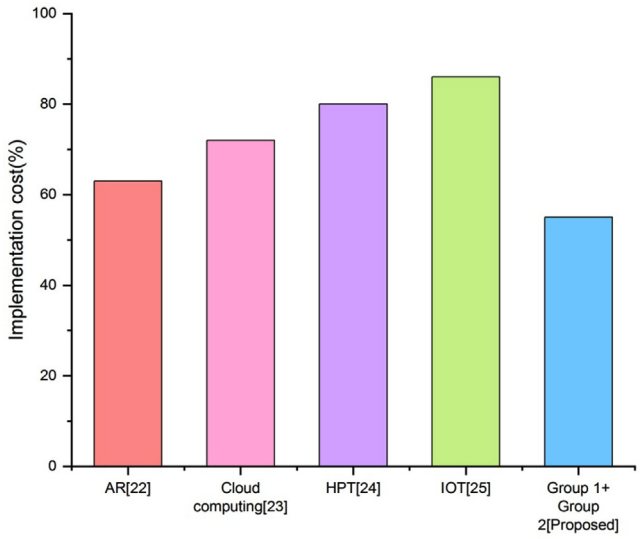

Fig. 9. Comparative analysis of implementation cost for Suggested and Traditional Methods.

mentation costs. The following Fig. 9 represents the implementation cost. Comparisons show that the proposed method is lower than any of the four existing techniques.

iv. Efficiency

It has an impact on the number of samples that are correctly classified. It decides how closely the results match the original result. The following Fig. 10 represents the implementation cost. Comparisons show that the proposed method is higher than any of the four existing techniques.

5. Discussion

Most smartphones cannot sense the external camera in real-time. AR technology has the potential to lead to individuals being increasingly reliant on their gadgets, which might lead to a wide range of health problems. The cost of developing and maintaining AR-based solutions is prohibitive (Wu and Li, 2020). Denial-of-service (DoS) threats and theft of data or leakage are both possible because of poorly secured APIs and interfaces. Cloud computing technology has a lot of flaws and vulnerabilities inherent in cloud computing, particularly when it is used in shared environments (Liu et al., 2021). It is more expensive to produce than 2D projection. Fluorescent lighting obscures its visibility. The use of holographic projection in product design is expensive. Constructing pictures using 3D holograms takes a long time. As IoT devices improve and expand in usage, securing the data they collect and transmit becomes increasingly difficult. There is a degree of difficulty in the task at hand. Internet connectivity and a constant supply of power are necessities for many gadgets. Devices from different manufacturers may not operate with current technology because there is no consensus on IoT protocols and standards at this time. Deploying IoT devices frequently necessitates a significant financial and time commitment.

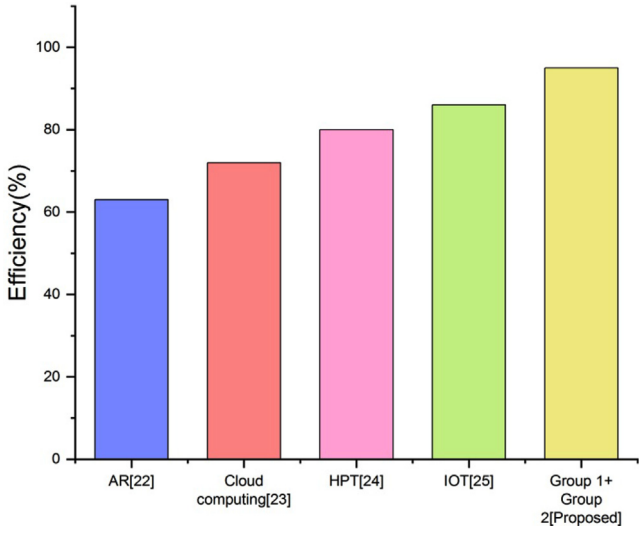

Fig. 10. Comparative analysis of efficiency for Suggested and Traditional Methods.

6. Conclusion

The DMA practice mixes contemporary science and technology with well-established forms of artistic expression. As a direct consequence of the extensive research and development of cutting-edge science and technology, more digital technology specialists will gravitate toward the practice of DMA. As digital technology advances, it may become possible to share labor and, in some cases, eliminate the need for certain types of workers. The DMA has seen a significant transformation. As artificial intelligence technology advances, machines are rapidly replacing people in the process of creating new content for media outlets from scratch. Virtual reality (VR) is a revolutionary approach to DMA that has quickly spread well beyond the internet age to different facets of living. Undoubtedly, AI will have a big impact on the arts, but we also need to take note of the new developments brought on by 5G and AI. As a result, in this work, we evaluate the characteristics of virtual reality technology as well as the two most popular methods, AI-IRT and AI-SRT. We conduct in-depth research on them and practice using them. When we compared these technologies to traditional methods of instruction, we found that students responded significantly better to and gained significantly more knowledge from the use of visuals and pictures than they did from traditional methods of instruction.

The capacity of 5G networks to operate more quickly on cellular and other devices is one of its main advantages. Contrary to its forerunners—2G, 3G, 4G, and 4G LTE—which required hours to download movies, videos, music, and streaming services 5G technology makes these chores simpler and downloads just take a few seconds. In addition, experts predict that the burgeoning global gaming market would benefit from 5G networks. With this technology, a typical user can access up to 20Gbps of the internet. Another significant benefit of 5G technology is that, in comparison to its forerunners, it has minimal latency, which makes it simpler to support other cutting-edge technologies like artificial intelligence, the Internet of Things, and virtual reality. In addition, its reduced latency makes browsing simpler, enhancing the user experience. The seamless movement of data made possible by 5G technology's greater bandwidth enhances user experience overall and communication between devices. Additionally, the technology offers users a smooth transfer of services between wireless wifi and cellular devices, enhancing performance. This is one more benefit of 5G technology. Additionally, customers would benefit from increased bandwidth if there were fewer 5G towers. One of the limits of 5G technology is that, although being advertised as having the highest speed, it is only available in a few places worldwide that have 5G towers. The testing, trialing, and installation of 5G towers is a costly procedure, so even if international businesses and governments are working to ensure that all cities have 5G cov-

erage, it would take years for the introduction and implementation.

Authors' contribution

This study was done by the authors named in this article, and the authors accept all liabilities resulting from claims which relate to this article and its contents.

Availability of data and materials

The data used to support the findings of this study are available from the corresponding author upon request.

Funding

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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