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ORIGINAL

DEVELOPING VR-BASED INTERACTIVE SYSTEMS FOR ENHANCED ATHLETIC TRAINING AND SPORTS ENGAGEMENT

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ABSTRACT

As virtual reality (VR) technology evolves alongside advancements in science and technology, its impact extends into various sectors, including sports and fitness. This technology, characterized by its sophisticated three-dimensional graphics, multi-sensory interaction, and high-resolution display capabilities, now offers unprecedented opportunities for enhancing athletic training and sports engagement. The integration of VR into digital media art within the sports industry allows for the creation of immersive training environments that simulate real-world conditions without the physical risks. These environments provide athletes with the ability to train more effectively, refine techniques, and enhance tactical awareness in a controlled setting. Additionally, VR technology revolutionizes fan engagement through interactive experiences that bring spectators closer to the action than ever before, offering a new dimension to digital sports viewership. This abstract explores the transformative potential of VR-based interactive systems in sports, detailing the technological foundations and their application in creating compelling, effective athletic and spectator experiences. The rapid evolution of digital media art, driven by these innovations, now supports a richer, more creative space for developing sports-related content, with significant implications for athletes, sports companies, and audiences alike.

KEYWORDS: Physical Interaction, Digital Media, Art, Virtual Reality

1. INTRODUCTION

Virtual reality (VR) technology, once confined to the realms of science fiction, has rapidly evolved into a formidable tool across diverse sectors, including entertainment, education, healthcare, and notably, sports and fitness.

This immersive technology, leveraging cutting-edge advancements in computing power, sensor technology, and graphical processing, creates simulated environments that can either mirror the real world or forge entirely new, fantastical landscapes. In the context of sports, VR's potential to transform traditional methodologies—whether in athlete training, game strategy development, or fan engagement—is unprecedented(Bastug, Bennis, Médard, & Debbah, 2017).

1.1 Historical Context and Technological Evolution

The journey of VR from concept to reality began in earnest in the 1960s, with early devices like the Sensorama and the Head-Mounted Display (HMD). However, it wasn't until the last two decades that VR technology began to realize its potential, driven by major advancements in video, audio, and interactive technologies. The improvement in HMDs, motion tracking, and user interface devices has facilitated the creation of highly immersive and interactive experiences. In sports, these technologies allow for the simulation of physical presence in different locations and the virtual replication of competitive environments, which are both critical in training and entertainment(Freeman et al., 2017).

1.2 VR Integration in Sports: Enhancing Training and Performance

In athletic training, VR has the capacity to revolutionize traditional practices. It offers athletes the ability to engage in repetitive practice sessions without the physical strain or risk of injury associated with intense physical activity. For instance, VR can simulate a high-stakes environment for a sprinter, complete with a virtual crowd and competitive pressure, or it can create diverse weather conditions for a skier to navigate repeatedly. These scenarios not only improve physical skills but also enhance psychological preparedness, which is crucial in high-level competitions(Alper, Öztas, Atun, Çinar, & Moyenga, 2021).

1.3 Analyzing Biometric Feedback and Tactical Training

Beyond physical training, VR systems integrate biometric sensors that provide real-time feedback on an athlete’s physiological responses. This data is invaluable for coaches and trainers to customize training regimes that optimize performance while minimizing injury risks. Furthermore, tactical training in team sports can be significantly enhanced through VR, allowing players to experience game situations countless times, interact with virtual opponents, and practice team strategies in a controlled virtual setting(Vankipuram et al., 2013).

1.4 Revolutionizing Fan Experience through Immersive Engagement

For sports fans, VR technology offers a new paradigm of engagement.

Traditional viewing experiences are passive and limited to the perspectives provided by camera placements. VR changes this by offering immersive experiences where fans can choose their viewpoint, whether it's on the sidelines, in the stands, or even from the perspective of a player on the field. This not only enhances the viewer's experience but also creates a more profound emotional connection to the sport and its athletes (Sucipto, Adrian, & Kencono, 2021).

1.5 Opportunities in Marketing and Fan Interaction

The immersive nature of VR opens up novel avenues for fan interaction and marketing. Sports marketers can create unique, engaging content that can be experienced in VR, from virtual tours of sports facilities and museums to interactive advertisements featuring athletes. Moreover, VR enables fans to participate in virtual sports communities, where they can interact with fellow fans and partake in discussions and activities, further increasing their loyalty and engagement.

1.6 Challenges in Implementation

Despite its potential, the implementation of VR in sports is fraught with challenges. The cost of VR technology, including the hardware and the development of high-quality content, remains high, posing barriers to widespread adoption. There are also technical challenges related to resolution, latency, and user comfort—issues that can detract from the user experience and limit the utility of VR in long training sessions or viewing experiences. Holographic images provide viewers with a visual psychological experience, and virtual reality works give users a variety of experiences.(Di & Kim, 2020). Through visuals or photos that are played in the environment, the interactive art of space elicits various emotions in viewers (Figure 1). The Smartphone interface, web interface, gaming connection point, and different connection points all give a visual, material, and sound experience thanks to the connection point plan (Figure 2). Other interactivity concepts are still being developed, and the somatosensory interaction offers a more tangible experience.

Figure 1: X-BOX

Figure 2: Interface design

2. Review of Litreature

2.1 VR Technology Facilitates the Creation of Digital Media Art

In the present virtual reality technology family, QuickTime VR technology is more popular, and many different technologies were used. A popular virtual reality solution that uses static graphics on the microcomputer platform is QuickTime VR.(Jung & Kim, 2021) Individuals can notice the all-encompassing perspective on the three-layered realistic picture as well as encountering the vivid 360° climate and perceiving how it feels to be in a three-layered virtual region while remaining on a level perception stage. With the equivalent, QuickTime VR innovation gives a decent involvement with expansion to having a decent presentation of 3D things or space. Furthermore, it offers a helpful and predominant altering device. The new media and participants utilizing QTVR virtual reality innovation are more participatory, permitting the watcher to control the playback cycle, partake in the play's plot, and even appear as one of the participants. It should be changed at any second to satisfy the numerous assorted requirements of numerous clients. Cameras and SLRs are just two instances of info gadgets that QuickTime VR innovation can go through. Virtually any electronic information gadget can be matched with the information gadget. The QuickTime VR module, for example, permits clients to openly alter, grade, and alter various pictures and movies that are put away in the camera. A video picture can be made by interfacing numerous photographs together, which is an extraordinary capability. By integrating the picture's data, you can likewise produce a liquid articulation that will build the watcher's advantage in the story as well as how the picture is seen, The advancement of QuickTime VR innovation has made the making of digital media art simpler and more reasonable, QuickTime VR innovation is reasonable, has an expansive scope of uses, and is popular with everybody (Kihonge, Vance, & Larochelle, 2002). Also, QuickTime VR innovation offers more imaginative internet browser module capacities for business, recreation, and instructive organizations, adding new preferences M. Clan 2006 Moreno's point is to think about the new

place of galleries in the digital period. (Utami, Rukiyah, & Andika, 2021)The job of the artist is decreased in works utilizing new media, and the client finishes up the public cycle, making them a setting for non-hierarchical discourse. New strategies and perspectives on the utilization of digital advancements to treat injury related infections are talked about. Not with standing possibilities for general wellbeing intercessions by backing gatherings and the digital media area, Ceranoglu underlines significant intercessions for guardians and doctors to help youths who are reliant upon digital media.

2.2 VR Technology Expands the Flexibility of Digital Media Artworks

Innovation for virtual reality offers more artistic liberty than customary canvas. Numerous artists started utilizing virtual space ideas and Slant Brush VR innovations, for example, programming that can be utilized and made in virtual space, as virtual reality and expand reality innovation improved and progressed. It mixes conventional art paper and pen with 3D computer creation. Cherker can use virtual reality technological tools to directly conduct virtual forms. (Dascal et al., 2017)A programme called Tilt Brush creates stereographic graphics in a virtual environment. It makes use of hand-standing apparatus, envelopes, and headers 2006 Cherker is generated using a mobile or handheld device in virtual space in accordance with an internal concept. It can be articulated without difficulty, and some consider this to be a creative approach. Creators can observe and admire their work in virtual worlds because they were developed there as well. The new method of creation has improved engagement and experience for the makers while also being more adaptable. The world's first virtual reality art exhibition hosted by Google in San Francisco will also be collecting this Tilt Brush VR painting. This technology has increased the number of animation productions, enhanced the authenticity of character and scene portrayals, and opened up new creative avenues.

2.3 VR Technology Increases the Freedom of Digital Media Art Creation

The geometry of stereo space is more easily accessible and freely playable thanks to VR technology. Designers can "construct" homes directly in the virtual space using the architectural design technique XRTISAN. The designer can alter the object's height and size in the virtual environment using the portable device's working lever, as well as add convenience-enhancing extra material as required. To achieve the most realistic appearance, the designer just needs to work in a virtual environment. This method makes it possible to complete more work in less time, which boosts both the productivity and quality of design work. The designer can walk through the house's construction using an external equipment helmet, and the experience has the same effect as strolling through a newly refurbished home. Holo Studio D. M. I. Lopes is a product bundle that is tantamount in such manner; creators can add materials and varieties while performing three-layered displaying

straightforwardly inside the virtual climate. Direct 3D printing of the piece is more modern S. Poole, 2000 Furthermore; comparative down to earth programs exist.(Lenoir, Cotin, Duriez, & Neumann, 2006) Plume in the field of film and TV grants is a program that spotlights on liveliness and film creation, participating in split script organization and delivering imaginative artwork for motion pictures. This program accomplishes direct altering highlights while additionally adding time aspects for painting.

3. Virtual Reality and Augmented Reality

3.1. Digital 3D Panoramic Technology of Virtual Reality

Prior to inspecting scene creation strategies, it is fundamental to have a hypothetical comprehension of the camera imaging computational space and the subsequent picture change model. It fills in as the establishment for creating all-encompassing photos. At the end of the day, the picture change model and camera imaging math are two particular outer portrayals of a similar sort of thought.

The new technique between the gathered photos might be resolved utilizing the camera imaging design. The data from the model made between pictures can likewise be utilized to decide the mathematical stance of the sensor during imaging reversibly. They give the numerical structure to photograph sewing and enlistment. (Munafo, Diedrick, & Stoffregen, 2017)A reasonable picture change relationship model should be chosen before picture sewing in light of the mathematical relationship of camera imaging. A prerequisite for picture sewing is the ability to dominate sensor imaging math. In this way, a hypothesis of the change connection between camera checking calculation and picture is presented prior to depicting display creation innovation.

The pinhole imaging guideline is commonly utilized in a smoothed out camera imaging model. It likewise goes by the name of viewpoint projection. The planning of three-layered space focuses to two-layered plane pixels is depicted by the viewpoint projection equation. This part will likewise present the universe of Cartesian facilitates, the camera coordinate framework, and the picture plane direction. Figure 3 portrays schematically the camera coordinate framework and the universe until the end of time. The surface photogrammetric coordinate framework, some of the time alluded to as the impact of intersystem in photogrammetry, is meant by the letters X, Y, and Z.

A right-hand mainland coordinate situation is shaped by the beginning, which is at a particular point on the ground of the shooting scene, the X hub, which relates to the even course of the heading, the Y pivot, which is the perfect inverse of the X hub, the Z hub, which is upward vertical. (Thies, Zollhöfer,

Stamminger, Theobalt, & Nießner, 2016)The optical hub of the camera is the Zc pivot, and the plane characterized by the Xc and Yc tomahawks is lined up with the field of vision. This is the means by which the reasonable change framework is addressed as Xc, Yc, and Zc. The emotional three-layered climate has the camera in a particular area. There are connections as far as interpretation and revolution between the world synchronize framework and the image coordinate framework.

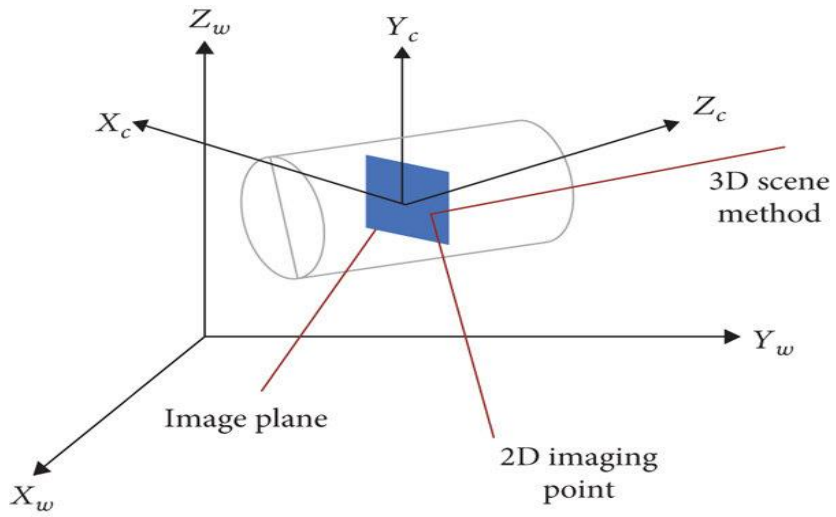

Figure 3: The coordinate system for the camera and the systems used to process global data are separate systems.

The world coordinates:

$$\begin{pmatrix} x_c \\ y_c \\ Z_c \\ 1 \end{pmatrix} = \begin{pmatrix} R & T \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x_w \\ y_w \\ z_w \\ 1 \end{pmatrix} = M \begin{pmatrix} x_w \\ y_w \\ z_w \\ 1 \end{pmatrix} \quad (1)$$

The world reference outline is shown by the colon w, the addendum c demonstrates the camera coordinate framework, T the 31 interpretation vector, R the 33 pivot tensor, and 0 the 13 component vector with every one of the 0 components. As represented in Figure 4, the picture plane directions describe the connection between the camera coordinate framework and the picture plane direction framework and show the projection areas of the three-layered scene focuses on the imaging plane.

The optical hub of the camera and the upward foot of the picture plane (portrayed in the figure as point P) act as the beginning of the picture plane direction framework, and the X and Y tomahawks are lined up with the X and Y tomahawks of the camera coordinate framework, separately. The central length (f) is the partition between the image plane and the optical focus (O) of the camera coordinate framework. The connection between the camera coordinate framework and the picture plane direction framework in homogeneous

directions can be communicated utilizing the viewpoint projection condition (2).

$$Z_c \begin{pmatrix} x_c \\ y_c \\ 1 \end{pmatrix} = \begin{pmatrix} f & 0 & 0 \\ 0 & f & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x_c \\ y_c \\ Z_c \\ 1 \end{pmatrix} \qquad (2)$$

It is critical to decipher the picture plane directions in physical aspect units to a portrayal in pixel units to accelerate PC handling. Condition (3), in which u0, v0 are the directions of point O in the direction framework ouv and dx, dy are utilized to address the width and level of every pixel, can be utilized to communicate the transformation between the two portrayals (in units of physical size). For PC handling, it is critical to change over the image plane directions' physical sizes to pixel portrayals. Condition can be utilized to address how the two pictures change (3). The direction framework ouv's boundaries for 0° are u0 and v0, and every pixel's length and expansiveness are dx and dy (estimated in units of physical size).

$$\begin{pmatrix} u \\ v \\ 1 \end{pmatrix} = \begin{pmatrix} \frac{1}{d_x} & 0 & u_0 \\ 0 & \frac{1}{d_y} & v_0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x_c \\ y_c \\ 1 \end{pmatrix} \qquad (3)$$

3.2 Augmented Reality Digital Media Art Display

The capacity to give virtual things that should be overlay with constant spatial stances is a vital part of the AR framework. It can connect with and see things in virtual scenes when joined with genuine scenes and human-PC interaction. This part essentially resolves the issues of spatial situating of virtual 3D items in the genuine scene, assessing the last identification model, making models that are viable with AR computational limit, and scene interaction. The precision of resulting situating and development, which principally includes worldwide and neighbourhood highlights, is straightforwardly impacted by the nature of component discovery.

Worldwide capabilities, for example, picture surface and picture tone, decipher the picture according to the point of view of the whole picture. A point or district in the picture that stands apart from its environmental elements is alluded to as the neighbourhood highlight. The component point can convey the nearby characteristics of the picture and is the picture's provincial articulation. After highlight focuses and related include descriptors have been recovered, highlights should be contrasted all together with evaluate how intently two pictures look like each other and how component focuses connect with each other. Here, Euclidean, Hamming, and Mahalanobis distances are used to determine the relationship between feature points using the registration technique. A strategy for matching nearby picture features is shown in Figure 4.

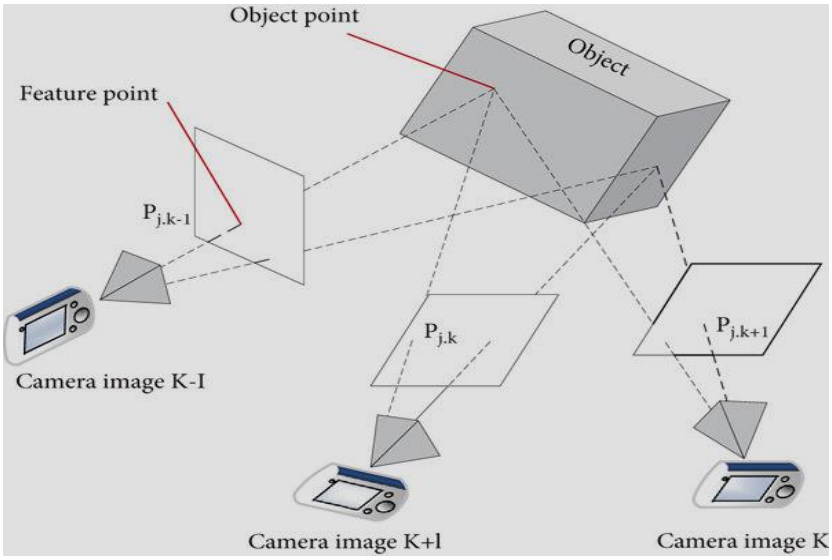

Figure 4: adjacent image feature matching.

In the previous element extraction stage, two arrangements of component descriptors, D1 and D2, are acquired for two arbitrarily picked pictures:

$$D_1 = (x_0, x_1 \ldots . x_n), \qquad (4)$$

$$D_2 = (y_0, y_1 \ldots . y_n),$$

In n-dimensional space, the Euclidean distance determines the precise separation between two points, as in

$$d(D_1, D_2) = \sqrt{\sum_{i=1}^{N} (x_i + y_i)^2} \qquad (5)$$

When two vectors of the same dimension are compared, the Hamming distance determines how many different related elements there are, such as

$$d(D_1, D_2) = \sum_{i=1}^{N} (x_i + y_i) \qquad (6)$$

Mahalanobis distance measures the separation between the covariances of various vectors after the variance is normalised to ensure that the distance has no bearing on the scale dimension. It is calculated by and primarily utilised in probability statistics.

$$d(D_1, D_2) = \sqrt{(D_1, D_2)} T_{s-1}(D_1, D_2) \qquad (7)$$

The standard practice for approaches in light of monocular vision is beast force coordinating. At the end of the day, given two pictures, picture 1 and picture 2, it is important to decide the distance between each component descriptor in one of them and all element descriptors in the other. Then, the element descriptor with the littlest distance is picked as the enlistment object to guarantee the most ideal matching result. The spline can be isolated into insertion spline and estimated spline relying upon whether all control focuses are on the created spline. The addition spline bend, which goes through every one of its control focuses as delineated in Figure 5 is suitable when the direction data for the information focuses is sensibly exact. Accordingly, the particular of liveliness course and digital portraying are the chief purposes of such splines. Normal cubic splines, Hermite splines, and cardinal splines are many times utilized insertion splines. Figure 6 exhibits that the fitted spline bend doesn't go through all or a piece of the control focuses in light of the fact that this spline bend is reasonable for the situation where there are numerous data of interest and the direction data of the information focuses is loud. Thusly, Bezier splines and B-spline bends are estimated splines that are much of the time used to make the outer layer of articles. The spline approach can create a meager portrayal cubic polynomial bend and afterward build a cubic spline bend over each war room by adjusting a given arrangement of present focuses to a piecewise second-request polynomial bend. Figure 6 shows the direct interjection fitting of these chokepoints in the event that there are n + 1 safety efforts, where Pk = Xk, Yk, and Zk, and k = 0, 1, and n. As the boundary u differs from 0 to 1 (the point addressed by x, y, and z u will transform from the prior control highlight the later control point along the spline), the parametric cubic polynomial fitting each sets of control focuses is portrayed by the arrangement of conditions (8) as follows:

$$x(u) = a_x u^3 + b_x u^2 + c_x u + d_x \quad (8)$$

$$y(u) = a_y u^3 + b_y u^2 + c_y u + d_y$$

$$z(u) = a_z u^3 + b_2 u^2 + c_2 u + d_2$$

The values of the four coefficients a, b, c, and d must be calculated for each equation in the equation set (8), and

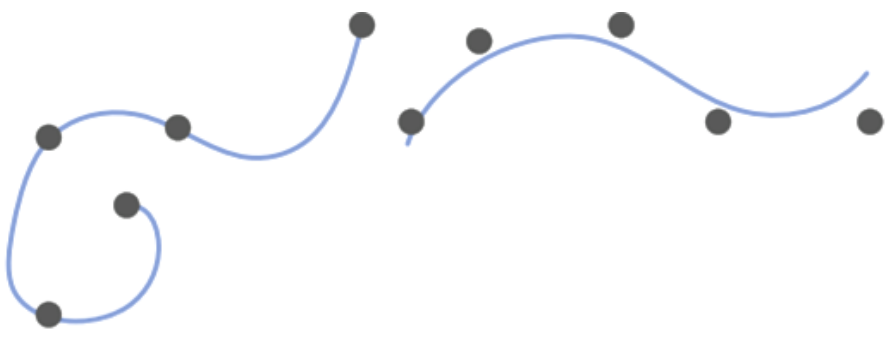

Figure 5: Classification of spines

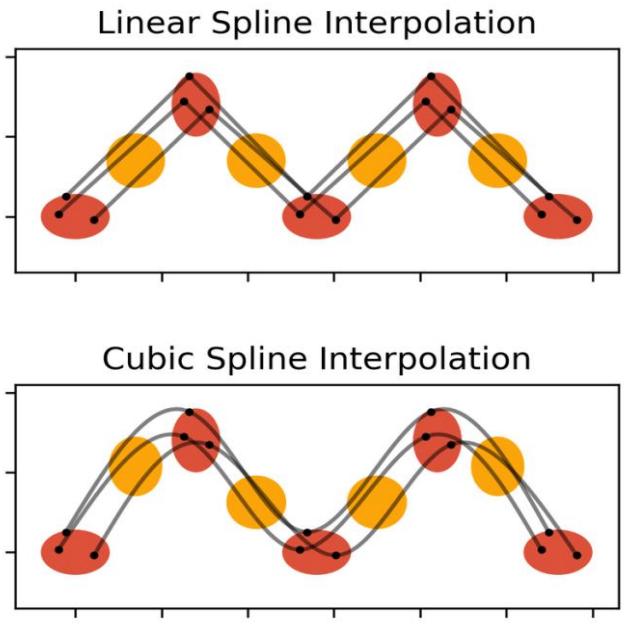

Figure 6: Piecewise continuous cubic spline interpolation

The number of curve segments produced by n control points plus one must be determined in advance by the user, as well as the coefficients for each curve segment. By imposing adequate boundary constraints at the intersection of two spline segments, all coefficient values can be achieved

3.3 Digital Media Art Expressions

The features of creative abstraction that are formed by the expression of human subjective comfort and desire can be seen in digital art graphics. It is not just a phenomenon of culture; it is also a significant method of emotional communication. The primary and most important characteristic that sets art apart from other idealistic pursuits is its aesthetic appeal. However it is higher than life, art is gotten from it. (Tromp, Peeters, Meyer, & Hagoort, 2018).

It is personally connected with human exercises and social agreement. The most vital thing is to learn and value the art and magnificence that exist in human undertakings. The amicability and solidarity of all tone, creation, and surface in the image content and the otherworldly domain of individuals is alluded to as style. (J. You, 2021)Through assorted artistic ways of behaving like photography, painting, and plan creation, individuals show the study of nature and mindfulness.

$$AM = \frac{O_0}{O_c}$$

where Oo stands for an object's internal order and Oc for an object's internal complexity. Inner complexity and order are factors in determining

beauty. Oo, for instance, contains intersection and symmetry in polygonal images, while Oc denotes the quantity of edges. This equation is thought to have served as the inspiration for aesthetic digitalization. On the basis of conventional aesthetics, this work suggests a new aesthetic formula and concretizes its variable calculations. As per this article, what partitions picture intricacy into PC and IC intricacy, the "excellence" of an image is converse to PC intricacy and proportionate to IC intricacy. The new tasteful rule is as per the following:

$$M = \frac{IC}{PC}$$

Digital art designs and different pictures with high innate repeatability contain rich substance and fine designs, which add to their high IC worth. Notwithstanding, in light of the fact that individuals' understanding of these convoluted components is generally clear thus has a low PC esteem, they feel calm, similar to it, and see themselves as "gorgeous." While not set in stone by separating the fractal wavelet change rate by the pressure rate, still up in the air by partitioning the JPEG picture pressure mistake rate by the pressure rate. The overall qualities of the image are reflected in the colour.

The image in this paper is typically described using general techniques like colour histograms, colour moments, and colour correlation diagrams, although advanced statistical techniques like colour distribution and chromaticity can also be utilised. The luma and chrominance components are independent of one another and are inconsistent with hue information, which gives the HSV colour model two unique advantages. Hue and chroma components have a strong relationship to how people perceive colour visually.

There are various ways to express the quantity of colour physically, and mathematical formulas can be employed to map one theory to another. All three elements of the RGB colour space have values of 0255. In this study, the values of the three components are normalised, and maximal and minimal represent, respectively, the highest and lowest values of B, G, and R. Information Systems for mobile phones

Table 1: Changes in The Number of Chinese Internet Users and Their Penetration Rate.

YEAR	PENETRATION (%)
2018	2.36
2019	3.22
2020	4.25
2021	5.63
2022	6.22

4. Digital Media Art Display Design and Analysis

4.1 Virtual Reality Technology and Digital Media Art

Participants can collaborate and draw in with machines, a registering framework, in a virtual world because of virtual reality innovation. It utilizes a PC to fabricate a virtual world with a unique three dimensional view that speaks with the telephone because of the client's developments. Clients can totally submerge themselves in the re-enacted space by utilizing it to establish a reproduction model virtual reality climate. Vivid scene configuration is promoted in numerous areas of digital media art as a plan strategy. (Moreno, 2019). In this way, the numerous application spaces and characterization of online media art should initially be figured out to dissect the arrangement of drenched scene plan in digital media art.

The four expert application fields of time media plan, intuitive item plan, visual correspondence plan, and intuitive diversion configuration are remembered for the arrangement of media items for digital media art. The size and dispersion of Chinese Web clients as of right currently are displayed in Figure7. It is evident that internet users are now using different techniques. On the PC side, portable Web access has made a disastrous difference. The PC Web is steadily being supplanted by versatile Web access, which has basically arrived at full inclusion. Individuals have inadvertently entered the self-media period because of the quick progression of Web innovation and continuous advancement and change, which has bit by bit moved individuals' data trade from PCs to cell phones.

Digital media art is essential in the self-media period, which gives new driving force to the continuous entrance of data media into the universes of art and culture. Digital media art is broadly and profoundly utilized in film and TV publicizing, depending on network media as the transporter in the self-media time with the advocacy of 4G and the improvement of 5G, network art and intelligent establishments, and different fields. Digital media art has the attributes of intuitiveness, cross-reality and reconciliation. As of now, the "purchasing" and "selling" of digital media art isn't adequate to decide its business esteem; rather, a buyer industry chain is required. The huge extra things and added esteem behind it give it its new plug esteem.

Figure 7 shows the result worth of China's way of life area. The assorted and special ways that digital amusement art is communicated are on top of the necessities of the present youthful purchaser gatherings and answer their inclinations, which are chiefly addressed in the monetary worth of digital media art. Second, "individuals situated" thought and "shopper update" welcomed on by the development of digital innovation may be the following significant defining moment for the digital social area.

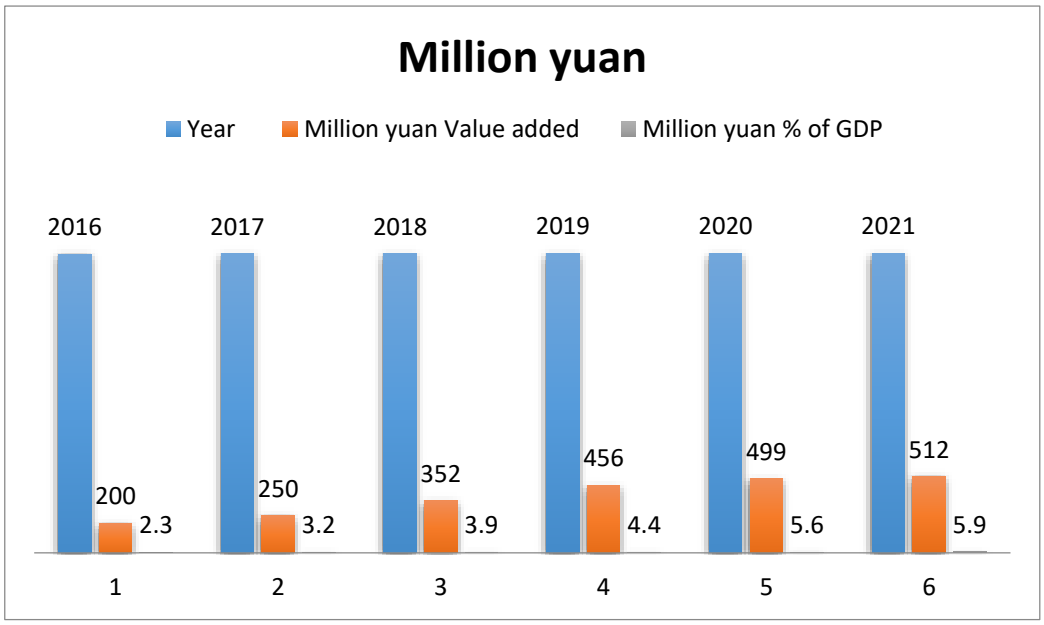

Figure 7: Added value of Chinese culture-related industries.

4.2 Offers Unique Innovation and Digital Media Art

Truth be told, augmented reality (AR) is another private-name innovation that "perfectly" associates the virtual and physical universes by mimicking physical characteristics like vision, hearing, taste, contact, and other physical viewpoints that individuals, in actuality, can only with significant effort access. To fulfil data that individuals can't feel in reality, augmented reality innovation intently looks like the certified world prior to re-establishing the data to this present reality.

A definitive goal is to satisfy human tactile experience past what is veritable. Since AR innovation bases its re-enactment of the virtual world on this present reality, the two universes will cover and get better with time. Through the protective cap recreation show, the client can consolidate the genuine world and virtual conditions into a solitary spot. The virtual cap will do this by using various new augmented reality advancements. Ongoing following, scene combination in three aspects, multisensory combination, continuous video reality and control, and other creative advances and apparatuses are undeniably covered by the innovation. Table 1 shows the four primary hardware pointers utilized in virtual reality innovation. The presence of 3D representation is demonstrated by the gadget's high revive rate, goal, low inertness, and strong handling capacities; upgrading these signs improves the inundation of the experience material.

Visitors interact visually by observing the exhibits with their eyes and evoking associated feelings and behaviours. One of the first technologies to be created is visual interaction technology. Through vision, the audience gains knowledge and produces related behaviours to complete the encounter. In the

show, for example, augmented reality AR and unaided eye 3D, which are progressively far reaching in multimedia applications, are shown alongside some variety designs, dynamic iconography, and multimedia data interfaces that could communicate particular implications. Moreover, in a few new media display pieces, guests can connect outwardly with the shows by moving their eyes.

Eyeball innovation, for example, "eyeball acknowledgment" and "eye following," is another field of study. To control intelligent contraptions with the eyes, it for the most part utilizes PC vision, infrared location, or remote detecting. Intuitive structures including page turning, shooting, and moving items are acknowledged utilizing eye movements. Table 2 shows key metrics for augmented reality hardware.

Table 2: Key metrics for augmented reality hardware.

NAME	MINIMUM STANDARDS	MATURE STANDARD	CURRENT LEVEL
SCREEN REFRESH RATE	100 Hz	200-310 MHZ	100 Hz
RESOLUTION	3 K	6 K	1080 p
DELAY	20.4 ms	Continue to decrease	20 ms
CALCULATE ABILITY	Qualcomm 820	Continuous improvement	CORE-i7

Table 3: Audience initial ability questionnaires

PROBLEM	RESULT			
KNOWLEDGE OF VR	Know it well 0.03	Generally 0.18	Heard about it 0.25	Do not Understand 0.70
KNOWLEDGE OF VR GAME	Involved in the deign 0	Played 0.41	Heard about it 0.23	Have no idea 0.36
HAVE YOU EVER BEEN IN CONTACT WITH VR EQUIPMENT?	Been Touched 0.02	Heard about it 0.23	Have no idea 0.75	
HAVE YOU EVER TOUCHED VR TEACHING?	Frequently 0	Occasionally 0.02	No 0.98	
WILLINGNESS TO APPLY VR TO TEACHING	Powerful 0.67	Generally 0.21	It does not Matter 0.12	
ADVANTAGE OF VR	Intuitive 0.2	Interesting 0.45	Interactivity 0.35	

Table 4: Questionnaire statistical results.

AVERAGE SCORE	USE EXPERIENCE		
	Sensory Experience	Interactive Experience	Cognitive experience
0.2	2.3	1.9	1.3
0.3	2.6	2.2	2.2
1.2	3.2	2.9	2.6
1.6	3.6	3.2	3.1
2.1	4.1	3.6	3.5
2.3	4.5	4.2	4.2
2.6	5.2	4.6	4.6
3.2	5.6	5.2	4.9
3.9	6.2	5.9	5.2
4.2	6.6	6.2	5.5

Digital media innovation supports the development of digital media art. Internet media material is currently more than just a means of artistic expression. Table 3 shows audience initial ability questionnaires. Table 4 shows questionnaire statistical results. It is today difficult to distinguish between stylish, inventive, and calculated abilities. The development of digital entertainment art has given rise to numerous new digital art categories, including motion art, nouvelle film, video art, realistic symbolism, and organisation art. The development of new innovations is essential to its course of events. This study examines the evolution of visual language as a medium for multimedia contexts and globalisation, starting with idea, thinking, and creativity. Additionally, it considers how to enhance images' capacity to influence behaviour. Visual communication creators and users pursue aesthetic modernity while retaining a creative mindset. Interaction design research in new media display design is a relatively young area of study. The number of shows is still increasing, and the style of presentations is developing quickly due to associated issues, even if domestic research and practise are still in their early phases and, in some ways, are not competitive.

The design of China's new media programme appears promising thus far in terms of scene and site growth. A VR-based design that enables users to manipulate a digital painting with their bodies. To test the design, we enlist 20 participants. We give them a number of VR interface-based tasks to do, such as adjusting the painting's colours or zooming in and out. The time it takes for each participant to complete the activities is then recorded, along with any mistakes or problems they may have while taking the test. On a scale from 1 to 5, we also ask users to score the VR-based design's usability and overall efficacy.

Table 5: Task Completion Time and Participant Ratings Based on VR Design

PARTICIPANT	TIME TO COMPLETE TASKS (IN SECONDS)	RATING (1-5)
1	30	4
2	45	3
3	20	5
4	60	2
5	25	4
...	...	...
20	35	4

The ratings of participants with various ages and degrees of VR experience can be compared using ANOVA testing as follows: Let's say we enlist 60 participants to evaluate a VR-based strategy for hands-on engagement with digital art. We divide the participants into three age groups—18 to 24 years old, 25 to 40 years old, and over 40—as well as three groups according to their VR experience (novice, intermediate, and expert). Table 5 shows task completion time and participant ratings based on VR design.

5. Result

After testing, we ask participants to grade the VR-based design's usability and overall efficacy on a scale of 1 to 5. The following table (table 6) lists the results:

Table 6: Compare the opinions of participants with various ages and degrees of VR experience.

PARTICIPANT	AGE	EXPERIENCE	RATING (1-5)
1	18-24	Novice	4
2	18-24	Novice	3
3	18-24	Novice	5
...	...	...	...
20	18-24	Intermediate	4
21	18-24	Intermediate	5
...	...	...	...
40	25-40	Expert	4
41	25-40	Expert	3
...	...	...	...
60	over 40	Novice	2

The non-significant p-values in the ANOVA table demonstrate that neither age group nor experience has a significant impact on how well the VR design is rated. Age may have a slight influence on rating, but the p-value for this group (0.298) is closer to the significance level of 0.05. We can use Tukey's HSD test to evaluate the mean rating across all potential pairs of age and

experience groups in post-hoc analyses. This enables us to pinpoint the groups that considerably diverge from one another.

For instance, we might discover that participants with intermediate experience who are 18–25 years old score the VR design much lower than participants with advanced expertise who are 36–45 years old. We may make educated decisions to improve the design for particular user groups by using ANOVA and post-hoc tests to acquire insights into how various aspects, such as age and experience, may influence the success of VR-based physical engagement in digital media art.

6. Discussion

Future work will include more tasteful characteristics that can address picture data, with an emphasis on unpretentious surface and shape highlights and the chase after more exact calculation strategies. (Ayu et al., 2021)Extra research is expected to deal with the digital works made by creating advancements including wearable innovation, blended reality, AI, and keen frameworks that have surfaced as of late. Consolidating virtual reality innovation with digital media art can make it simpler for watchers to encounter the imaginative climate. Despite the fact that individuals esteem art, an adjustment of involvement mode will biggerly affect society. In the event that individuals consolidate the tasteful voice of online media art with the force of 3D representation, they will foster another kind of imaginative language. Digital art visuals are pictures created by clients of PCs utilizing numerical estimation procedures.

They frequently exhibit dynamic balance, symmetry, complete and partial self-similarity, and fine structure. They combine the importance of science and art while having rich implications and distinctive styles. In order to deepen our understanding of this topic, it is important to concentrate on the following aspects: investigation of the psychological effects and emotional laws that diverse visual elements have on people. The main task of picture aesthetic study is to investigate the appropriate ways to describe and extract these aspects.

7. Conclusion

The integration of virtual reality (VR) technology into sports and fitness represents a significant leap forward in how athletes train and how audiences engage with sports. Through detailed exploration in this paper, it has become evident that VR not only has the capacity to transform athletic training but also revolutionizes the spectator experience, providing immersive interactions that were previously inconceivable.

Firstly, for athletes, VR-based systems offer a myriad of benefits, from

the ability to simulate complex, real-world environments to providing safer training contexts where skills can be honed without the physical risks associated with high-impact sports. These interactive systems enable precise analysis and feedback, crucial for improving performance metrics such as reaction times, strategic thinking, and overall fitness.

For sports organizations and teams, the adoption of such technology leads to more efficient training sessions and potentially shorter recovery times, thanks to controlled and customizable training intensities. Secondly, from the perspective of audience engagement, VR introduces a new dimension to viewing sports. Fans can experience games from virtually any perspective, including positions that would normally be impossible or extremely costly. This not only enhances fan enjoyment and engagement but also opens new revenue streams for sports companies through virtual tickets and exclusive VR content. Moreover, this technology allows fans to experience historical or impossible matchups, further deepening their connection with the sport(Zhu, 2020). However, the widespread implementation of VR in sports also presents challenges.

Technical issues, such as latency and the physical discomfort known as VR fatigue, need ongoing attention. Furthermore, the high cost of VR equipment and the need for specialized knowledge to create and maintain these systems can be prohibitive for smaller sports companies or lower-funded teams. Despite these challenges, the potential of VR to enhance athletic training and redefine fan experiences is immense. Moving forward, the development of more user-friendly and cost-effective VR solutions will be crucial. Additionally, continuous collaboration between technologists, sports scientists, athletes, and fans will ensure that the evolution of VR technology aligns with the real-world needs of the sports and fitness industry(Liu, Wu, Xu, & Liu, 2021).

In conclusion, as VR technology continues to advance, its integration into sports and fitness heralds a new era of interactive media art with profound implications for training, performance, and fan engagement. By embracing these innovations, the sports industry can look forward to not only enhanced athletic performance but also an enriched fan experience that brings the excitement of live sports into the digital age.

REFERENCES

Alper, A., Öztas, E. S., Atun, H., Çinar, D., & Moyenga, M. (2021). A Systematic Literature Review towards the Research of Game-Based Learning with Augmented Reality. *International Journal of Technology in Education and Science, 5*(2), 224-244.

Ayu, R. F. K., Jannah, Z., Fauziah, N., Ningsih, T. N., Manilaturrohmah, M.,

Suryadi, D. A., . . . Fitriyah, F. K. (2021). Planetarium glass based on augmented reality to improve science literacy knowledge in Madura primary schools. *Child Education Journal, 3*(1), 19-29.

Bastug, E., Bennis, M., Médard, M., & Debbah, M. (2017). Toward interconnected virtual reality: Opportunities, challenges, and enablers. *IEEE Communications Magazine, 55*(6), 110-117.

Dascal, J., Reid, M., IsHak, W. W., Spiegel, B., Recacho, J., Rosen, B., & Danovitch, I. (2017). Virtual reality and medical inpatients: a systematic review of randomized, controlled trials. *Innovations in clinical neuroscience, 14*(1-2), 14.

Di, M., & Kim, H. G. (2020). Shape of light: interactive analysis of digital media art based on processing. *TECHART: Journal of Arts and Imaging Science, 7*(4), 23-29.

Freeman, D., Reeve, S., Robinson, A., Ehlers, A., Clark, D., Spanlang, B., & Slater, M. (2017). Virtual reality in the assessment, understanding, and treatment of mental health disorders. *Psychological medicine, 47*(14), 2393-2400.

J. You, J. H., E. Kim, and K. Kim,. (2021). “Research on social information processing using the augmented reality device: comparison with real-world human interaction,” *Journal of KIISE, 48*(3), 308–316.

Jung, E., & Kim, N. (2021). Virtual and augmented reality for vocational education: a review of major Issues. *J Educ Inf Media, 27*(27), 79-109.

Kihonge, J. N., Vance, J. M., & Larochelle, P. M. (2002). Spatial mechanism design in virtual reality with networking. *J. Mech. Des., 124*(3), 435-440.

Lenoir, J., Cotin, S., Duriez, C., & Neumann, P. (2006). Interactive physically-based simulation of catheter and guidewire. *Computers & Graphics, 30*(3), 416-422.

Liu, Y., Wu, S., Xu, Q., & Liu, H. (2021). Holographic projection technology in the field of digital media art. *wireless communications and mobile computing, 2021*, 1-12.

Moreno, L. D. R. (2019). Museums and digital era: preserving art through databases. *Collection and Curation, 38*(4), 89-93.

Munafo, J., Diedrick, M., & Stoffregen, T. A. (2017). The virtual reality head-mounted display Oculus Rift induces motion sickness and is sexist in its effects. *Experimental brain research, 235*, 889-901.

Sucipto, A., Adrian, Q. J., & Kencono, M. A. (2021). Martial art augmented reality book (arbook) sebagai media pembelajaran seni beladiri nusantara pencak silat. *Jurnal Sisfokom (Sistem Informasi Dan Komputer), 10*(1), 40-45.

Sudirman, S., Kusumah, Y., & Martadiputra, B. (2021). Augmented reality blended learning instruction: the impact on growing motivation, attitudes, and knowledge in 3D geometry. *Turkish Journal of Computer and Mathematics Education, 12*(4), 674-683.

Thies, J., Zollhöfer, M., Stamminger, M., Theobalt, C., & Nießner, M. (2016).

Facevr: Real-time facial reenactment and eye gaze control in virtual reality. *arXiv preprint arXiv:1610.03151*.

Tromp, J., Peeters, D., Meyer, A. S., & Hagoort, P. (2018). The combined use of virtual reality and EEG to study language processing in naturalistic environments. *Behavior Research Methods, 50*, 862-869.

Utami, F., Rukiyah, R., & Andika, W. D. (2021). Pengembangan media flashcard berbasis augmented reality pada materi mengenal binatang laut. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, 5*(2), 1718-1728.

Vankipuram, A., Khanal, P., Ashby, A., Vankipuram, M., Gupta, A., DrummGurnee, D., . . . Smith, M. (2013). Design and development of a virtual reality simulator for advanced cardiac life support training. *IEEE journal of biomedical and health informatics, 18*(4), 1478-1484.

Zhu, W. (2020). Study of creative thinking in digital media art design education. *Creative Education, 11*(2), 77-85.