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**ABSTRACT**

*This report covers all aspects of computer graphics. It talks of the past, present and future of this subject. It talks about the use of software in various areas and its potential. Computer graphics has applications in healthcare, technology, mathematics, sciences. It has two main branches – vector and raster graphics. It is used in entertainment, gaming industries. In this report, the topics covered are graphics hardware, software, algorithms, applications and challenges. It is a useful source of information. It talks about input and output devices, since CG originated with the development of these devices. It provides an analysis of the topic and talks about the future research. This report discusses 2 rendering techniques, 2 shading models as well as animation and simulation. This report further explores the ethical dimensions of AI-driven graphics, delving into the challenges of deepfake regulation and digital privacy. It highlights emerging technologies like AR integration and sustainable rendering practices. It serves as a roadmap towards the future.*

**Introduction**

**Background Information**

Computer graphics, the interdisciplinary field of visual computing, has revolutionized the way we perceive and interact with digital information. It encompasses a wide array of technologies used to create, manipulate, and display visual content on computers and other digital devices. The evolution of computer graphics has been intricately linked with advancements in hardware, software, and algorithms, leading to immersive visual experiences and innovative applications across various industries.

**Historical Evolution**

The roots of computer graphics can be traced back to the mid-20th century when researchers and engineers began exploring ways to represent visual data electronically. Early developments in vector displays and cathode-ray tubes laid the groundwork for the graphical user interfaces (GUIs) that are now ubiquitous in modern computing. In the 1970s and 1980s, pioneers like Ivan Sutherland and Alan Kay introduced fundamental concepts such as graphical interaction and object-oriented programming, paving the way for graphical applications in design, gaming and scientific visualization.

**Technological advancements**

The rapid progress of graphics hardware, particularly Graphics Processing Units (GPUs), has been a driving force behind the evolution of computer graphics. GPUs are specialized processors designed to handle complex mathematical calculations required for rendering images and videos. Parallel-processing capabilities of modern GPUs enable real-time rendering of intricate 3D scenes and simulations, leading to lifelike graphics in video games, virtual reality environments and simulations.

**Diverse Applications**

Computer graphics finds applications in diverse fields, including entertainment, education, healthcare and engineering. In the entertainment industry, computer-generated imagery has transformed filmmaking and animation, allowing the creation of fantastical worlds and lifelike characters. Educational software and simulations leverage graphics to enhance learning experiences, making complex concepts more accessible and engaging. In healthcare, medical imaging and visualization techniques powered by computer graphics aid in diagnosis, surgical planning and medical research.

**Challenges and Innovations**

Despite the remarkable progress, challenges persist in the field of computer graphics. Realism in graphics, especially in areas like human facial expressions and natural environments, remains a focus of research. Additionally, the integration of machine learning and artificial intelligence techniques with computer graphics, opens new avenues for creating intelligent, interactive environments.

This report delves into the intricacies of computer graphics, exploring its fundamental principles, technological underpinnings, diverse applications, and the future landscape. By examining the historical context and contemporary developments, this report aims to provide a comprehensive understanding of the dynamic field of computer graphics.

**Purpose** **of** **the** **Report**

The purpose of the report is to provide a comprehensive exploration of the field of computer graphics, encompassing its fundamental principles, historical evolution, technological advancements and diverse applications. By delving into the intricacies of computer graphics, this report aims to achieve the following objectives:

1.Educational insight: To offer readers including students, researchers and professionals, a detailed understanding of the foundational concepts and theories underlying computer graphics.

2.Industry Relevance: To inform industry professionals, decision-makers, and stakeholders about the latest trends, innovations, and challenges in the realm of computer graphics, providing valuable insights for business and technological decisions.

3.Research Contribution: To present recent research findings, methodologies, and advancements in computer graphics, contributing to the academic and scientific community’s knowledge base.

4.Practical Applications: To showcase real-world applications of computer graphics in various sectors, highlighting its impact on fields such as entertainment, healthcare, education and engineering.

5.Technical Guidance: To provide practical guidance and instructional content for individuals interested in enhancing their skills in computer graphics, including tips, best practices and software recommendations.

**Scope** **and** **Limitations**

The scope of this report encompasses a wide range of topics within the field of computer graphics, including but not limited to:

1.Fundamental Concepts: Exploration of fundamental principles and theories underlying computer graphics, covering areas such as rendering techniques, algorithms and graphical user interfaces.

2.Technological advancements: Discussion of recent advancements in graphics hardware, software and algorithms, with a focus on their impact on real-time rendering, virtual reality and augmented reality.

3.Diverse applications: Examination of practical applications in industries such as entertainment, healthcare, education, and engineering, highlighting key innovations, and use cases.

4.Challenges and future trends: Analysis of challenges faced by the industry, such as achieving realistic graphics and overcoming limitations, along with insights into emerging trends and future possibilities.

**Limitations**

While this report aims to produce a comprehensive overview of computer graphics, it has certain limitations:

1.Depth of coverage: Due to the vastness of the field, in-depth coverage of highly specialized topics may be limited. The report provides a broad understanding and may not delve into niche areas.

2.Temporal constraints: The report focuses on information available up until the knowledge cutoff date in January 2022.

3.Commercial Product Endorsement: This report does not endorse or promote specific commercial products or brands within the realm of computer graphics.

**Fundamentals** **of** **Computer** **Graphics**

**Definition and Concepts**

Computer Graphics refers to the creation, manipulation and representation of visual images and animations using computers. It encompasses a diverse range of techniques to generate graphical content, including 2D images, 3D models, animations and interactive simulations. At its core, computer graphics involves algorithms and mathematical computations to translate digital data into visual displays that can be perceived by humans.

Primitives are basic units which a graphics system may combine to create more complex images and models. Examples include sprites, character maps, polygons and triangles.

**History of Computer Graphics**

The history of computer graphics dates back to the mid-20th century when researchers and engineers began experimenting with digital displays. One of the pioneering systems was the Cathode-Ray Tube Amusement Device created by Thomas Goldsmith Jr. and Estle Ray Mann in 1947, considered one of the earliest examples of electronic interactive entertainment.

In the 1960s, Ivan Sutherland and his student David Evans, developed Sketchpad, an innovative computer program, that allowed users to interact with graphical objects directly on the screen using a light pen. This laid the foundation for modern GUIs.

**Types of Computer Graphics**

1.2D Graphics: 2D graphics involve 2-dimensional images displayed on a plane. Techniques such as rasterization and vector graphics are used to create and manipulate 2D images. In computer graphics, rasterization is the task of taking an image described in vector graphics format and converting it into a raster image.

2.3D Graphics: It involves the use of geometric modelling, rendering and shading techniques to generate 3D visuals.

3.Vector Graphics: Vector graphics use mathematical equations to define shapes, allowing them to be scaled infinitely without loss of quality.

4.Raster Graphics: Raster graphics are composed of pixels arranged in a grid. Each pixel contains colour information, allowing the creation of detailed images.

**Graphics Hardware**

**Graphics Processing Units (GPUs)**

Graphics Processing Units, commonly known as GPUs, are specialized processors, designed to handle complex mathematical calculations, required for rendering images and videos. Modern GPUs are highly parallel processors, allowing them to perform multiple calculations simultaneously. This parallelism is essential for real-time rendering of intricate 3D scenes, simulations and complex visual effects.

Parallel Processing: GPUs excel at parallel processing tasks, dividing complex computations into smaller tasks that can be processed concurrently. This capability significantly enhances the rendering speed and efficiency.

Shader units: GPUs consist of shader units responsible for executing shader programs. Shaders are algorithms used for rendering and manipulating graphics. There are different types of shaders, such as vertex shaders, fragment shaders, and geometry shaders, each serving specific purposes in the rendering pipeline.

**Display Devices**

Monitors: Monitors serve as the primary output devices for computer graphics. Modern monitors come with various specifications such as resolution, refresh rate, and colour depth.

Projectors: Projectors are widely used in presentations, gaming and immersive environments. They project computer-generated images onto large screens or surfaces, enabling collaborative workspaces and interactive experiences.

**Input Devices**

Graphics Tablets: Graphics tablets are input devices used by artists for digital drawing and illustration.

Digital cameras: Digital cameras capture real-world scenes and convert them into digital images. Image processing techniques, often involving computer graphics algorithms, enhance and manipulate these images for various applications.

**Graphics Software**

**Graphic Design Software**

Adobe Creative Suite: Adobe offers a suite of graphic design software including Photoshop for image editing, Illustrator for vector graphics, and InDesign for layout design. These tools are widely used in the design industry to create digital artwork, illustrations, and print materials.

CorelDRAW: CorelDRAW is a popular vector graphics editor that provides powerful tools for graphic design, layout and photo editing. These tools are CAPTURE, Corel PHOTO-PAINT, Corel Font Manager, CorelDRAW.app, AfterShot 3 HDR.

**3D Modelling Software**

Blender: Blender is a 3D open-source modelling software used for creating animations, visual effects, art, 3D games, and more. It offers a comprehensive set of tools for modeling, texturing, rigging, rendering and compositing.

Autodesk Maya and 3ds Max: Maya and 3ds Max are industry standard 3D-modelling and animation software developed by Autodesk. They are widely used in film, television and game development for character animation, visual effects and 3D modelling.

**Computer Aided Design Software**

AutoCAD: AutoCAD is a leading CAD software used by architects, engineers and designers for creating precise 2D and 3D drawings. It is essential for drafting and modelling in fields such as architecture, modelling and civil engineering.

SolidWorks: SolidWorks is a 3D CAD software known for its parametric modelling and simulation tools. It is extensively used in product design and mechanical engineering for creating detailed 3D models and assemblies.

**Animation and Video Editing software**

Adobe After Effects: After Effects is a powerful tool for motion graphics, visual graphics and compositing. It is widely used in the film and television industry for creating animations, special effects and motion graphics.

Final Cut Pro and Adobe Premiere Pro: These video editing software applications are used by software professionals to edit and produce videos. They offer advanced editing tools, effects and transitions, making them essential for video post-production.

**Graphics Algorithms and Techniques**

**Rendering Definition and Techniques**

It is the generation of a 2D image from a 3D model. A scene file would contain geometry, viewpoint, texture, lighting and shading information describing the virtual scene. If a scene is to look relatively realistic and predictable, the rendering software must solve the rendering equation.

**Ray Tracing**: Ray tracing is a technique that simulates the behaviour of light to create highly realistic images. It traces the path of light rays as they interact with objects in a scene, calculating reflections, refractions and shadows to create lifelike visuals. Ray tracing is widely used in film production and is gaining traction in real-time graphics, thanks to advances in hardware acceleration.

**Rasterization**: Rasterization converts 3D objects into 2D images by projecting them on a 2D plane. It involves determining which pixels on the screen are covered by a 2D model and applying appropriate colour and textures. Rasterization is the foundation of real-time rendering and in video games and interactive applications.

**Shading and Lighting**

**Phong Shading Model**: The Phong Shading Model is used to calculate surface lighting in 3D computer graphics. It contains ambient, diffuse and specular lighting components to determine how light interacts with surfaces. This model contains smooth shading and is essential for achieving lighting effects in rendered images.

**Global Illumination**: Global illumination algorithms such as radiosity and photon mapping, simulate the complex interactions of light in a scene. They account for indirect lighting, reflections and colour bleeding, resulting in more accurate and visually appealing renderings. Global illumination techniques are used in architectural visualization and high-quality movie production.

**Animation and Simulation**

**Keyframe Animation**: Keyframe animation involves defining frames in a specific sequence. The computer interpolates between these frames to create smooth motion. Keyframe animation is widely used on character animation in special effects and games.

**Particle systems**: Particle systems simulate the behaviour of individual particles in a dynamical system. These particles can represent elements like fire, smoke or raindrops, creating realistic or dynamic visual effects. Particle systems are used extensively in video games and simulations to enhance realism and emotion.

**Physics-based simulation**: Physics-based simulation techniques, such as rigid-body dynamics and fluid dynamics, simulate real-world physical properties. These simulations are used to create realistic images of objects interacting with each other and with the environment. Physics-based simulations find applications in areas like CAD, virtual prototyping and visual effects.

**Applications of Computer Graphics**

**Entertainment industry**

**Video Games**: Computer graphics are fundamental to the gaming industry, enabling the creation of immersive virtual worlds, realistic characters, and interactive gameplay experiences. Advanced rendering techniques and real-time graphics contribute to visually stunning games across various platforms.

**Movies and Animation**: Computer-generated imagery plays a crucial role in modern filmmaking and animation. From creating fantastical creatures to entire visual environment. VFX studios utilize sophisticated software and rendering technologies to integrate CGI seamlessly with live-action footage.

**Virtual Reality and Augmented Reality**

**Virtual reality (VR):** VR applications use computer graphics to create immersive, 3D environments. VR technology finds applications in gaming, training simulations, virtual tours and therapy.

**Artificial Reality (AR)**: AR overlays digital information onto the real world. Through smart phones, smart glasses, AR headsets, computer graphics enhances users’ view of their surroundings. AR is used in fields like education, marketing, and navigation, offering interactive and informative experiences.

**Scientific Visualization and Simulations**

**Medical Imaging**: Computer graphics aid medical professionals in visualizing complex structures within the human body. Techniques such as volume rendering enable 3D visualization of medical scans, assisting in diagnosis, surgical planning and medical research.

**Engineering Simulations**: Engineers use computer graphics simulations to test and visualize designs before physical prototypes are created. Finite element analysis and computational fluid dynamics simulations help optimize structures and systems, saving time and resources in the product development process.

**Education and Training**

**Educational software**: Computer graphics enhance educational materials by making learning interactive and engaging. Educational software uses animations, simulations and interactive diagrams to explain complex concepts, making learning more accessible and enjoyable to students.

**Training Simulations**: Industries such as aviation, military and healthcare, utilize computer graphics-based training simulations. Simulated environments allow trainees to practice procedures, decision-making and problem-solving in a risk-free and realistic setting.

**Art and Design**

**Digital Art**: Artists use computer graphics software to create digital paintings, illustrations and sculptures. Digital art tools offer a wide range of brushes, tools and effects, enabling artists to explore innovative and expressive forms of artistic expression.

**Architectural Visualization**: Architects and designers use computer graphics to create detailed visualizations of buildings and interior spaces. These visualizations help clients and stakeholders envision the final design, incorporating lighting, textures and realistic perspectives.

Computer graphics applications continue to evolve, shaping diverse industries and revolutionsing the way we experience and interact with digital content.

**Current Challenges**

**Real-time rendering complexity**

Achieving real-time ray tracing, especially in complex scenes, is a significant challenge. Although recent advances in hardware acceleration have improved this, it remains computationally intensive.

**Complex Scene Simulation**

Realistic Physics Simulations: Simulating intricate physical interactions, such as fluid dynamics, and soft body dynamics, in real-time graphics is challenging and often requires significant computational resources.

Large-Scale Environments: Creating large-scale environments with intricate details while maintaining real-time performance is a challenge, especially in open-world games and virtual reality experiences.

**Visual Realism and Immersion**

Uncanny Valley: Achieving realistic human faces and movements in CGI without falling into the uncanny valley – where the human likeness is close to lifelike but still unsettling – is a persistent challenge, particularly in movies and games.

Immersive Augmented and Virtual Reality: Achieving high-quality, immersive experiences in augmented and virtual reality without causing motion sickness and with convincing object interaction is a significant challenge.

**Data and Bandwidth**

Large Data Handling: Managing large datasets for high-resolution textures, 3D models, and animations, can strain computational resources and images.

Streaming and Bandwidth: Delivering high-quality graphics and content via online streaming services, especially for gaming, requires overcoming limitations in bandwidth and latency.

**AI-driven graphics**

Procedural Content Generation: Implementing AI-driven procedural content generation techniques for creating vast and diverse game worlds while maintaining coherence and creativity is a challenge.

AI-enhanced graphics: Using AI for enhancing graphics, such as denoising techniques, comes with

the challenge of balancing accuracy and computational efficiency.

**Cross-platform compatibility**

Optimization for Various Platforms: Ensuring consistent graphical quality and performance across a wide range of devices, from high-end gaming PCs to mobile devices is a challenge.

**Ethical and Privacy Concerns**

Deepfakes and misinformation: The rise of AI-generated graphics raises concerns about deepfakes, misinformation and digitial identity theft.

Privacy in AI: Augmented Reality applications that overlay information on the real world raise privacy concerns, especially in public spaces.

**Sustainability**

Energy consumption: High-performance graphics rendering, especially in data centers for cloud gaming and large-scale simulations, contributes to significant energy consumption, posing environmental challenges.

**Emerging Technologies and Trends (AI in graphics, real-time ray tracing)**

**Real-Time Ray Tracing**

Advancements in Hardware: Modern GPUs are becoming more capable of real-time ray tracing, enabling highly realistic lighting and reflections in real-time applications and games.

Hybrid rendering: Combining rasterization and ray-tracing techniques for efficient real-time rendering of complex scenes.

**AI-Driven Graphics**

AI-based upscaling: Using artificial intelligence for upscaling images and videos to higher resolution, enhancing visual quality in real-time applications.

Deep Learning in Rendering: Implementing deep learning techniques to optimize rendering process, denoise images and simulate realistic materials and lighting.

**Immersive Technologies**

AR advancements: AR applications are becoming more sophisticated, integrating digital elements seamlessly into the real world.

VR Innovations: VR technologies continue to advance with improvements in motion tracking, haptic feedback and wireless VR experiences, leading to more immersive virtual environments.

**Real-Time Simulation**

Physics-based Simulation: Advancements in simulating complex physical interactions such as fluids, cloth and soft bodies, in real time, enabling realistic simulations for games and virtual environments.

Behavioral Simulation: Simulating realistic behaviours and interactions of AI-driven characters and objects in virtual worlds.

**Blockchain and Digital Assets**

NFTs (Non-Fungible Tokens): NFTs are being used to tokenize digital art and assets, including computer-generated artwork and 3D models, allowing artists to sell and monetise their creations in digital marketplaces.

**Sustainable Graphics Computing**

Energy-Efficient Rendering: Research and development focused on creating energy-efficient algorithms and hardware for rendering, reducing the environmental impact of graphics processing.

Green Rendering Practices: Industry initiatives promoting eco-friendly rendering techniques and encouraging the use of renewable energy sources for data centers.

**Generative Adversarial Networks (GANs) in Graphics**

GAN-Generated Content: GANs are being used to generate realistic images, textures and 3D models, enabling the creation of synthetic content for various applications, including gaming and design.

**3D Web and Augmented Reality on the Web**

**Web-based 3D graphics**

Integration of 3D graphics directly into web browsers, enabling interactive 3D experiences without the need for additional plugins or applications.

**WebAR**

Augmented reality experiences, accessible through web browsers, allowing users to interact with AR content directly from websites.

**Holography and Light Field Displays**

**Holographic Displays**

Advances in holographic display technologies for creating 3D, full-colour, and interactive holograms for applications in education, healthcare and entertainment.

**Light Field Displays**

Displays that capture the full light field of a scene, enabling realistic depth and parallax in 3D visuals.

**Future Challenges and Innovations**

**Challenges in Realism and Immersion**

**Hyper-Realism**: Achieving levels of realism where virtual environments and characters are indistinguishable from reality, challenging the limitations of hardware capabilities and computational power.

**Sensory Immersion:** Advancing graphics to stimulate multiple senses, including touch and smell, to create truly immersive experiences, requiring innovative interfaces and technologies.

**Ethical and Social Implications**

**Deepfake Regulation**: Developing robust regulations and detection methods to address the ethical concerns surrounding deepfakes and manipulated content, ensuring the authenticity of digital media.

**Digital privacy**: Safeguarding user privacy in augmented reality scenarios, especially in public spaces, to prevent unauthorized data collection and protect user identities.

**AI and Generative Graphics**

**Explainable AI**: Creating AI systems that generate graphics in a transparent and interpretable manner, ensuring that the creative process remains understandable and controllable for human designers.

**AI-driven Creativity**: Exploring AI as a creative collaborator, assisting artists and designers in generating novel and visual concepts, challenging traditional notions of artistic creation.

**Interactive and Adaptive Graphics**

**Real-time Adaptation**: Developing graphics systems that adapt in real-time based on user interactions, and preferences, providing personalized and dynamic visual experiences.

**Human-AI collaboration**: Enhancing collaboration between humans and AI systems for interactive storytelling and creative content generation, pushing the boundaries of co-creative processes.

**Environmental Sustainability**

**Green Rendering Technologies**: Researching and implementing energy-efficient rendering algorithms and hardware algorithms to reduce the environmental impact of graphics on processing, focusing on sustainable computing practices.

**Recyclable Hardware**: Innovating hardware designs for GPU and displays that are easily recyclable and environmentally friendly, addressing the growing concern of electronic waste in the industry.

**Cross-reality integration**:

**Extended Reality (XR) Integration**: Seamlessly integrating AR, VR and MR experiences, enabling users to transition between realities efficiently.

**Spatial Computing**: Developing spatially aware systems that understand the physical environment, allowing for more natural interactions and object placements in AR scenarios.

**Educational and healthcare applications**

**Immersive Learning environments**: Creating immersive educational experiences using computer graphics, enabling engaging and interactive learning environments for students of all ages.

**Therapeutic AR/VR**: Advancing VR and AR therapies for mental health disorders and physical rehabilitation, exploring innovative approaches to treatment and prevention.

**Global Collaboration and Cultural Representation**

**Cultural Inclusivity**: Ensuring cultural diversity and inclusivity in computer-generated content, avoiding biases in algorithms and representations to create culturally sensitive and respectful digital experiences.

**Virtual Cross-Cultural Collaboration**: Facilitating global collaboration through virtual environments, enabling individuals from diverse backgrounds to collaborate, learn and create together in shared digital spaces.

**Conclusion**

In the ever-evolving landscape of computer graphics, we find ourselves at the intersection of creativity, technology and innovation. From the early days of pixelated images to the current era of immersive virtual worlds, computer graphics have transformed the way we perceive and interact with digital content. Through this exploration of fundamental concepts, applications, challenges and emerging trends, it becomes evident that the journey of computer graphics is both a testament to human ingenuity and a gateway to uncharted territories.

As we navigate the future, the challenges we face – from achieving hyper-realism to ensuring AI-driven creativity – are opportunities for growth and discovery. The ethical implications deepfakes, the quest for sensory immersion, and the imperative of environmental sustainability challenge us to tread carefully as we harness the power of graphics technology.

Moreover, the collaborative efforts of researchers, developers and artists continue to fuel the engine of innovation. By embracing the potential of interactive technologies, and cross-reality integration, we are on the brink of a new era, where the boundaries between the real and the virtual blur, and where creativity knows no bounds.

In this dynamic landscape, education remains our guiding light. As we educate the next generation of computer scientists, artists and innovators, we empower them to push the boundaries further, to explore the unexplored, and to redefine what is possible. The future of computer graphics is not just a matter of technological advancement; it is a narrative of human imagination, determination and the relentless pursuit of excellence.

As we conclude this exploration, we do not merely reflect on the past and the present; we gaze forward with anticipation. The canvas of computer graphics, once confined to the realm of screens, is expanding to encompass the entirety of human senses and experiences. With every pixel rendered and every line of code written, we are architects of a digital future, where the fantastical becomes feasible, and the unimaginable becomes our reality.

In the words of Alan Kay, the best way to predict the future is to invent it. The future of computer graphics is ours to invent, and in this boundless realm of possibilities, the journey is as exciting as the destination. As we embark on this journey, let us do so with curiosity, integrity, and a steadfast commitment to shaping a world, where the beauty of imagination knows no limits.

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**References**

Hearn, David (1997) Computer Graphics C Version. Pearson