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Sanatta Yeterlik Tezi

ANİMASYON FİLM VE DİJİTAL OYUNLARDA TEKİNSİZ VADİ OLGUSU, THE UNCANNY VALLEY PHENOMENON IN ANIMATION FILM AND DIGITAL GAMES

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YEMİN METNİ

Sanatta Yeterlik tezi olarak sunduğum "*Animasyon Film Ve Dijital Oyunlarda Tekinsiz Vadi Olgusu, The Uncanny Valley Phenomenon İn Animation Film And Digital Games*" adlı çalışmanın, tarafımdan, bilimsel ahlak ve geleneklere aykırı düşecek bir yardıma başvurmaksızın yazıldığını ve yararlandığım eserlerin kaynakçada gösterilenlerden oluştuğunu, bunlara atıf yapılarak yararlanılmış olduğunu belirtir ve bunu onurumla doğrularım.

Tarih
02 / 02/ 2026

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İmza

TUTANAK

Dokuz Eylül Üniversitesi Güzel Sanatlar Enstitüsü' nün …… / …… / ..... tarih ve …… sayılı toplantısında oluşturulan jüri, Lisanüstü Öğretim Yönetmeliği' nin …….. maddesine göre Sanat ve Tasarım Anasanat Dalı öğrencisi Asadul ISLAM'ın "The Uncanny Valley Phenomenon in Animation Film and Digital Games" konulu tezi incelenmiş ve aday …… / ……. / ……... tarihinde, saat..... 'da jüri önünde tez savunmasına alınmıştır. Adayın kişisel çalışmaya dayanan tezini savunmasından sonra ..... dakikalık süre içinde gerek tez konusu, gerekse tezin dayanağı olan anabilim dallarından jüri üyelerine sorulan sorulara verdiği cevaplar değerlendirilerek tezin …….. olduğuna oy ..... ile karar verilmiştir.

BAŞKAN

ÜYE ÜYE

ÜYE ÜYE

ÖZET

Animasyon film ve dijital oyun endüstrilerinde, tekinsiz vadi (UV) kavramının önemli etkileri vardır. Tekinsiz vadi kavramı, insanların insan gibi davranan veya görünen, ancak gerçek bir insana pek benzemeyen bir şey gördüklerinde yaşadıkları rahatsızlık veya huzursuzluk hissi olarak tanımlanmaktadır. Teknoloji ilerledikçe ve bilgisayarla oluşturulan görüntüler (CGI) daha da geliştikçe, animasyon filmlerinde ve dijital oyunlarda insan figürleri ve yaratıklar yaratma yeteneği de hızlanmıştır. Ancak, bu teknolojik genişlemeyle birlikte gerçek karakterlerin gerçekçiliği genellikle görülmez. Tekinsiz vadi bağlamında, karakterlerin rahatsız edici derecede doğal olmayan doğası, izleyicilerde olumsuz duygusal tepkiler ve bilişsel uyumsuzluğu tetikleyebilir. Buna rağmen, tekinsiz vadi etrafında dönen animasyon filmleri ve dijital oyunların üretiminde önemli bir büyüme olmuştur.

Bu bağlamda, bu araştırmanın amacı, "tekinsiz vadi" kavramını ele alarak, tekinsiz vadiyi animasyon filmlerinde ve dijital oyunlarda keşfetmeyi hedeflemektedir. Bu araştırma, mevcut literatürün, ilgili teorilerin, mitolojik bakış açılarının, sanatta gerçekçiliğin, teknolojik gelişmelerin ve tekinsiz vadi üzerine animasyon film ve dijital oyunlara yönelik önceki bilimsel araştırmaların kapsamlı bir analizini içermektedir. Araştırma, iyi bilinen animasyon filmleri ve dijital oyunlardan karakterlerin görsel gerçekçilik perspektifinden estetik olarak incelendiği bir içerik analizi yöntemi yaklaşımı kullanılarak yürütülmüştür. Son olarak, "THE GAZE" adlı proje için dramatik olmayan bir anlatım oluşturulmuştur. Kısa animasyon veya dijital oyun olarak daha da geliştirilebilecek yeni bir stil türü olarak teşvik etme çabasıyla, tekinsiz vadi gösteren anlatıma dayalı olarak temsili görsel oluşturulmuştur.

Anahtar Kelimeler: Tekinsiz vadisi, Animasyon, Dijital Oyunlar, Gerçekçilik, Teknoloji

ABSTRACT

In the animation film and digital game industries, the Uncanny Valley (UV) phenomenon has significant implications. The concept of the uncanny valley phenomenon is described as the feeling of discomfort or unease that people experience when they see something that behaves or looks humanly, but is not quite like a real human. As technology developed and computer graphics imagery (CGI) became more advanced. The ability to create human figures and creatures in animated films and digital games also accelerated. However, actual character realism is often not seen with this technological expansion. In the uncanny valley context, the disturbingly unnatural nature of the characters can trigger unfavorable emotional responses and cognitive dissonance in the viewers. In spite of this, there has been a significant growth in the production of animation films and digital games that revolve around the uncanny valley phenomenon.

Hence, the goal of this research is to explore the uncanny valley phenomenon as a possible genre of animation films and digital games. This research includes a comprehensive analysis of existing literature, related theories, mythological perspectives, realism in art, technological advancements, and previous scientific research on the phenomenon of uncanny valley towards animation film and digital games. The research is conducted using the qualitative method with content analysis approach in which characters from well-known animation films and digital games are aesthetically studied from the perspective of visual realism. Lastly, a de-dramatic narration is created for the project entitled “THE GAZE”. Several representative visuals are created based on the narration, which illustrates the uncanny valley phenomenon in an effort to stimulate it as a new style genre that can be further developed as a short animation film or a digital game.

Keywords: Uncanny Valley, Animation, Digital Games, Realism, Technology

PREFACE

I've always been intrigued by the progression of realism in animation films and later in digital games. It's something I've given a lot of thought to because, with each passing year, so many different technologies are available and emerging that it seems as though we are constantly crossing the edges of realism in visualization. In my understanding of animation, I have been noticing that there is a great improvement in the quality of animation films year after year. Also, the same situation is with the digital games. This raised the question for me of how viewers cope with these changes, where, unlike in the past, animation characters are becoming more and more realistic. That curiosity is what led me to the idea for the research about the uncanny valley during my initial explorations. This research helped me to track the developments and deeply understand the evolution of the uncanny valley in animation films and digital games.

I would like to thank my esteemed thesis advisor, Prof. Dr. Simber Atay, for the invaluable support she provided throughout my research work. With respect to her wisdom, I am fortunate enough to say that I have learned a lot and reflected the knowledge in my work. I would like to extend my gratitude to my family members, my mother and sister, for their strong support and encouragement during the period of research. Lastly, to Melike for every time backing me up and providing clarity to my thoughts.

TABLE OF CONTENTS

YEMİN METNİ.....ii

TUTANAK.....iii

ÖZET.....iv

ABSTRACT.....v

PREFACE.....vi

LIST OF FIGURES.....xii

LIST OF TABLES.....xx

ABBREVIATIONS.....xxi

INTRODUCTION.....1

CHAPTER I

THE UNCANNY VALLEY

1.1. History and Origin of the Uncanny (Das Unheimliche).....6

1.1.1. Definition of the Uncanny Valley (Bukimi no Tani).....9

1.1.2. Graphical Explanation and Implications.....10

1.2. Theories Related to Uncanny Valley Phenomenon.....12

1.2.1. Freudian Psychoanalysis Approach....13
1.2.2. Intertextual Vision....14
1.2.3. Cognitive Dissonance Intervention....15
1.2.4. Perceptual Incongruence Theory....17
1.3. Masahiro Mori....17
1.4. Human Likeness and Anthropomorphism....22
1.4.1. Classical Mythology....25
1.4.2. Indian Mythology....27
1.5. Eeriness....29
1.6. Previous Studies of Uncanny Valley in Animation Films and Digital Games....31
1.6.1. Animation Films....31
1.6.2. Digital Games....32
1.7. Realism, Hyperrealism and Photorealism....33
1.7.1. Zeuxis....34
1.7.2. Realist Image....36
1.7.3. Photorealist Painting....44
1.7.4. Hyperrealist Image Production....49
1.7.5. Realistic Humanoids....54
1.8. Technological Advancements....62
1.8.1. Artificial Intelligence-based Art and Animation....62
1.8.2. Prompt Engineering....67
1.8.3. Deepfake Technology....70
1.8.4. Human Emulation in Artificial Intelligence....72
1.9. Posthumanist Future....74

CHAPTER II

UNCANNY VALLEY IN ANIMATION FILMS AND DIGITAL GAMES

2.1. Uncanny Valley in Animation Films.....87
2.1.1. Golden Age: Early Animation (1920s-1930s) 87
2.1.1.1. Technological Limitations and Animation Techniques.....87
2.1.1.2. Unrealistic Features and Exaggeration of Characters.....92
2.1.2. Technological Advances in Animation (1940s-1960s).....97
2.1.2.1. Transformation to Stylized Character.....103
2.1.3. Emergence of Uncanny Valley in Animation (1990s).....112
2.1.3.1. 2D to 3D Animation Transition.....116
2.1.3.2. Animation and Live Action Fusions in films.....121
2.1.3.3. Early Challenges in Realistic 3D Characters.....125
2.1.3.4. Holographic Techniques.....128
2.1.4. The Genre of Uncanny Valley.....132
2.1.4.1. Features of Uncanny Genre.....137
2.1.4.2. Stylistic Evolution.....139
2.1.5. Contemporary Trends and Technological Advancements.....145
2.1.5.1 Balance between Realism and Stylization.....153
2.1.5.2. Improvements in Rendering and Modeling.....158
2.1.5.3. Advancements in Motion Capture Techniques.....164
2.1.5.4. Virtual Reality.....167
2.1.6. Animation Films Featuring Realistic Characters.....172
2.1.7. Uncanny Valley Indicators of 3D Animation Film.....177
2.1.7.1. Uncanny Valley Visual Indicators..... 177
2.1.7.2. Uncanny Valley Behavioral Indicators..... 180
2.2. Uncanny Valley in Digital Games…….....182
2.2.1. Pixel Art and 16 Bit Era (late 1980s – mid 1990s) 182

2.2.1.1. Humanised Characters in Pixel Art Games.....187
2.2.2. Transition to 3D Polygonal Character Modelling.....189
2.2.2.1. Technological Limitations.....190
2.2.2.2. Character Realism Technology in Digital Game.....195
2.2.3. Animation Advancements in Digital Games (1990s-2000s)….....201
2.2.3.1. Motion Capture Integration for Digital Games.....206
2.2.4. Realism and Visual Components…….....208
2.2.4.1. Ray Tracing, Simulations and Graphics Advancements.....208
2.2.4.2. Realistic Avatars and Facial Expression.....210
2.2.4.3. Realistic Environments.....214
2.2.4.4. Interactive Gameplay.....218
2.2.5. Digital Games with Realistic Characters.....221
2.2.6. Uncanny Valley Indicators of Digital Games.....228
2.2.6.1. Uncanny Valley Visual Indicators.....228
2.2.6.2. Uncanny Valley Behavioral Indicators.....230

CHAPTER III

PROJECT: "THE GAZE"

3.1. The Concept of "THE GAZE".....233
3.2. The Mythological Source of the Concept "THE GAZE".....234
3.3. The Literary Source of the Concept "THE GAZE".....236
3.4. The Theoretical Source of the Concept "THE GAZE".....237
3.4.1. Ways of Seeing (1972) by John Berger 237
3.4.2. Discipline and Punish: The Birth of the Prison (1975) by Michel Foucault.238
3.4.3. Visual Pleasure and Narrative Cinema (1975) by Laura Mulvey.....238
3.5. The Plot of "THE GAZE" 239
3.6. The Features of the Plot.....240

3.7. Monologue of “THE GAZE” 240
3.8. Technical Development of the Project “THE GAZE” 241
3.9. Final Cut.....242
3.10. Presentation of the Project “THE GAZE” 247

FINDINGS.....248

CONCLUSION.....250

REFERENCES.....253

CURRICULUM VITAE

LIST OF FIGURES

Figure 1. Polyphemus.....7
Figure 2. Coppelia.....8
Figure 3. Mori's uncanny valley diagram.....11
Figure 4. Masahiro Mori.....18
Figure 5. Original Uncanny Valley Graph.....19
Figure 6. Simplified Uncanny Valley Graph.....20
Figure 7. Uncanny Cliff Graph.....21
Figure 8. The Prague Golem.....24
Figure 9. The Muses.....26
Figure 10. Representation picture of God Krishna.....28
Figure 11. Representation picture of God Ganesha.....29
Figure 12. Unnatural Eyes as an example of Eeriness.....30
Figure 13. A screencap from the animation film "The Polar Express" 2004 by Robert Zemeckis.....32
Figure 14. Painting Representing Zeuxis' "Grape and the Birds" (1842) by Johann Georg Hiltensperger.....35
Figure 15. "Contest between Zeuxis and Parrhasius" (1630) by Matthäus Merian.....35
Figure 16. "Zeuxis and the Girls of Crotone" (1889) by Eleuterio Pagliano.....36
Figure 17. "The Gross Clinic" (1875) by Thomas Eakins.....37
Figure 18. "Benefits Supervisor Sleeping" (1995) by Lucian Freud.....38
Figure 19. "Mr and Mrs Clark and Percy" (1970-71) by David Hockney.....38
Figure 20. "The Gleaners" (1857) by Jean-François Millet.....40
Figure 21. "A Burial at Ornans" (1849-1850) by Gustave Courbet.....41
Figure 22. "The Stone Breakers" (1849) by Gustave Courbet.....42
Figure 23. "The Third-Class Carriage" (1862-1864) by Honoré Daumier.....43
Figure 24. "Ploughing in the Nivernais" (1849) by Rosa Bonheur.....44
Figure 25. "Big Self-Portrait" (1967-1968) by Chuck Close.....46

Figure 26. “Telephone Booths” (1968) by Richard Estes.....47
Figure 27. “John’s Diner with John’s Chevelle” by John Baeder.....48
Figure 28. “Marilyn (Vanitas)” (1977) by Audrey Flack.....49
Figure 29. “Big Man” (2000) by Ron Mueck.....51
Figure 30. “Candy Rainbow” (2010) by Roberto Bernardi.....52
Figure 31. “Woman Eating” (1971) by Duane Hanson.....53
Figure 32. “Foodscape” (2014) by Tjalf Sparnaay.....54
Figure 33. Sophia by Hanson Robotics.....55
Figure 34. Geminoid DK by Hiroshi Ishiguro.....56
Figure 35. The Actroid Model by Kokoro Company Ltd.....57
Figure 36. Nadine by Nanyang Technological University, Singapore.....57
Figure 37. ASIMO by Honda.....58
Figure 38. Robear by Riken-SRK Collaboration Center for Human-Interactive Robot Research.....59
Figure 39. Ameca by Engineered Arts 60
Figure 40. HRP-5P by AIST (National Institute of Advanced Industrial Science and Technology, Japan).....61
Figure 41. Atlas by Boston Dynamics.....61
Figure 42. “Edmond de Belamy” (2018) by Obvious.....63
Figure 43. “The Next Rembrandt” (2016) by J. Walter Thompson.....64
Figure 44. “Memories of Passersby I” (2019) by Mario Klingemann.....64
Figure 45. “Melting Memories” (2018) by Refik Anadol.....65
Figure 46. “Quantum Memories” (2020) by Refik Anadol.....66
Figure 47. Production still from **“**Spider-Man: Into the Spider-Verse” (2018) by Bob Persichetti, Peter Ramsey and Rodney Rothman.....67
Figure 48. “The Electrician” (2022) by Boris Eldagsen.....68
Figure 49. “Salaf, Ancestors” (2020) by Nouf Aljowaysir.....69
Figure 50. Obama Deep Fake (with transferred facial emotions) by Jordan Peele.....70

Figure 51. “Imagine this…” (Facebook CEO Mark Zuckerberg deepfake), 2019 by Canny AI.....71
Figure 52. Artificial General Intelligence (AGI) 73
Figure 53. Celebrating Johann Sebastian Bach.....74
Figure 54. “Manifesto Cyborg” by Donna Haraway’s.....75
Figure 55. “How We Became Posthuman” by N. Katherine Hayles.....76
Figure 56. “The Posthuman” by Rosi Braidotti’s.....77
Figure 57. Brain-Computer Interfaces (BCIs) 78
Figure 58. Neil Harbisson.....79
Figure 59. Jesse Sullivan in prosthetic arm system.....80
Figure 60. “Ghost in the Shell” (1995) by Mamoru Oshii.....81
Figure 61. “Blade Runner” (1982) by Ridley Scott.....82
Figure 62. “Altered Carbon” (2018) by Miguel Sapochnik and Uta Briesewitz.....82
Figure 63. “The Matrix” (1999) by Lana Wachowski and Lilly Wachowski.....83
Figure 64. “Deus Ex” (2000) by Ion Storm.....84
Figure 65. “Her” (2013) by Spike Jonze.....84
Figure 66. “Ex Machina” (2014) by Alex Garland.....85
Figure 67. “Steamboat Willie” (1928) by Walt Disney Studio.....88
Figure 68. Cel animation.....89
Figure 69. Rotoscoping.....90
Figure 70. Multiplane camera technique “Snow White and the Seven Dwarfs” (1937) by Walt Disney Productions.....91
Figure 71. Rubber Hose Animation Technique, “Betty Boop” (1931) by Dave Fleischer..92
Figure 72. “Felix the Cat” (1919) by Pat Sullivan and Otto Messmer.....93
Figure 73. “Looney Tunes” (1930 - 1969) by Warner Bros. Entertainment.....94
Figure 74. “Popeye the Sailor” (1933) by Max Fleischer.....95
Figure 75. “Tom and Jerry” (1940) by William Hanna and Joseph Barbera.....96
Figure 76. “The Three Little Pigs” (1933) by Walt Disney.....97
Figure 77. “Fantasia” (1940) by Walt Disney Productions.....98

Figure 78. Multiplane camera.....99
Figure 79. “Bambi” (1942) produced by Walt Disney.....100
Figure 80. “One Hundred and One Dalmatians” (1961) by Walt Disney Productions.....101
Figure 81. “The Flintstones” (1960) by Hanna-Barbera Productions.....102
Figure 82. “Mighty Joe Young” (1949) by Argosy Pictures.....103
Figure 83. “Red Hot Riding Hood” (1943) by Tex Avery.....104
Figure 84. “Droopy” (1943) by Tex Avery.....105
Figure 85. “Mr. Magoo” (1949) by Millard Kaufman and John Hubley.....106
Figure 86. “Gerald McBoing-Boing” (1950) by John Derevlany.....106
Figure 87. “The Jetsons” (1962) by Hanna-Barbera Productions.....107
Figure 88. “Yellow Submarine” (1968) by George Dunning.....108
Figure 89. “Fritz the Cat” (1972) by Ralph Bakshi.....109
Figure 90. “Wizards” (1977) by Ralph Bakshi.....109
Figure 91. “Akira” (1988) by Katsuhiro Otomo.....110
Figure 92. “The Simpsons” (1989) by Matt Groening.....111
Figure 93. “Thundercats” (1985) by Theodore Walter Wolf.....111
Figure 94. “Final Fantasy: The Spirits Within” (2001) by Hironobu Sakaguchi.....112
Figure 95. “The Polar Express” (2004) by Robert Zemeckis.....113
Figure 96. “Toy Story” (1995) by John Lasseter, Pixar Animation Studio.....114
Figure 97. Star Wars: Special Edition (1997), CGI version of Jabba the Hutt.....115
Figure 98. Casper (1995) Dr. Harvey’s ghost.....115
Figure 99. “The SpongeBob Movie: Sponge Out of Water” (2015) by Paul Tibbitt.....116
Figure 100. “The Lego Movie” (2014) by Phil Lord and Christopher Miller.....117
Figure 101. “Spider-Man: Into the Spider-Verse” (2018) by Bob Persichetti, Peter Ramsey, and Rodney Rothman.....118
Figure 102. “Paper Man” (2012) by John Kahrs.....119
Figure 103. “Klaus” (2019) by Sergio Pablos.....119
Figure 104. “Entergalactic” (2022) by Fletcher Moules.....120

Figure 105. “Arcane” (2021-2024) by Pascal Charrue, Arnaud Delord and Bart Maunoury….....121
Figure 106. “Looney Tunes: Back in Action” (2003) by Joe Dante.....122
Figure 107. “Osmosis Jones” (2001) by Piet Kroon and Tom Sito.....123
Figure 108. “Cool World” (1992) directed by Ralph Bakshi.....124
Figure 109. “Who Framed Roger Rabbit” (1988) by Robert Zemeckis.....124
Figure 110. “Shrek” (2001) by Andrew Adamson and Vicky Jenson.....126
Figure 111. “Frozen” (2013) by Chris Buck and Jennifer Lee.....127
Figure 112. “Brave” (2012) by Mark Andrews and Brenda Chapman.....128
Figure 113. “Star Wars” (1977) by George Lucas Princess Leia’s holographic message.129
Figure 114. “Iron Man” (2008) by Jon Favreau.....129
Figure 115. “Ghost in the Shell” (2017) by Rupert Sanders.....130
Figure 116. “Ready Player One” (2018) by Steven Spielberg.....131
Figure 117. “Detroit: Become Human” (2018) by Quantic Dream..... 133
Figure 118. “Westworld” (2016-2022) by Jonathan Nolan and Lisa Joy.....134
Figure 119. “A.I. Artificial Intelligence” (2001) by Steven Spielberg.....135
Figure 120. “I Am Mother” (2019) by Grant Sputore.....136
Figure 121. “Soma” (2015) by Frictional Games.....136
Figure 122. “Beowulf” (2007) by Robert Zemeckis.....140
Figure 123. “The Lion King” (2019) by Jon Favreau.....140
Figure 124. “Alita: Battle Angel” (2019) by Robert Rodriguez.....141
Figure 125. “Avatar: The Way of Water” (2022) by James Cameron.....142
Figure 126. “Gemini Man” (2019) by Ang Lee.....142
Figure 127. “Inside Out” (2015) by Pete Docter.....143
Figure 128. “Soul” (2020) by Pete Docter.....144
Figure 129. “Love, Death & Robots” (2019) by Tim Miller.....144
Figure 130. “Avatar” (2009) by James Cameron.....145
Figure 131. Making of “Avatar: The Way of Water” (2022) by James Cameron.....146
Figure 132. “The Under Presents” (2019) by Tender Claws.....147

Figure 133. Google's "DeepDream" (2015), Interprets Prince William, Kate duchess of Cambridge and Prince George.....148
Figure 134. DeepDream painting of Vincent van Gogh's, "The Stary Night" 148
Figure 135. Real-time rendering: game engines like Unreal Engine and Unity.....150
Figure 136. Procedural animation.....150
Figure 137. "Kubo and the Two Strings" (2016) by Travis Knight.....151
Figure 138. "A Scanner Darkly" (2006) by Richard Linklater.....152
Figure 139. "Loving Vincent" (2017) by Dorota Kobiela and Hugh Welchman.....153
Figure 140. "Ratatouille" (2007) by Brad Bird.....154
Figure 141. "The Adventures of Tintin" (2011) by Steven Spielberg.....155
Figure 142. "The Triplets of Belleville" (2003) by Sylvain Chomet.....156
Figure 143. "The Iron Giant" (1999) by Brad Bird.....156
Figure 144. "The Incredibles" (2004) by Brad Bird.....157
Figure 145. "Avatar: The Last Airbender" (2005-2008) by Michael Dante DiMartino and Bryan Konietzko.....158
Figure 146. "The Mandalorian" (2019) by Jon Favreau.....160
Figure 147. Path Tracing Process of how the human eye receives light information when bounces from different objects.....161
Figure 148. "Purl" (2019) by Kristen Lester.....161
Figure 149. "Zootopia" (2016) by Byron Howard.....162
Figure 150. "Kubo and the Two Strings" (2016) by Travis Knight.....163
Figure 151. "Moana" (2016) by John Musker & Ron Clements.....164
Figure 152. Motion Capture (mocap) 165
Figure 153. Markerless motion capture by ReMoCapp.....166
Figure 154. VR Headset Quest 3 by Oculus.....168
Figure 155. VR Headset, Apple Vision Pro.....168
Figure 156. Previsualization of "The Jungle Book" (2016) by Jon Favreau.....169
Figure 157. "Invasion" by Baobab Studios.....171
Figure 158. "Asteroids" by Baobab Studios.....171

Figure 159. “Super Nintendo Entertainment System (SNES)” (1990), developed by Nintendo.....183
Figure 160. “Sega Genesis” (1988), developed by Nintendo.....184
Figure 161. “Super Mario World” (1990) developed by Nintendo EAD (Entertainment Analysis & Development Division) 185
Figure 162. “Sonic the Hedgehog” (1991) developed by Sonic Team.....185
Figure 163. “Street Fighter II” (1991) by Capcom.....186
Figure 164. “Mortal Kombat” (1992) by Midway Games.....187
Figure 165. “Celeste” (2018) by Maddy Makes Games.....188
Figure 166. “Undertale” (2015) by Toby Fox.....189
Figure 167. “Final Fantasy VII” (1997) by Square.....191
Figure 168. “Tomb Raider” (1996) by Core Design.....191
Figure 169. “Grand Theft Auto IV” (2008) by Rockstar North.....192
Figure 170. “Uncharted” (2007) by Naughty Dog.....193
Figure 171. “Cyberpunk 2077” (2020) by CD Projekt Red.....193
Figure 172. “Horizon Forbidden West” (2022) by Guerrilla Games.....194
Figure 173. Normal Mapping.....195
Figure 174. Subsurface Scattering (SSS) 196
Figure 175. Ray tracing..... 197
Figure 176. Physically based rendering (PBR) materials.....197
Figure 177. PBR Maps.....198
Figure 178. Photogrammetry.....199
Figure 179. Camera setup for Photogrammetry.....199
Figure 180. Unreal Engine 5 (Nanite and Lumen) 200
Figure 181. “The Last of Us Part II” (2020) by Naughty Dog Studio.....201
Figure 182. “Gibbon: Beyond the Trees” (2022) by Broken Rules.....202
Figure 183. Red Dead Redemption 2 (2018) by Rockstar Games.....203
Figure 184. Inverse Kinematics (IK) 204
Figure 185. Non-Player Characters (NPCs) from “The Matrix Awakens” 2021.....205

Figure 186. Vicon Optical tracking systems.....206
Figure 187. Faceware Studio (real-time mocap tool) 207
Figure 188. Raytracing Technology on Minecraft RTX (2020) by Mojang Studios.....209
Figure 189. Battlefield 2042 (2021) by Electronic Arts.....209
Figure 190. Facial mocap.....211
Figure 191. Blend Shapes.....211
Figure 192. Meta human Face Rig.....212
Figure 193. "Baldur's Gate 3" (2023) by Larian Studios.....213
Figure 194. "Prince of Persia: The Sands of Time" (2003) by Ubisoft Montreal.....214
Figure 195. A visual of Florence from Assassin's Creed 2 (2009) by Ubisoft Montréal..215
Figure 196. A visual of Venice from Assassin's Creed 2 (2009) by Ubisoft Montréal.....215
Figure 197. "Microsoft Flight Simulator" (2024) by Asobo Studio.....216
Figure 198. "Farming Simulator 25" (2024) by GIANTS Software.....217
Figure 199. "The Witcher 3: Wild Hunt" (2015) by CD Projekt.....219
Figure 200. "The Last of II" (2020) by Naughty Dog.....219
Figure 201. "Fortnite" (2017) by Epic Games.....220
Figure 202. "Apex Legends" (2019) by Respawn Entertainment.....221
Figure 203. Pygmalion Adoring His Statue (1717) by Jean Raoux.....235
Figure 204. A scene from R.U.R (1921) by Karel Čapek.....236
Figure 205. Project "THE GAZE" representative visual 01.....243
Figure 206. Project "THE GAZE" representative visual 02.....243
Figure 207. Project "THE GAZE" representative visual 03.....244
Figure 208. Project "THE GAZE" representative visual 04.....244
Figure 209. Project "THE GAZE" representative visual 05.....245
Figure 210. Project "THE GAZE" representative visual 06.....245
Figure 211. Project "THE GAZE" representative visual 07.....246
Figure 212. Project "THE GAZE" representative visual 08.....246

LIST OF TABLES

Table 1. Features of Uncanny Valley Genre.....138

Table 2. Timeline of Animation Films Featuring Realistic Characters.....172

Table 3. Visual Indicators for Animation Films.....178

Table 4. Behavioral Indicators for Animation Films.....180

Table 5. Timeline of Digital Games Featuring Realistic Characters.....222

Table 6. Visual Indicators for Digital Games.....229

Table 7. Behavioral Indicators for Digital Games.....230

Table 8. Monologue used in “THE GAZE” 240

ABBREVIATIONS

AI	:	Artificial Intelligence
AGI	:	Artificial General Intelligence
AR	:	Augmented Reality
ASIMO	:	Advanced Step in Innovative Mobility
BCIs	:	Brain-Computer Interfaces
CGI	:	Computer Graphics Imagery
DVD	:	Digital Versatile Disc
EVA	:	Extravehicular Activity
GAI	:	Generative Artificial Intelligence
GANs	:	Generative Adversarial Networks
GI	:	Global Illumination
GPU	:	Graphics Processing Unit
HD	:	High Definition
IK	:	Inverse Kinematics
MOCAP	:	Motion Capture
NASA	:	National Aeronautics and Space Administration
NES	:	Nintendo Entertainment System
NLP	:	Natural Language Processing
NPC	:	Non-Playable Character
NPR	:	Non-Photorealistic Rendering
OS	:	Operating System
PBR	:	Physically Based Rendering
QR	:	Quick Response
RAM	:	Random Access Memory
RTX	:	Ray Tracing Texel eXtreme

SNES	:	Super Nintendo Entertainment System
TV	:	Television
TMR	:	Targeted Muscle Reinnervation
2D	:	Two dimensional
3D	:	Three dimensional
UPA	:	United Productions of America
UV	:	Uncanny Valley
VFX	:	Visual Effects
VR	:	Virtual Reality
RPG	:	Role Playing Game
RUR	:	Rossum's Universal Robots

INTRODUCTION

This thesis seeks to investigate the uncanny valley phenomenon in the light of animation films and digital games. The term uncanny valley was first initiated by Japanese scientist Masahiro Mori in robotics. However, the theory of uncanny was pioneered by German psychiatrist Ernst Jentsch and later elaborated by Sigmund Freud in his theory of psychoanalysis. Since then, several theories have grown around the uncanny valley phenomenon significantly in animation films and digital games.

The uncanny valley phenomenon in visual culture has always been of interest in regard to realism's limitations. When a human-seeming figure falls in the uncanny valley, its effects can be far deeper psychologically and philosophically. In terms of cybernetic nature, the relationships between humans and machines are more emotional than merely functional. In contemporary terms, the uncanny valley took the form of algorithmic work. The uncanny valley nowadays exists more virtually on digital screens. Digital avatars, voices, and even facial movements are crafted through algorithmic data and patterns. These algorithmic reproductions fall short in creating simulations of intricate human expressions. This presents the question of how synthetic realism with imperfections can represent uncanny feelings to the viewers.

Uncanny and realism in the visual arts have always been associated. The reason for choosing the uncanny valley phenomenon for this research is primarily because it falls in the intersection of technology, visual aesthetics, and the viewers experience. It brings to broader questions about the creative limits in digital media. Animation and digital gaming have always been pushing for hyper-realism. Hence uncanny valley has always been a central theme of it. In terms of literature review of this thesis was done using institutional libraries from Dokuz Eylul University and Yasar University, online thesis databases, virtual libraries, online databases for academic journals and articles such a Jstor, Google Scholar, Ebesco,

ScienceDirect, physical books, live action films, animation films and digital games, youtube videos, conferences, digital archives and websites were used for this study.

In terms of methodology, a hybrid methodological combination of qualitative research methods is applied in which descriptive methods, content analysis, and palimpsestuous analysis were used. The literature section, contextual understanding, and the interpretation of the subject are primarily based on the qualitative method. Content analysis technique was used to identify the uncanny valley indicators for animation films and digital games. Lastly, the palimpsest method is used to add new information without losing the existing pieces of information.

The first chapter focuses on the origins of the uncanny and the theory of the uncanny valley. Freud's psychoanalysis and other theories that are related to the uncanny valley are discussed. Subtopics of the uncanny valley, such as human likeness, eeriness, and anthropomorphism in the context of classical and Indian mythology, are explained. The chapter further presents realism, hyperrealism, and photorealism, all concepts that directly originates from the uncanny valley phenomenon. Analysis of the emerging technologies such as artificial intelligence (AI) based art and animation, deepfake technology, and human imitation are also discussed. Furthermore, this chapter explores about the post-humanist world and how the uncanny valley may manifest on an everyday basis.

The second chapter deals with the uncanny valley in regards to animation films, paying attention to how changes in technology have affected its prominence as a medium. It discusses how animation has changed from the 1920's to the 1990's including the change from two-dimensional (2D) to three-dimensional (3D) animation, the change from cartoony type characters to realistic types, and overall stylistic changes in the medium. This chapter also presents how new forms of technology such as virtual reality (VR) together with motion capture (Mocap) techniques have added new dimensions to the realism. A detailed compilation of known 3D animation films with realistic characters is provided, along with

an analysis of the specific visual and behavioral indicators that evoke the uncanny valley effect in animation. Similarly, the research explores the uncanny valley phenomenon in digital games and the progression from pixel art to 16-bit graphics alongside the increasing use of humanized characters in the earliest games. Moreover, this chapter covers the progression of character modeling from 2D sprites to 3D polygonal characters and the concerns about how realistically characters can be represented. The integration of motion capture technology in digital games is discussed. Analysis about the topics such as environment design, character animation, speech and expressions, as well as realistic avatars, is included. The chapter summarizes with the scrutiny of popular video games featuring realistic characters, as well as a discussion of visual and behavioral indicators that are distinctive of digital games.

In the third chapter, a project titled "THE GAZE" is presented. The narrative structure of the project is de-dramatic, representing the essence of mythological and theoretical ideas in a science fiction setting. The soul of "THE GAZE" comes from the Pygmalion's story. The modern touch to it is given by Karel Čapeks' drama "R.U.R" (Rossum's Universal Robots). Theories from John Berger, Michel Foucault, and Laura Mulvey are also used in the ideation process. The project plot depicts a narration of an uncanny encounter between two characters: the interaction of a humanoid Xy and Dr. Capek. The design of the scenario and setting of this project is intentionally made to portray the uncanny valley phenomenon's theme. The main aim of this project is to visually showcase the phenomenon to the viewer and deliver the feeling of being in the uncanny valley. The visual part of the project is divided in two parts. In the first part the graphics from the complete narration is produced matching to every sequence and in the second part these produced graphics are used to generate the automated AI based animation that can closely reflect the realism in the context of uncanny valley.

What are humans when machines can think and act intelligently by becoming our uncanny reflections?

- KAREL ČAPEK

CHAPTER I

THE UNCANNY VALLEY

1. CHAPTER

THE UNCANNY VALLEY

1.1. History and Origin of the Uncanny (Das Unheimliche)

The term “The Uncanny” has its origins from the German word Das Unheimlich. It refers to the feeling of uneasiness that comes when one meets with something that is both familiar as well as strange. The developmental origins of the feeling of the uncanny is at a much earlier age in human beings. An existing research indicates that around the age of 12 months, children start feeling the discomfort of the uncanny due to the perception of familiarity with human faces (Lewkowicz & Ghazanfar, 2012, pp. 1-2). Ernst Jentsch, a German psychiatrist, was the first person to write about the word the uncanny in his essay “On the Psychology of the Uncanny” (1906), in which he focuses on the intellectual ambiguity surrounding the strange and the eerie gap troubling the distinction between the animate and the inanimate. His work dealt with the psychological conflict involved when a person’s reality is split between alien and familiar worlds or things, leading to cognitive dissonance (Jentsch, 1997). This concept of the uncanny is closely related and often considered together with Sigmund Freud’s foundational essay on psychoanalysis discourse, “The Uncanny” (1919).

Freud’s exploration of the uncanny is captured by the idea of instancing something both familiar and strange at once, which generates dissonance leading to uneasiness (Mrówczyńska, 2021, p. 50). He developed on Jentsch’s concepts by relating the uncanny with fears and wishes, which are repressed and come back in the form of something unusually familiar. He was concerned with the return of forgotten memories and the psychological tensions of the split personality that is accompanied by the sensation of uncanny (Collin & Jervis 2008 p. 216).

German idealism has also explained the concept of the uncanny. In “Philosophy of Mythology” (1837) (Philosophie der Mythologie in German), philosopher F.W.J. Schelling

presents his thoughts about the uncanny. His arguments shows that Homeric poetry was written on a repression of the uncanny (Vidler, 1993, p. 26). Schelling claimed that the uncanny was foundation for epics like “The Iliad” and “The Odyssey”. These epic poems in themselves contained suppressed uncanny elements to facilitate sociopolitical and literary order. For example, this can be seen in a episode in “The Odyssey” where Odysseus and his men cross paths with the Cyclops Polyphemus (Figure 1), a one-eyed giant creature (Schelling, 2008, p. 83; Hernandez, 2000, pp. 347-358). The Cyclops Polyphemus is a blend of both the familiar (a human-like creature) and the alien (a gigantic one-eyed monster). This contrast is extremely unusual. The narrative presents the feeling of the uncanny by concentrating on the creature Polyphemus and on Odysseus’ showing the cleverness and bravery of his heroic adventure. In “Iliad”, the divines do meddle in human affairs and possess humanity. The potential to exist as humans and control events brings a particular sense of the uncanny as it blurs the boundary between the divine and the human (Schelling, 2008, pp. 85-88).



Figure 1. Polyphemus

Source: https://www.maicar.com/GML/Polyphemus2.html

Furthermore, Nihilism is often related to disbelief and involves questioning the reality. Friedrich Nietzsche describes nihilism as very much an unforeseen existence or

disturbing and refers to it as, ‘the uncanniest of all guests’ in the manuscript ‘The Will to Power’ (Brobjer, 1999, pp. 63-64). Furthermore, in “On the Genealogy of Morals”, he claims that the true value of western civilization in Europe is because of nihilism due to the values pursued which have been built on truthism (Conway, 2000, p. 119). The term “European nihilism” is a reference of nihilism that one accrues when western values are pursued. Thereupon, the way in which Nietzsche expresses his thoughts about nihilism indicates that it is a familiar phenomenon that evokes a state of discomfort and unease feeling. Thus, as noted earlier, to state that nihilism evokes discomforting feelings suggests a link between the term nihilism and the term uncanny.

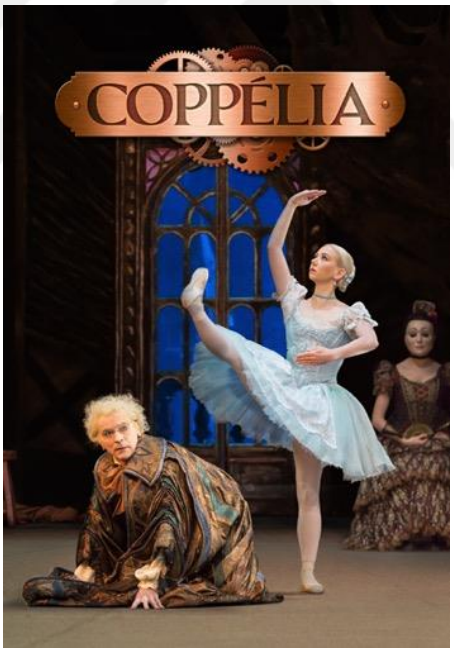


Figure 2. Coppelia

Source: https://www.ngi.org.uk/resources/news/bringing-coppelia-to-life-a-truly-doll-lightful-ballet-for-the-whole-family-to-enjoy-at-sunderland-empire/

E.T.A. Hoffmann’s “The Sandman” was published in 1817, is one of the many works that is looked up when discussing the uncanny because of automata and human-like figures in the story (Geistfeld, 2015, pp. 1-4). In 1870, choreographer Arthur Saint-Léon and composer

Léo Delibes turned parts of the story of "The Sandman" into the comic ballet named "Coppélia." In this ballet Dr. Coppelius, an inventor who builds a very realistic doll called Coppélia (Figure 2). This doll was built with automata and the attempt to reproduce the motions of living beings (Austin, 2016). The believable appearance of the doll made the protagonist Nathanael fall in love with the very humanized woman-like personification of the automaton, ignoring the mechanical interior and movements. Moreover, Freud's analysis of Hoffmann's works draws attention to the unsettling features of characters that appear to be neither alive nor dead, thereby provoking a high level of intellectual uneasiness and distress (Schlipphacke, 2015, p.164). Also, "The Mystery of Edwin Drood" by Charles Dickens and "Rebecca" by Daphne du Maurier evoke the uncanny feeling of these literary works through unmatched fears, contradictions, and cultural norms that are too powerful to conceive (Smith, 1992, p. 286). These examples backs up arguments that the uncanny within literature is not restricted to ghost-like visions, but comes from more psychological and less tangible aspects, which in their own way disrupts the reader's expectations or understanding of the reality.

1.1.1. Definition of the Uncanny Valley (Bukimi no Tani)

The "Uncanny Valley" (Bukimi no Tani in Japanese) is a term that describes the unsettling feelings experienced by observers of robots and animated characters that look exceptionally realistic yet not lifelike. The term was proposed for the first time by the Japanese roboticist Masahiro Mori in 1970 (Zell & Botsch, 2012, p. 1). Mori explains that as robots become more anthropomorphic, they garner empathy from spectators until a certain point where they start to feel "almost humanish" until they trigger a negative emotional response. At this moment, he suggests the observers will develop the feeling of uncanniness (Mori, 2020, p. 90). In addition to this, there is a philosophical argument, according to which, an object that bears human resemblance evokes stronger emotional responses, which go up to a definable point where emotional responses become negative. This argument is appreciated through empathy and imaginative perception (Misselhorn, 2009, pp. 345-346).

In addition, Borody (2013) examines the uncanny valley in regard to modern-day Japanese culture. He connects it with wider philosophical and cultural debates, including Buddhist elements and the roboticization of human culture. It can also emerge from a deeper philosophical speculation regarding the essence of ontology and the limits of humans and machines. Moreover, Wang et al. (2015) suggests that the uncanny valley is likely more than just an engineering problem; it may also be a complicated psychological phenomenon.

This psychological perspective is further explained by Mitchell et al. (2011), who suggest that interactions of mismatched human-like attributes actually augment feelings of uncanny. In conjunction with interpretations, this idea supports the argument that the inconsistencies in features of resemblance to humans is the start of the uncanny valley effect. Together, these interpretations provide a finer comprehension of the uncanny valley and its consequences within the framework of human-robot interaction and more broadly philosophical discourse.

1.1.2. Graphical Explanation and Implications

The uncanny valley effect is shown as a line graph (Figure 3), it has “human likeness” in the x-axis and “familiarity” or “affinity” in the y-axis. In the graph the valley is shown at a point of sharp decrease in familiarity (affinity) then followed by a steep increase of the familiarity. This change in the movement creates a dip or valley in the curve. This graphically illustrates the phenomenon of discomfort or uneasiness when people encounter entities that are almost but not quite human.

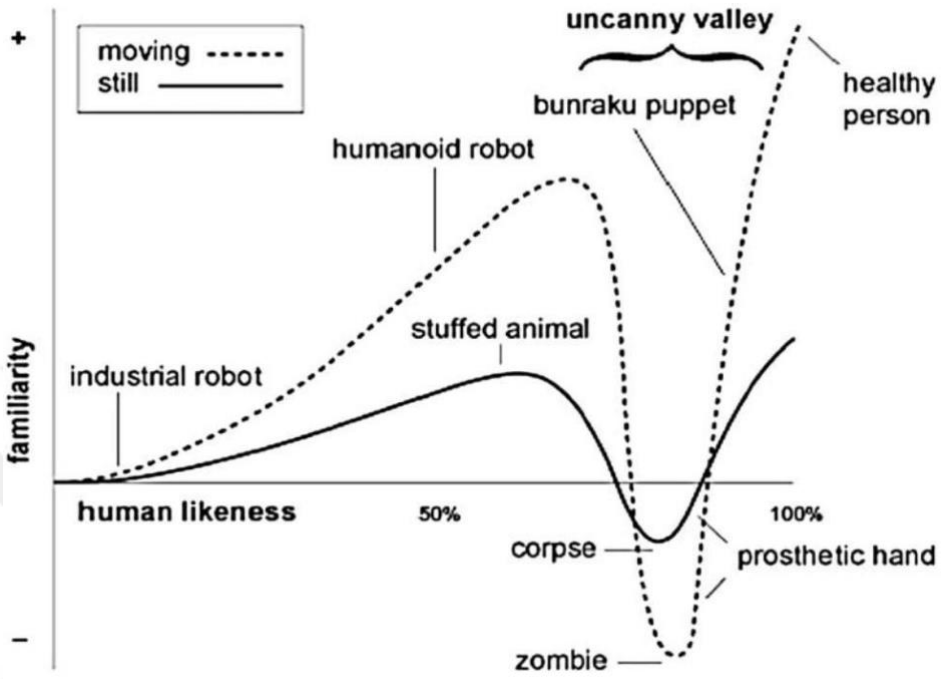


Figure 3. Mori's uncanny valley diagram (MacDorman, 2005)

Key Elements of the Graphical Representation:

1. **X-Axis - Human Likeness:** This axis indicates how closely an entity resembles to a human being. A single quality or specific sets of fixed features, which may be static, dynamic, or behavioral, does not categorize an entity to be a human. Instead, the shape of the curve is changed along the x-axis, meaning that, while moving along the axis, an entity continues to reflect a human appearance or behavior in countless ways (Kätsyri et al., 2015, p. 6).

2. **Y-Axis - Familiarity or Affinity:** The Y-axis indicates the emotional response or affection a person associates with the subject. As emotional responses positively correlate and affinity increases on the y-axis, whereas discomfort or uneasiness emotions negatively correlate with lower values. Affinity in this case is the

psychological reaction that people have towards a humanoid figure and how anthropomorphically the figure is perceived. (MacDorman, 2005, p.116), (Wang et al., 2015, p.398)

3. **Uncanny Valley:** Uncanny valley is the depiction of the point in the graph where the curve drops and rises completely again. It is the most eminent feature of the graph. The negative dip in graph affinity occurs when an entity has reached a certain level of human likeness but has failed to completely trigger a positive emotional response. (Misselhorn, 2009, p.11). At that time, the human features of the entity trigger the likeness to the person observing it. However, an incorrect entity resemblance causes a sharp drop in the likeness, and a toggle occurs where the viewer is disrupted, leading to uncertainty in observation and to feel confused, as well as a sense of eeriness. This perceptual inconsistency gives rise to confusion and the feelings of eeriness (Wang et al., 2015, p. 400).

In summary, this uncanny valley graphical visualization gives an easy and clear understanding of how an artificial entity can resonate to be a human being to a certain point based on the degree of human likeness and familiarity. The motions of eeriness, which people feel while interacting with artificial entities, are caused at different levels in the uncanny valley. Hence, this graph suggests that artificial entities with realistic appearance can show a unerring compatibility of familiarity and likeness, leading to the acceptance of them.

1.2. Theories Related to Uncanny Valley Phenomenon

There are several theories that closely resemble to the uncanny valley phenomenon and offer varying approaches and discussions. Theories on perceptual mismatches and cognitive dissonance explain how people's expectations and reality seem to conflict and provoke discomfort. Emotions and empathy responses to the nearly human figures are evaluated in psychological perspectives, whereas intertextual vision reflects how different

cultural and media texts shape one's perception about the entities. All these kinds of related theories add to the understanding and provide insight into the complexities of the uncanny valley phenomenon.

1.2.1. Freudian Psychoanalysis Approach

The nuclei of the uncanny valley phenomenon can be first interpreted from a Freudian psychoanalysis approach, as articulated in Sigmund Freud's essay "The Uncanny" written in 1919. Freud describes the uncanny as a discomfort or fear that occurs when something that is known transforms into something unknown, or becomes unfamiliar. This is closely linked to Freud's psychoanalytic model of the human mind and the unconscious's influence on affecting the emotional responses (Freud, 1919). Freud's psychoanalytic interpretation of the uncanny is grounded on attempts made by Ernst Jentsch in his article "On the Psychology of the Uncanny" published in 1906. Jentsch argues that the phenomenon of the uncanny emerges from a feeling of ambiguity or uncertainty, particularly with regard to the question of whether an object is animate or inanimate (Jentsch, 1997, p. 7). Freud builds on this point and proposes that the feeling of the uncanny emerges as a psychological conflict stemming from repressed fears and desires.

In his essay, Freud mentions that the uncanny is a subset of the frightening, which revisits something that was well known and previously familiar. He argues that the uncanny cannot be classified as for something which is incomprehensible or terrifying, but is, in fact, a manifestation of fear rooted in one's unconscious. This fear is often related with suppressed fears and previous experiences that arise in the form of an uncanny feeling we experience when we face something new or abnormal (Limano et al., 2020, p. 429).

His theory further emphasizes the feelings of fear and disgust originating from the manifestation of the unknown. This phenomenon is explained with the mind's masked effort to harmoniously blend with familiar and frightful denunciation the unfamiliar. In addition, uncanny is triggered by the fear of lifeless objects that are too humanlike, such as wax figures,

dolls, and robots (Limano et al., 2020, pp. 429-430). This fear emerges from the fact that such objects can be considered alive, inciting a subconscious response associated with former conflicts, such as the fears and anxieties that Freud attempts to explore through Hoffmann's "The Sandman" which prominently encompasses those themes (Mrówczyńska, 2021, p. 53).

Schlipphacke (2015, p.116) affirms Freud's approach, that the feelings of strangeness and fear we encounter with robots and other entities that are humanoid in nature but not completely human come from the conflict of unconscious. The conflict arises when attempting to blend the familiar (human-like features) and the unfamiliar (absence of true human characteristics). which, as a result, has the potential to evoke discomfort or fear. In this conflict the unconscious mind attempts to process and comprehend something that is foreign. Freud also discusses the uncanny valley phenomenon through his conversation on doubles (doppelgangers), automata, and wax human likenesses. Where the distinction between organic and inorganic beings is difficult to differentiate. He broadens the discussion to phenomena like déjà vu or the irrational fear of being buried alive. Overall, Freud's psychoanalysis views on the uncanny valley focuses on the emotional impact that can evoke feelings towards uncanny interplay of the familiar and unfamiliar.

1.2.2. Intertextual Vision

Intertextuality asserts that a single text does not exist in isolation but is part of a set of texts that influence and are being influenced by one another. This idea argues for the interconnectedness of texts (Alfaro, 1996, pp. 280-282). The term intertextuality was first introduced by the Bulgarian-French literary critic Julia Kristeva, in the 1960s. She developed this theory by bringing together the concepts of Bakhtin's dialogism and the concepts of the texts shaped by texts (Zengin, 2016, p. 310). Levin (2011) reveals that intertextuality can be examined through the aspects of the uncanny in novels "Under Western Eyes" (1911), as it has consistent use of spectral imagery and unsettling scenes, which results in the same underlying atmosphere of the uncanny valley phenomenon. These reflections on writing

illustrate how intertextuality has the capacity of promoting the uncanny by layering more and more disturbing familiar elements into the text. Thus, we see that the uncanny valley and intertextuality can be related in a number of ways.

Intertextuality in the uncanny valley can be exemplified by the concept of the characters composed in the virtual space and their interactions with the humans. The more these characters' designs and their communication exhibit intertextuality elements, the closer and relatable they get to the humans and thus the more the uncanny valley effect is reduced (Gaziyeva, 2020, p. 672). For instance, elaborated character design can employ intertextuality by adding human behavioral traits as well as emotions and actions incorporated in the appearances and gestures (Jiang et al., 2022, p. 405). It is important that human interactions are drawn from texts such as literature, film or from real life-based events. Consequently, by doing so, the characters will become acceptable and hence eliminate the need to experience the discomfort associated with the uncanny valley effect (Cheng et al., 2023, p. 90). Additionally, intertextuality can be applied to achieve uniformity and harmony among characters and environments. For instance, in a virtual reality context, intertextuality can be used to design the different environments and scenarios using different elements, which enhances the user's immersive experience and engagement.

To summarize, intertextuality and the uncanny valley are related to an extent. Intertextuality is capable of reducing the effects of the uncanny valley by enhancing the empathy of virtual characters for humans. Designers can facilitate a better user engagement by using intertextuality in the design of the characters and the virtual environments. This will help to counter the unpleasant feeling caused by the uncanny valley.

1.2.3. Cognitive Dissonance Intervention

Psychologist Leon Festinger's book "Theory of Cognitive Dissonance" published in 1957 was the first literature to mention the incongruence in thoughts as cognitive dissonance.

The term is described as when people are facing with discrepancies and how they seek for internal consistency. It can be further defined as the mental unease or discomfort that arises from having conflicting behaviors, beliefs, and attitudes (Festinger, 1957, p. 24). This unease pushes person to consciously decide to change one of their conflicting beliefs, behavior, or rationalize their behavior to align their belief despite the opposing views.

The relation between the cognitive dissonance interventions and the uncanny valley effect can be studied by understanding how cognitive conflicts and mind attribution affect one's perception about humanoid figures. When encountering a figure with mixed human and inhuman characteristics a cognitive dissonance is experienced . This triggers cognitive awareness and an uncanny feeling that is associated with the uncanny valley phenomenon. The unease arises from the attempt to categorize such entities that appear to be human but are most certainly not human (Weis & Wiese, 2017, p. 1599). Humans experience cognitive dissonance as a result of the uncanny valley effect for example a highly humanoid robot or android is likely to invoke a very small sense of discomfort. However, a robot possessing subtle traits that mark them as inhuman, as it becomes less human-like, can generate discomfort and even eeriness on the part of the observer. Cognitive dissonance can also arise from the apparent expectations of the observer and the manifested traits that does align with the human qualities (Macdorman et al., 2009, p. 695).

Similarly, the findings of Burleigh et al. (2013) suggest that cognitive dissonance can occur from problems related to the categorization of almost-human entities, which supports the notion that dissonance is caused by ambiguity and non-human-like features of humans. Also, Moosa and Ud-Dean (2010) suggest that dissonance is evoked when the looks and behavior of non-human entities partially conform to human standards, causing greater discomfort. The studies together demonstrate that interventions of cognitive dissonance within the context of the uncanny valley phenomenon relate mainly to discomfort and emotional conflict of human-like entities.

1.2.4. Perceptual Incongruence Theory

Perceptual incongruence theory examines the alienation of the sensory information and perceptual mismatch. It manifests itself through the actual visual data captured by an eye that does not correlate with the visual algorithms computed by the brain. This gap, in turn, activates certain areas of the brain that, in an attempt to facilitate understanding, deepen information searching (Schutz, 2013). This theory is also applicable to the uncanny valley notion of human perception and responses to artificial objects. The sensation of discomfort is triggered by a mismatch between expected values and perceptual sensory information. This is related to the uncanny valley, where touch, eeriness, or discomfort rises when you see something that can almost pass off as a human, but not quite.

According to research conducted by Urgen et. al. (2018), perceptual discrepancies within the uncanny valley can stimulate emotional and social cognition centers of the brain, revealing that it takes more cognitive effort to address the strangeness. The brain experiences tension when trying to process differing stimuli from a single source as it tries to classify it. Moreover, the tension that exists around the margins of classification may contribute to feelings of eeriness that resemble the phenomena of uncanny valley (Moore, 2012, p. 2). The two theories agree on the point that violation of a person's expectation can elicit emotional reactions. In the context uncanny valley, the response is typically negative (e.g., eeriness, revulsion). This can be described by the perceptual incongruence theory as the brain's attempt to resolve conflicting information from likeness to a human, which results in discomfort. Thus, the existence of the uncanny valley is better understood in the context of the perceptual incongruence theory in conjunction with the perceptual gap between artificial objects that resemble nearly human.

1.3. Masahiro Mori

Masahiro Mori (Figure 4) is a Japanese roboticist and designer born in 1927, known for his work in the field of robotics and automation and his studies in humans' affective

responses to machines. He served as an engineering professor at the Tokyo Institute of Technology in the 1970s (Caballar, 2019). Mori's contributions are never-ending. His work titled "Bukimi No Tani" (The Uncanny Valley) was first published in the magazine Energy in 1970 and is one of his works that brought him into the spotlight in metaphysics, robotics, and even religion (Kageki, 2012). Besides this, Mori has worked on various other endeavors, including robot design and advertising robotic contests. He is the founder of the "Mukta Research Institute" that specializes in using robotics and automation in industries and is based in Tokyo.



Figure 4. Masahiro Mori

Source: https://spectrum.ieee.org/an-uncanny-mind-masahiro-mori-on-the-uncanny-valley

Mori's theory suggests that when people grow more affinity towards artificial humans as they become more lifelike, this feeling drastically drops the affinity when they are almost realistic but have slight imperfections. He suggested that this phenomenon occurs due to the human brain's predisposition to respond to human features, which becomes discomforting for them if these features are sub-human. In his 1970 essay, Mori introduced the original uncanny valley graph (Figure 5). The graph shows two curves, one for still and one for moving objects. The curve for moving objects is steeper as compared to one for still objects, signifying that movement creates an uncanny effect which is more pronounced than when

the object is still (Mori et al., 2012, pp. 98-100). This is illustrated by Mori's example of the unsettling movement of a robot's smile during the 1970 World Exposition in Osaka, Japan.

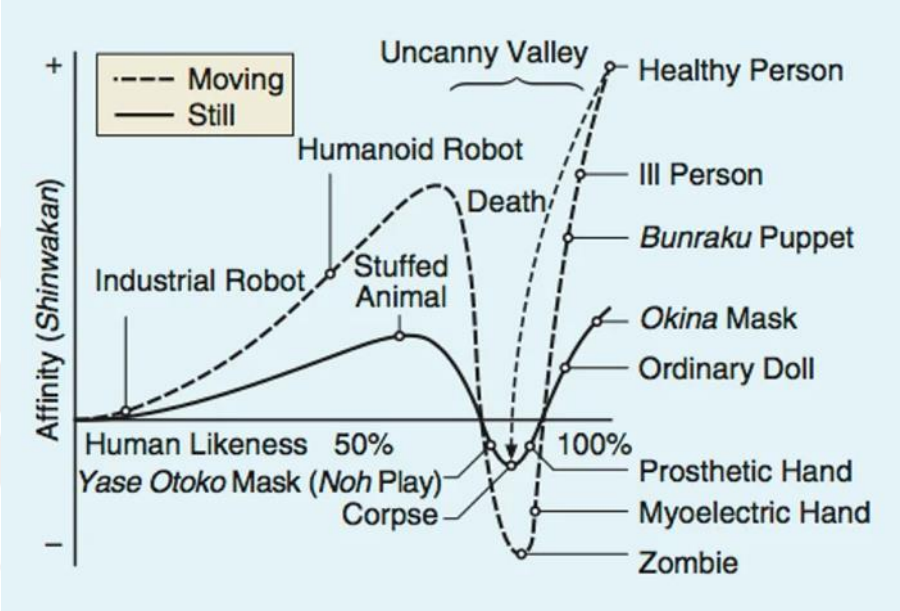


Figure 5. Original Uncanny Valley Graph (Mori, 2012)

Source: https://spectrum.ieee.org/the-uncanny-valley

In contrast, modern discussions often present and depict the uncanny valley graph in a very simplified form (Figure 6) as having only one curve, suggesting the relationship between human likeness and affinity. Most of these curves start by showing an incline in affinity, which then sharply decreases when total accuracy is approached by the human likeness. Affinity then increases once again after a true likeness has been accomplished. This simplified graph presents the concept of the uncanny valley; however, it does not account for the nuance and complexity of Mori's original theory.

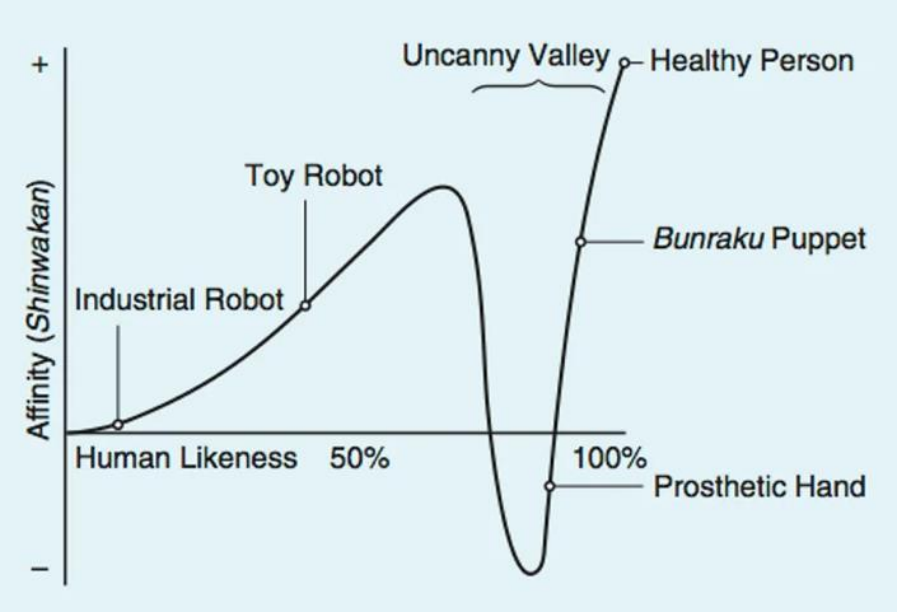


Figure 6. Simplified Uncanny Valley Graph (Mori, 2012)
Source: https://spectrum.ieee.org/the-uncanny-valley

Mori's uncanny valley theory didn't grasp much attention until it was published in English language in 2005. Afterwards the translation, it gained attention by different sectors like robotics, film, and other forms of scientific research areas (Wang et al., 2015, p. 398). As a result, more research was done on this topic. Originally, Mori's theory on the uncanny valley was not backed by sufficient anecdotal evidence, nor did it seek to theoretically test. Hence, many studies have been done since then to try and measure the phenomenon and its potential causes. Depending on several studies, the results would be mixed, some were validating and some were contradicting. Some researchers have advanced the claim that the uncanny valley can be better termed as "Cliff" indicating a smooth slope. Where an abrupt decrease and increase of the affinity changes with the human likeness as the entity starts to resemble closely to a human figure (Bartneck et al., 2007, p. 369)

Conversely, some researchers have question the accuracy of the original uncanny valley theory and put forth what they call the "Uncanny Cliff" (Figure 7). This is a hypothesized theory to challenge the original uncanny valley theory. This theory explains that the decline of the likeness curve does not steeply descend down but rather, steadily drops-off at an angle after reaching the cliff which is the maximum-level of human likeness. There is no gradual increase in the curve unlike the uncanny valley theory curve. This means that photographs of actual human beings are regarded as less likable than those of humanoids, toy robots and wax figures. The cliff shows an abrupt, sharp drop-off in likeability as the entity is humanized beyond a specific threshold (Bartneck et al., 2007, pp. 372-373). Supporting researches has backed the Uncanny Cliff theory with evidence of even highly human-like androids not being preferred as much as toy robots or humanoids. This happens because the human brain is pre-set to appreciate human-featured forms, however, when these forms begin to approach on the non-human side of the spectrum, they can cause fear or uneasiness due to their extreme elusiveness (Zlotowski et al., 2015, p. 2).

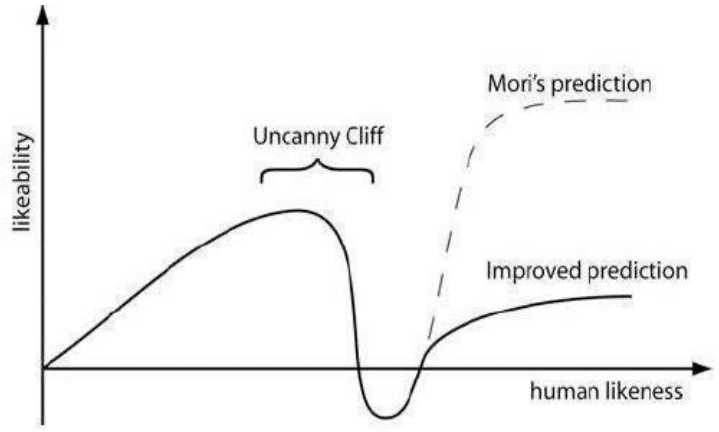


Figure 7. Uncanny Cliff Graph (Bartneck et. al., 2007)

Source:https://www.researchgate.net/publication/4304547_Is_The_Uncanny_Valley_An_Uncanny_Cliff

Moreover, in the field of robotics, the uncanny valley theory is utilized to develop robots that could seamlessly interact with humans. Researchers try to improve the acceptance of robots by designing them in a way that tries to avoid the uncanny valley. This means that through humans' interaction and technological developments, some robots are made more or less humanlike (Zlotowski et al., 2015, pp 2-3). which makes them more acceptable. For example, while designing assistive robots, designers try to make them look more like humans without getting into the uncanny valley. This is because when some robots are overly humanlike, they cause uneasiness and discomfort which may deter the user from engaging with the robot or using it for assistance altogether.

1.4. Human Likeness and Anthropomorphism

Human likeness is the resemblance to human being, which refers to the level of likeness between an object, entity, or a concept to that of a person. This aspect is shown in numerous disciplines, philosophy, anthropology, and even robotics. In philosophy, human likeness surfaces from issues surrounding human sensing, consciousness, and self-identity (Remmers, 2019, p. 2). For instance, George Berkeley, an Anglo-Irish philosopher, mentioned that two entities may be considered the same because they have identifiable resemblances. In his view, people's perception of the world is largely dependent on these similarities. He claims that the way we understand our world, both tangibly and intangibly, rests on the perception of similarity (Bartha, 2022, p. 18).

Human likeness as an anthropological concept that combines components from biological and cultural perspectives. According to Harrison (2009), human likeness is discussed regarding the "image" and "likeness" of God, where "image" could indicate unique human features such as reasoning, and "likeness", relates to the capacity for spiritual growth. Furthermore, this concept has been studied in robotics, particularly during the creation and designing of the humanoid robots. Researchs indicates that there are variations in how comfortable people are with humanlike robots across cultures, This suggests that the level of

human likeness in robots affects their perception and acceptance in different cultures (Castelo & Sarvary, 2022, pp. 1-7).

Anthropomorphism is concerned with the traits such as emotions and intentions attributed to anything other than real humans, for instance, animals, objects, and even abstract concepts. This simply means, endeavoring to understand the actions of the non-human actor from a human perspective (Tang and Hammer, 2024, p. 667; Harris et al., 2020, p. 40). This states that as an entity becomes more human-like, the closeness that a person feels towards it increases. At some point, after which the closeness decreases rapidly, which leads to feelings of discomfort and disgust towards the entity (Cantrell and Hawkes, 2021, pp. 580-581). Which is very much related to the uncanny valley phenomenon, but differs in the anthropomorphism perspectives.

One of the earliest cases of anthropomorphism, where non-human elements are attributed human-like abilities, comes from the legend of The Golem of Prague (Figure 8), where Rabbi Loew created this Golem to safeguard the Jewish community from anti-Semitic violence during the late 16th century. Golem is an anthropomorphic figure in Judaism that is created out of clay or mud. This depicts a blend of reality and imagination (Maidenbaum, 2021, p. 207). As per the legend, Rabbi Leow sculpted the Golem out of clay and brought it to life by doing mystical ceremonies and pronouncing specific Hebrew words. He referred to the Shem HaMephorash, one of the names of God (Rappaport, 2006, pp 9-10). Hence, it shows that the Golem was given human-like attributes, which is a classical case for anthropomorphism.



Figure 8. The Prague Golem

Source: https://livingprague.com/legends/prague-golem/

Anthropomorphism can be seen in our everyday lives when people try to assign human-like attributes to non-human entities. This is noticeable when people talk to their pets as if the animals are human and can communicate in a language they can understand (Large & Burnett, 2018, p. 2). Furthermore, children engagement in anthropomorphism can also be seen in toys that resemble humans or animals and have human-like faces. Giving human emotions, thoughts, and actions to characters in cartoons, movies, or video games is also anthropomorphism. Assigning life-like names to devices like smartphones, tablets with human voices such as Siri and Alexa, and engaging with virtual assistants is also a form of anthropomorphism (Williams et al., 2020, p. 301). Moreover, there are other forms of anthropomorphism that is related to the natural phenomenon such as the wind "howling" or the sun "smiling" that we use in our regular communications. Such expression shows that anthropomorphism is also in our attitude towards nature. Treating objects such as bikes, cars, computers, and even one's favorite possessions as living things that have feelings and find expression is also a form of anthropomorphism (Epley et al., 2007, p. 865).

Overall, the interrelation of human likeness and anthropomorphism has existed from a long time. The acceptance of both the forms and figures has changed in different ways. In some cases, more realistic figures were believable and likeable, whereas in some other cases

just tangible objects were having the attributes of anthropomorphism. Therefore, it is significant to observe how human being relate themselves to these entities.

1.4.1. Classical Mythology

Classical mythology involves the narratives that were developed in ancient Greece and Rome involving gods, heroes, and fantastic creatures. Greek and Roman mythology make ample use of anthropomorphism to envision the gods and natural phenomena. Anthropomorphism was monotonous and particularly pronounced in Greek religion, where gods were able to act and think like human being and their actions were determined by human principles (Zelinova & Skvrnda, 2023, pp. 173-175). Notable Greek mythological figures are Zeus, the king of the gods; his wife, Hera; Poseidon, who was the sea god; and Athena, who was the goddess of wisdom. Meanwhile, Roman mythology, which is heavily derived from the Greeks, has its own unique set of gods, which include Jupiter, Juno, Neptune, and Minerva. Such gods and goddesses were regarded as humans who possessed good and evil traits in their personalities and behaviors (Rajabov et al., 2020, p. 109).

In addition, Greek and Roman mythology describe their gods with emotions such as love, jealousy, anger, and other feelings that are distinct from humans. For example, the Greek god Zeus is famously known to have numerous romantic relationships from which he expresses extreme jealousy by clearly demonstrating human emotions (Sanders, 2021, p. 1). There are also many myths that contain direct contact between gods and human beings, where the gods would sometimes take human form in order to manipulate certain situations. For example, Apollo falls in love with the mortal woman named Daphne, while Zeus is known to take different forms in order to interact with mortals (Vega, 1998, pp. 15-17). Natural elements such as the sea have also been personified. An example of this is the god Poseidon, known as lord of the sea. He is invariably depicted holding a trident (Beaulieu, 2015), representing his dominion and authority over the oceans. Similarly, the god Helios is commonly described as representing the sun (Hurwit, 2017, pp. 541-542).

Within the context of Greek mythology, the anthropomorphism of deities with human characteristics is taken from the Theogony by Hesiod. The central figure of this work is the Nine Muses (Figure 9). They were the daughters of Zeus and Mnemosyne, who embody art, foster creativity, and act as catalysts for inspiring creativity. In the Theogony the Muses are described to be "singing and dancing, contributing to everyday activities" (Athanassakis, 2022, p. 134). This anthropomorphism trait helps in establishing their role as divine yet approachable beings, crucial to the formulation and unfolding of the universe. Thus, in Theogony the Muses taunt, sing and dance, display beautiful voices and inspire poetry, for Hesiod associates as beautifully voiced beings to have divine qualities. This reveals that they are divine, but also human. Further affirming that they act as boundaries between mortals and gods. In Greek mythology, Hesiod equally stresses that the Muses do not only have indispensable divine functions in the universe, but he also emphasizes that they are accessible to humanity.



Figure 9. The Muses

Source: minervaclassics.com

1.4.2. Indian Mythology

In Indian mythology, anthropomorphism fills the gap between humans and the deity figures. These narratives span over various periods and texts such as the Vedas, Upanishads, Puranas, Mahabharata, Ramayana, and even various regional folklore narratives (Kabi, 2020, p.79). Each story captures vivid themes of heroism and devotion, performing the age-old ritualistic battles between good and evil. The Puranas are ancient texts that comprise an account of mythos, legendary figures, the family trees of famous gods, heroes, and sages. These stories often include supernatural entities such as gods and goddesses and demons, and they have a fundamental contribution to the moral and ethical fibers of Indian society. Prominent deities include such as Brahma (god of creation of the universe), Vishnu (god of preservation) and Shiva (god of destruction), as well as goddesses such as Saraswati (goddess of knowledge), Lakshmi (goddess of wealth), Durga (goddess of protection), Kali (goddess of destruction), and Parvati (goddess of devotion) (Sharma, 1969, pp. 208 – 213).

Indian deities are usually represented with anthropomorphic features, which include families, feelings, and engaging in activities similar to those of humans. For instance, God Krishna's (Figure 10) playful aspects that he shows while interacting with the Gopis (cowherd girls) depict him as a human (Jain, 2010, pp. 57-61). Some of God Vishnu's avatars are animal-like, such as Matsya the fish and Varaha the boar. These convey some of his roles as the guardian of the universe (Sukdaven, 2012, pp. 208-217). In addition, the God Rama from the Ramayana is exhibited as the ideal man and king, which is in accordance with virtue and righteousness, while the antagonist Ravana represents overwhelming pride and ambition masked in his knowledge and power (Johari, 2023, pp. 1-3). This shows moral archetypes.



Figure 10. Representation picture of God Krishna

Sources: https://iskcondesiretree.com/profiles/blogs/krishna-s-flutes

Anthropomorphic traits can be identified in other Indian deities too. Ganesha (Figure 11) is respected as the beloved elephant-headed god in Indian mythology. (Kumar et al., 2008, pp. 287-288). He is the human deity who possesses an elephant's head. He is known as the patron of the arts, the sciences, divinity of the intellect and wisdom, and the great remover of all obstacles. God Hanuman is the monkey god who, in possession of superhuman strength, can also fly, and is devoted unconditionally to Lord Rama. He is one of the most notable characters in the ancient texts of Ramayana (Verghese, 2004, p. 428). Narasimha is a form of Vishnu who is depicted as a man with the head of a lion. He is fierce and protective, which manifests in the form of a lion merged with human-like sentiments. Kali is known to have emerged from the dark cosmos, which shows her fierce persona. The goddess is depicted having a darker skin tone with numerous arms wielding weapons and decaying skulls adorning her neck (Pieruccini, 2014, p. 85). Shiva is popularly known as Nataraja. He is a cosmic dancer who, in the form of Nataraja, performs tandavas; a vigorous dance symbolizes creation, preservation, and destruction of the universe. In this form, Shiva is represented as a multi-armed human. The dance of him represents the unique balance of the universe and cosmic (Chowdhury, 2022). Lastly, Goddess Lakshmi, the goddess of wealth

and prosperity, is shown as a beautiful four-armed woman who sits or stands on a lotus flower with hands in a position from which gold coins are poured (Bai, 2001, p. 1237)



Figure 11. Representation picture of God Ganesha
Source: https://www.britannica.com/topic/Ganesha

Indian mythology is filled with anthropomorphic related gods and goddesses. This shows the cultural fabric of India and how the divine is well accepted in everyday life. The connection to the spiritual belief in India comes from this perspective in Indian society. Stories, beliefs, and understandings shape and provide the acceptance of this anthropomorphic depiction to the human nature connected with the sentiments.

1.5. Eeriness

Eeriness is one of the components of the uncanny valley phenomenon. As the likeness of a character or entity to a real human being increases, it is usually followed by a positive response from observers. However, when the likeness is too human-like, it can lead to the sensation of discomforting eeriness. This negative reaction comes from the activation of the negative state in the observer (Dobson et al., 2019). Artificial entities or robots look human, but move mechanically, which makes them eerie. This appearance and movement inappropriateness induces a feeling of discomfort. Eeriness is alleviated by smooth and

biologically fragmented movements, which reinforce the feeling of familiarity. As Saygin et al. (2012, p. 420) mention, smooth and biologically believable movements are critical to keep a familiar feeling and reduce eeriness.

The areas that are particularly prone to detect human likeness and eeriness are the face and, most importantly, the eyes. Unnatural eyes (Figure 12), which lack the depth of real eyes and have fragmented motions, can elicit a sense of eeriness. Likewise, expressions that fail to match the conveyed emotion precisely may be disturbing (MacDorman et al., 2005, p. 11). Furthermore, the voice of an artificial being is also important in determining whether a creature is perceived as eerie or not. If the voice is robotic, synthesized too much, the intonation is too monotone and the realism not present at all, it can be perceived as eerie. This difference in what is seen and heard simultaneously can amplify the uncanny valley effect (Mitchell et al., 2011, pp. 11-12).



Figure 12. Unnatural Eyes as an example of Eeriness
Source: https://phys.org/news/2009-09-scary-real-quantify-eeriness-virtual.html

Lastly, the pores in the skin textures and wrinkles are a form of detail that enables a humanoid robot or CGI character to look very real. Skin that is too realistic, along with subtle flaws in other regions, can increase the uncanny valley effect (Tinwell et al., 2011). Some degree of asymmetry and lack of proportionality in the size of the eye, length of the limbs, or structure of the face tends to evoke feelings of discomfort. Uncanny feeling arises from

hyper-realistic humanoid characters because humans are sensitive to the misrepresentation of reality (MacDorman et al., 2009).

1.6. Previous Studies of Uncanny Valley in Animation Films and Digital Games

The context of the uncanny valley is very central in animation films and digital games. It has been noted in animation films and digital games that characters can become so realistic that they actually begin to invoke unsettling or even disturbing feelings as a result of imperfections in their designs and subtle strange nuances of their behavior. Characters' faces, their speech, body movements, and other attributes are some of the areas that make it difficult to create engaging and lifelike characters without evoking negative emotional triggers. In this section, some key findings from animation films and digital games are elaborated.

1.6.1. Animation Films

In animation films, the uncanny valley effect is felt because of the unrealistic match between a character's face, voice, and actions (Mitchell et al., 2011, pp.10 to 12). Which leads to the feeling of eeriness. Semi-realistic animated characters in films such as "Beowulf" and "The Polar Express" (Figure 13) rated the highest on negative evaluations and eeriness as compared to cartoonish characters and real actors (Kätsyri et al., 2017, p. 159). In addition, the absence of natural facial expression greatly increases the uncanny feeling toward virtual characters, which further impacts the emotions such as fear, sadness, disgust, and even suppresses the elements of surprise (Tinwell et al., 2011). In contrast, Piwek et al. (2014) found in a study that improvements in the motion quality may lessen the uncanny valley effect, thus making even the most anthropomorphic characters acceptable.



Figure 13. A screencap from the animation film "The Polar Express" 2004 by Robert Zemeckis

Source:https://polarexpress.fandom.com/wiki/Hero_Girl_(Holly)?file=Polar-express-disneyscreencaps.com-7254.jpg

Another research conducted by Tinwell et al. (2013) analyzed the relationship between facial unfriendliness and the perception of psychopathic personalities in virtual characters. It was found that characters who did not show any natural response, such as fear, were judged as more uncanny and as being psychopathic. Nonetheless, innovations made in the rendering processes aid animators in overcoming the uncanny valley by improving motion or reducing the eeriness associated with the visual quality of the characters (Assaf et al., 2020, p. 98). Improvements in automation technologies also allowed the high-quality rendering of the realistic animations that reduce the aforementioned disturbing anomalies and promote viewers' acceptance and engagement of animation films.

1.6.2. Digital Games

Digital games have evolved tremendously with the advancement technology and become more and more realistic over the years. Despite this realism, the "uncanny" ratings given by the users to the CG characters tend to be nearly identical to the uncanny valley phenomenon (Flach et al., 2012, p. 115). So, it is important to assess the attributes that make

these CG characters evoke such an effect. Cheng and Cairns (2005) reported that realism enhances immersion in video games, but only to a certain limit. Advanced realism, together with an imperfect animation, makes the game less immersive. This kind of realistic visual rendering often leads to uncanny feelings. Many of game designers try to avoid this problem by rendering in a more stylized way (McDonnell and Breidt, 2010, p. 1).

The absence of believable responses or realistic facial movements of C.G. characters in digital games triggers the feeling that they are unnatural, evoking a sense of the uncanny (Tinwell et al., 2013, p. 1617). In a study a test was conducted on 9-11 years old children found the uncanny valley effect with humanised characters with strongly exaggerated facial movements (Tinwell & Sloan, 2014, p. 286). The gap between human and non-human elements present in characters in the games drives it to the phenomenon of uncanny valley (Kätsyri et al., 2015, p. 11). For instance, in horror digital games the uncanny valley effect can amplify a whole experience of horror by manipulating the creepy feelings that are connected with characters that are close to being human. This has been tested through the analysis of the public response (Cheng et al., 2023, pp. 89-94). Hence, the uncanny valley is a powerful phenomenon concerning the design of digital games, as it has an impact on the emotions and perceptions of the users. By learning about this effect designers can learn about enhancing immersion of the players in digital games.

1.7. Realism, Hyperrealism and Photorealism

The uncanny valley phenomenon usually happens to the viewers in pursuit and depiction of an extreme realism stage. In the case of realism, hyperrealism, and photorealism, the artworks' visual quality can be so accurate that it can trigger unpleasant feelings because the observer, at first sight, can understand it as a perfect representation of realism based on a distorted replication of reality. Realism, hyperrealism, and photorealism are three interconnected movements of art that share a common focus on the exact representation of life. The existence of the uncanny valley phenomenon in relation to these movements is discussed below.

1.7.1. Zeuxis

Zeuxis was a famous ancient Greek painter, exceptionally skilled with specializing in realism during the late 5th century BCE (Britannica, 2024). One of the areas he receives acclaim is creating immortal lifelike images, a practice that was highly admired during his lifetime. Zeuxis is known to have been a pupil of Apollodorus, one of the first artists to produce volumetric images with a sense of depth through the technique of shading; later this technique is called “skiagraphia” (Keuls, 1974, p. 105-106).

Ancient anecdotes suggest that Zeuxis had once competed with an artist named Parrhasius. In this competition, Zeuxis painted grapes (Figure 14) that were so lifelike that birds attempted to eat them. He then asked Parrhasius to reveal his painting. He was very confident of his win, but he found out that in Parrhasius’ painting (Figure 15), the curtain was an illusion because the curtain painted was much more realistic in comparison to Zeuxis painting. Acknowledging defeat, Zeuxis said that he had deceived birds, while Parrhasius had deceived the artist. (Cochran, 1947, p. 59). Zeuxis paid great attention to the proportions of a figure and its relation to nature, which was characteristic of realism. His art laid the foundation for realism and later evolved for many centuries. Additionally, he went even further with his devotion to realism by the way he selected his models for painting. For example, when portraying “Helen of Troy”**,** Roman philosopher Marcus Tullius Cicero recalls that Zeuxis painted Helen by selecting best aspects of five women from the town of Croton as depicted in the painting **“**Zeuxis and the Girls of Crotone” (Figure 16) to produce an ideal composition of feminine masterpiece which he rightly believed did not exist in one person. (Dillon, 2010, p. 1)

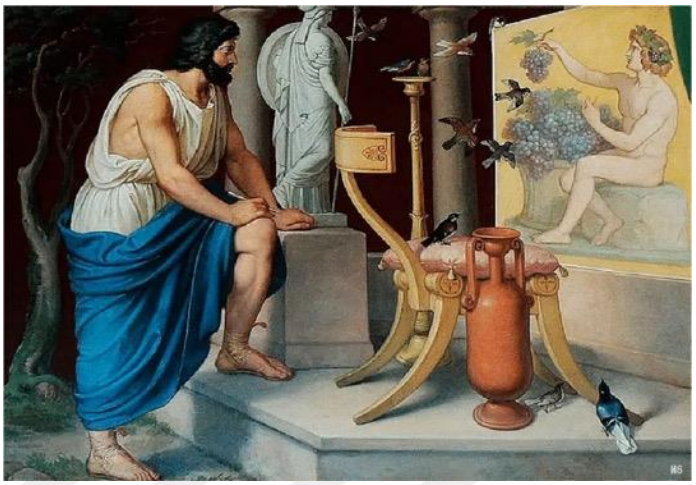


Figure 14. Painting Representing Zeuxis' "Grape and the Birds" (1842) by Johann Georg Hiltensperger

Source: https://www.thecollector.com/zeuxis/



Figure 15. "Contest between Zeuxis and Parrhasius" (1630) by Matthäus Merian

Source: https://newsletters.artips.fr/English/EN_Parrachius_Grapes/

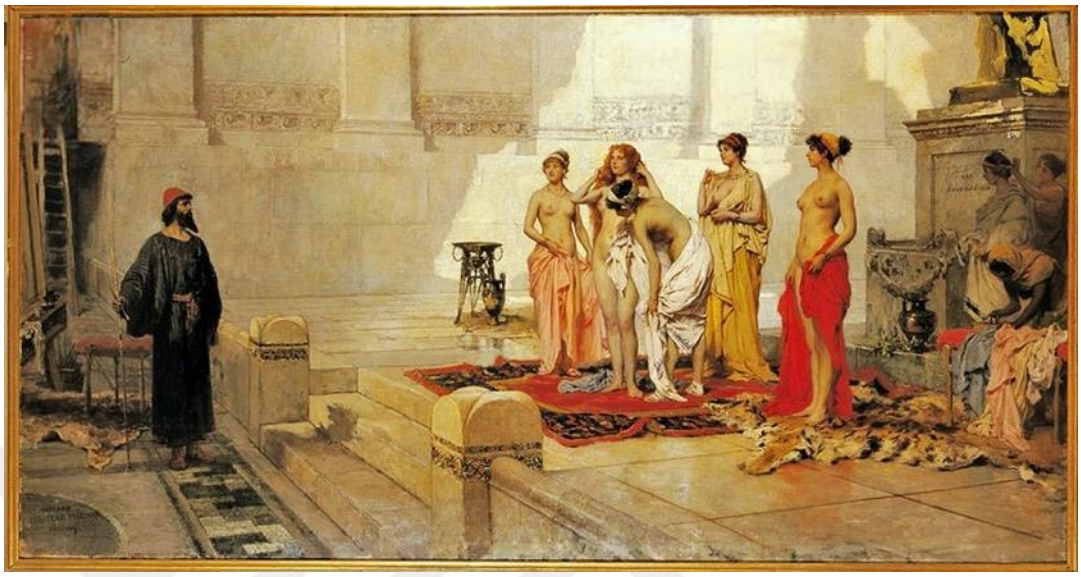


Figure 16. "Zeuxis and the Girls of Crotone" (1889) by Eleuterio Pagliano
Source: https://www.gruppoarcheologicokr.it/zeusi-e-le-modelle-di-kroton/

The contribution that Zeuxis brought to art is found in his use of realism and the essence he encompassed in his subjects through meticulous observation and technique. His paintings are examples of his proficiency in replicating figures to a level that seemed to deceive the human eye. Zeuxis's pioneering methods and his role in the evolution of realistic art show him as a legendary figure in the archives of realistic paintings. This pursuit of realism seems to be an attempt at what researchers currently call the uncanny valley phenomenon. Zeuxis's realism and depiction of likeness are indistinguishable from reality and have a very strong reaction from the viewers (Brecoulaki, 2015, p. 221), which undeniably provokes intense discomfort as shown in the present-day' uncanny valley phenomenon.

1.7.2. Realist Image

Realist images, also referred as the Realism art movement, where subjects depict from everyday life as they appear without any interpretation or modification. The term realism become prominent because of the exceptional works of the French painter Gustave Courbet,

who throughout his life produced paintings of the surroundings as it was without any alterations (Liu, 2024, p. 536). Additionally, contemporary literature and philosophy included writers like Gustave Flaubert and Leo Tolstoy who advocated for literary realism (Goodwin et al., 1990, pp. 409-410). The migration of the realism art movement began shifting to the United States and other parts of Europe. American artists such as Thomas Eakins in his painting "The Gross Clinic" (Figure 17) embraced and accepted the realism of the American culture and society, where the representation of the pragmatic and democratic values of the subjects are shown (Cabello, 2015, p. 788). Realism flourished in the early 20th century and began induced with the support of new artistic movements, improvements of techniques, and different forms of art coming into play. Through the incorporation of modern elements with traditional techniques contemporary artists like Lucian Freud in "Benefits Supervisor Sleeping" (1995) (Figure 18) and David Hockney in "Mr and Mrs Clark and Percy" (1970-71) (Figure 19) exhibited realism (Zhang 2023, p. 262; Kringelbach and DiPerna 2014, p. 449).



Figure 17. "The Gross Clinic" (1875) by Thomas Eakins

Source: https://philamuseum.org/calendar/exhibition/gross-clinic-thomas-eakins



Figure 18. “Benefits Supervisor Sleeping” (1995) by Lucian Freud

Source:https://medium.com/counterarts/benefits-supervisor-sleeping-1995-by-lucien-freud-1fa179aa970



Figure 19. “Mr and Mrs Clark and Percy” (1970-71) by David Hockney

Source:https://www.tate.org.uk/art/artworks/hockney-mr-and-mrs-clark-and-percy-t01269

Realism depicts an accurate and detailed rendering of nature along with the simplistic portrayal of people and objects. Its most valuable aspect is the accuracy with which the details of the subjects which is captured by the inclusion of the surface details, light, shadowing, textures and the anatomy of the figures (Abell, 2007, pp. 16-17). Moreover, the color palettes employed in realistic images tend to have the hues that are inherently present in the actual world. To paint realistic skin tones, landscapes, and cityscapes, artists utilize an extensive range of colors. Realist paintings usually depict scenes involving common people, and predominantly portray rural and urban lifestyles, working class people, and everyday home life (LaBudde, 1958, pp. 142-143).

This approach is found in "The Gleaners" (1857) (Figure 20) is one of the most recognizable paintings from the Realism movement by Jean-François Millet. The painting features three peasant women gleaning a field for leftover stalks of wheat, post-harvest. Gleaning was an old practice, especially among the poor, of picking up leftover grains from the cultivated fields, which was a laborious activity linked with poverty (Fratello, 2003, pp. 686-688). Millet uses an earthy palette with brown, gold, and green to depict the rural setting. Not only does this palette help to enhance the realism of the setting, but it also portrays the tough and unglamorous conditions of agricultural labor. Ultimately, the subject of the painting does not receive idealization, but instead is portrayed with dignity. The painting is a window into the life of people in rural 19th-century France (Vardi, 1993, pp. 1424-1426). Viewing Millet's painting, one has an emotional response that is sympathetic, respectful, and more socially conscious. The authenticity creates a bond with the beholders because of the humanity of the subjects.



Figure 20. "The Gleaners" (1857) by Jean-François Millet

Source: https://www.theartist.me/artwork/the-gleaners/

Similarly, Gustave Courbet's work "A Burial at Ornans" (Figure 21), is regarded as a great painting that captured the funeral rite from the artist's town in Ornans, France. This painting was completed between 1849 and 1850, and this work is a prominent piece of realism in the art world. Through this work, Courbet aimed to achieve the representation of life without any filters. The subject matter selection was unusual during this period, since it showcased ordinary persons and events as pieces of art. The people in the painting lack idealization; instead, they are portrayed in their real-life attire and without any attempt to dress them or romanticize their forms. Muted, neutral, and earthy tones are predominantly used by Courbet, which accompany the painting's essence and the scene's mood. The portrayal of buff and brownish tones indicates rurality and the grimness of the occasion. It does not create harsh highlights or theatrical lighting in the scene, so a dull tone is set.

(McCoy 2024). This approach further endorses realism's advocacy of depicting life as it is without exaggeration.



Figure 21. "A Burial at Ornans" (1849-1850) by Gustave Courbet
Source: https://www.dailyartmagazine.com/burial-at-ornans-gustave-courbet/

Another example of the painting "The Stone Breakers" (1849) (Figure 22) was created by the French artist Gustave Courbet that shows the labor of two men breaking stones beside a pathway. In this work, one is an older man hunched over actions to break stone with a hammer, while the other is a younger man carrying an extremely heavy basket filled with stones. Both men are shown in torn cloths and set against a backdrop of barren, rocky land surrounding them (Kiamaartgallery, 2015). This honest depiction in the painting potrays the struggle and brutality of their work. Courbet emphasises the problems that exist for the underprivileged working class. The colors reflect the dusty environment in which the laborers work and reinforces the severity of the working condition. The painting presents the brutal working conditions of the laborers, depicting the exploitation and social and economic inequalities present in the time of the artwork.

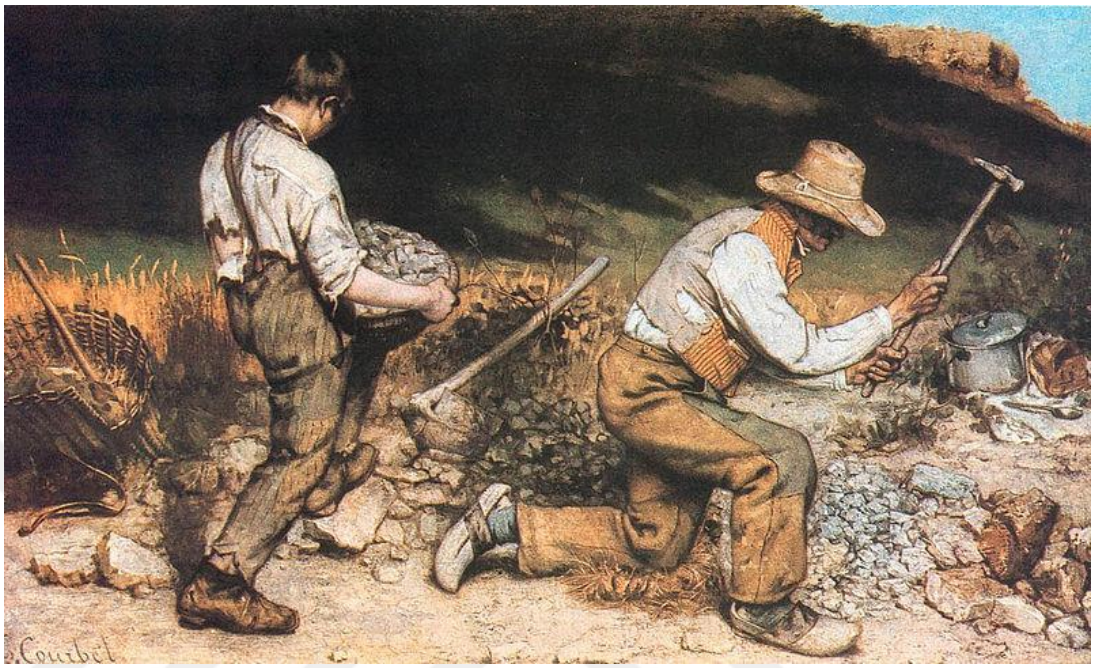


Figure 22. "The Stone Breakers" (1849) by Gustave Courbet
Source: https://smarthistory.org/courbet-the-stonebreakers/

Moreover, "The Third-Class Carriage" (1862-1864), by Honoré Daumier, and "Ploughing in the Nivernais" (1849) by Rosa Bonheur, are examples of the movement's adherence to authentically portraying the lives of common folk. In Daumier's, "The Third-Class Carriage" (Figure 23), melancholy lower-class train passengers in a packed compartment resonating with gloom and fatigue are shown, which accentuates the drudgery endured by the working poor. The unidealized detail, untidy clothes, and fatigued faces of the passengers contribute to the social inequality montage of the era (Artble.com, 2024). In the painting, the use of light is powerful, but it contrasts strongly with the dark surroundings, making the faces and hands of the passengers more pronounced. This focus, together with the lighting, aids in drawing attention to their gestures as well as expressions. Moreover, this technique makes the figures more substantial and three-dimensional, thereby enhancing the complexity of the work.



Figure 23. "The Third-Class Carriage" (1862-1864) by Honoré Daumier
Source: https://www.metmuseum.org/art/collection/search/436095

Likewise, Rosa Bonheur's "Ploughing in the Nivernais" (Figure 24) also shows rural laborers at the plough with a group of oxen. This realistic painting extends the time and the physicality of the labour of agricultural work, highlighting the natural landscape as well as the animals and the people laboring in it. The diffused light, soft yet hard, denotes a specific time of day that enhances the realism of the work. The artist's use of light and shadow on the parts of the landscape and figures gives it depth, volume, and life (Scott, 2023). Bonheur's painting of animals' skins, earth, and vegetation shows his deep understanding of nature and rural life.



Figure 24. "Ploughing in the Nivernais" (1849) by Rosa Bonheur
Source: https://www.musee-orsay.fr/en/artworks/labourage-nivernais-68

1.7.3. Photorealist Painting

Photorealism is an art form that began emerging in the late 1960s and early 1970s. It involves capturing specific scenes and subjects with meticulous detail and precision. This movement came in as a rebellion to the abstract and overly minimalistic styles of art that dominated the artistic world at that time (MasterClass, 2021). Photorealistic paintings are very detailed and clear, like actual photographs. As stated in The Art Story, (2024), the roots of photorealism are in Renaissance and Baroque era masters like Leonardo Da Vinci, Caravaggio, and Vermeer, who focused on detail and realism.

The evolution of technology, photography, and printing have contributed significantly to the expansion of photorealism. The ability to access high-quality photographs has allowed artists to use these as accurate references for the creation of detailed work of art rather than drawing with only sight references (Hoskins, 2007, p. 307). Moreover, artists were able to achieve accurate precision when painting murals on larger canvases with the use

of digital projectors and grid systems. The most noted artists in this movement of photorealism are Chuck Close, Richard Estes, John Baeder, and Audrey Flack. Chuck Close is known for his large-scale photorealistic portraits, Estes for his urban landscapes, Baeder for his depictions of iconic landmarks, and Flack for her strong symbols made with an airbrush. The emphasis on precision and details within photorealism produces artworks that are for the most part, replicas of their original photographs (Close, 2007, p. 130-131).

Chuck Close's "Big Self-Portrait" (1967-1968) (Figure 25) shows his self-portrait Close painted in black and white. By employing a novel approach with precise detailing and the exceptional application of a grid system, he achieved an unparalleled level of photorealism in this artwork. This artwork is massive in size, measuring 9 feet by 7 feet, the face of Close was rendered in a photographic level of realism, such that pores, hairs, and even wrinkles are visible on the skin. As a reference, he utilized a photo of himself. He split the photo into sections and conscientiously painted each section onto a canvas. The addition of black and white heightened the realism even more by removing the distraction of color and focusing solely on the texture and shape of the subject. It endorsed great accuracy while simultaneously underscoring the artistic nature of the subject. This marks the dichotomy between photography and painting by the act of capturing (Meyer, 2024).

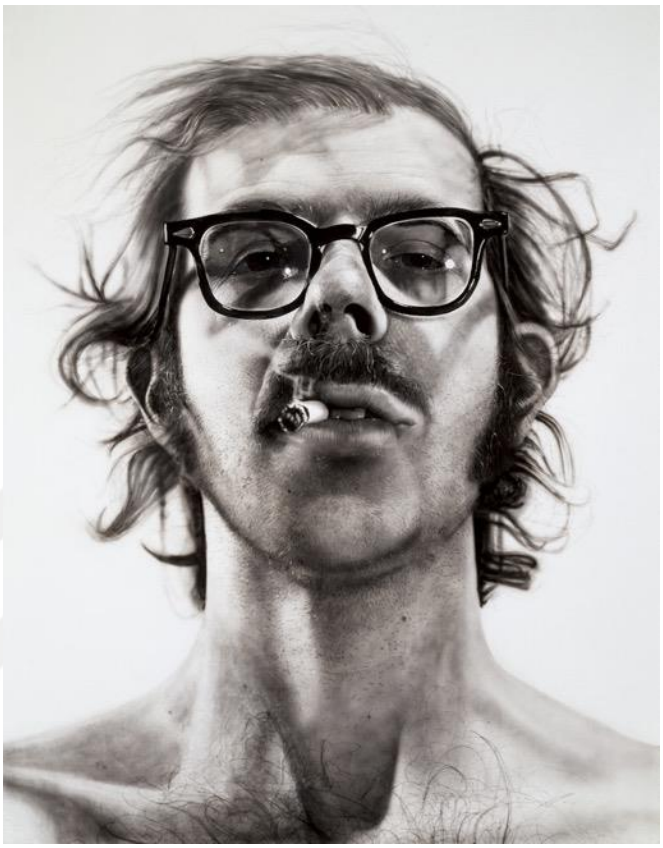


Figure 25. "Big Self-Portrait" (1967-1968) by Chuck Close
Source: https://walkerart.org/collections/artworks/big-self-portrait

Likewise, Richard Estes's "Telephone Booths" (1968) (Figure 26) portrays breathtaking detail and reflection of a row of telephone booths (Museo Thyssen-Bornemisza, 2024). This work sums up Estes's interest in urban geography and his skill in painting surfaces that reflect light. Each telephone booth contains special features such as the interaction of light and shadow, the transparency, reflections of glass, and the variations in colors and textures. The painting creates an almost surreal sense of depth and realism, which actively appeals to viewers in terms of exploration and engagement (Gayford, 2021).



Figure 26. "Telephone Booths" (1968) by Richard Estes

Source:https://www.museothyssen.org/en/collection/artists/estes-richard/telephone-booths

Additionally, John Baeder's painting "John's Diner with John's Chevelle" (2007) seen in (Figure 27) is an example of photorealistic style art representing American roadside diners' culture. This painting depicts a classic American diner, as well as its vintage signage and building structure. There is also a Chevrolet Chevelle, one of the classic muscle cars from the 1960s and 1970s, that is significantly displayed in the foreground of the diner. The shiny details of the diner and car are further emphasized in the brightly lit setting, and the scene is depicted under the warm rays of the sun (Heller, 2009). Baeder focuses on the Chevelle's details and captures the scene's textures, colors and environment surrounding them in a photorealistic manner.



Figure 27. "John's Diner with John's Chevelle" by John Baeder
Source:http://www.artnet.com/usernet/awc/awc_workdetail.asp?aid=425931865&gid=425931865&cid=179192&wid=425988811

Lastly, the painting "Marilyn (Vanitas)" shown in (Figure 28) created in 1977 by Audrey Flack, is based on a feminist theme with in-depth meaning. This art piece contains a still object of high liveliness with a Marilyn Monroe portrait, who represents wealth and beauty. Besides Monroe's portrait, there are various objects, each with its own special coded meaning: a candle, a rose, and a clock, along with a string of pearls and fruits such as pears and grapes. Together, they provide an archetypal vanitas which contemplates beauty, riches, and life itself (Baskind, 2009, pp. 107-109). The composition is also lushly detailed because Flack incorporated saturated bright colors into the painting, which was managed to mutilate the vibrance of the objects. Flack managed to photorealistically embody by pressing questions of humanity in the painting and using the artistic techniques that embodies deep philosophical and cultural questions.



Figure 28. "Marilyn (Vanitas)" (1977) by Audrey Flack

Source:https://uarizona.pastperfectonline.com/Webobject/434BAD78-C51E-483C-93FD-376140957290#gallery-1

1.7.4. Hyperrealist Image Production

The hyperrealist art movement has developed from the photorealism movement during the 1970s, However, there have been advances in hyperrealist works since the 2000s (Roelstraete, 2010, p. 6). Hyperrealism began to take form when artists strived to exceed the limits of photorealism. This movement extended beyond visual reproduction of reality to heightened emotional or narrative aspects of reality. The focus of hyperrealist art is not the subject but to the essence and context that the subject is rooted in (Savchuk and Tuchkova, 2020, p. 369). To achieve the results, hyperrealistic artists make use of high-resolution images and analyze the subject for a considerable amount of time. Hyperrealism works use photographic and digital design technology. Artists are free to use high-resolution cameras

and imaging software to alter and clarify features prior to reconstructing them onto paint or other surfaces.

Hyperrealism can be achieved in different mediums such as oil paint, acrylic, pencil, and even sculpture. Each medium offers a different set of possibilities for the form, lighting, reflection, texture, and detail. To get a desired result, the correct choice of the medium is significant. Distinguished hyperrealist artists include Carole Feuerman, Duane Hanson, John De Andrea, Ron Mueck, and Roberto Bernardi, known for their impressive works (Sun, 2023). Moreover, hyperrealism is one of the art forms that includes and has greatly influenced contemporary art, game art, and other innovative forms such as digital art and VR (Ruzanka, 2014).

The hyperrealistic sculpture called “Big Man” (2000), shown in (Figure 29) by Ron Mueck is one of his best pieces, as it captures a remarkably intense and confrontational expression in a sitting posture of a man. The figure is truly intense and lifelike, with astounding levels of detail in the man’s skin, hair, and posture. Nevertheless, Mueck’s intimate and vulnerable themes, along with emotions always shown in his sculpture works. This work is an example of how one statue can make the sensations of touch and intimacy as a powerful expression (Smithsonian Insider, 2016). Consequently, the sculpture is able to bring forth feelings of both discomfort and fascination and deeply invoke emotions due to its portrayal of an extreme degree of realism, but the optimistic stance of exhilaration allows viewers to feel as if the statue is both familiar and alien.



Figure 29. "Big Man" (2000) by Ron Mueck

Source:https://www.artsy.net/article/artsy-editorial-obsessed-ron-muecks-big-man

Hyperrealism still life artworks, such as "Candy Rainbow" (2010) as seen in (Figure 30) by Roberto Bernardi, fail to evoke emotions from the viewers as there are no human figures to intimate. Moreover, it will most likely not induce any uncanny sensations, but will still leave the viewer in a surrealistic confusion due to its depiction of everyday items in an exceptionally accurate manner. The remarkable portrayal of the objects can leave one to wonder if what is seen is truly a painting. The extreme detail and hyperrealism in ordinary objects leave an undertone of anxiety, as the eye perceives more details than it typically does in real life.



Figure 30. "Candy Rainbow" (2010) by Roberto Bernardi
Source: https://www.robertobernardi.com/projects-2

Duane Hanson's sculpture, "Woman Eating" (1971) shown in (Figure 31) depicts a woman sitting at a table and consuming her food. The clothing, skin, and expression of this sculpture are so intricate that it is almost impossible to distinguish it from a real person. These features give the sculpture a pseudo-living essence, but the lack of motion along with the dullness of the piece reminds the viewers it is a sculpture. This is why hyperrealistic sculptures are able to elicit strong and disturbing feelings within the viewers (Doss, 2006, p. 9).



Figure 31. "Woman Eating" (1971) by Duane Hanson

Source: https://americanart.si.edu/artwork/woman-eating-75123

Lastly, the artwork by Tjalf Sparnaay, "Foodscape" (2014), shown in (Figure 32) gives off an exaggerated feel of hyperrealism, making it more artificial than real. The food items are replicated with such intensity that they appear surreal. The details given to the items are mesmerizing, as every object shines beautifully with light and is embedded in minute detail. The details on the hamburger and the ketchup bottle are portrayed in a very intricate way. Glimmering surfaces of the salt and pepper glass objects highlight the beauty of the piece. Each element is captured with photographic clarity. The depth and volume within the food items through the play of light and dark tones allows a more realistic finish. The carefully painted reflections and highlights emulate the effects of both natural and artificial light (Sisto, 2024). This detailed designed food artwork advances the work of hyperrealist

art. Parts of the work can invoke different triggers to bring memories. Everything from taste to even smells become instinctual.



Figure 32. "Foodscape" (2014) by Tjalf Sparnaay
Source:https://www.christiesrealestate.com/blog/the-megarealist-food-art-of-tjalf-sparnaay/

1.7.5. Realistic Humanoids

The concept of realistic humanoids has been studied and represented in various ways in literature, animation films, digital video games, robotics, and other media. With the advancement of technology, the depiction of humanoids to resemble human appearance and behavior has advanced. Realistic humanoids usually have skin, facial, and body features that are within the human anatomical ranges. These humanoids are able to perform human-like movements and actions such as walking, talking, and representation of feelings through gesture, which depicts emotions (Swiatek et al., 2023, pp. 114-117). Several realistic humanoids use artificial intelligence technology in order to process information, learn through interaction, and modify their answers depending on the users and surroundings (Koenemann et al., 2014, p. 1).

Sophia, shown in (Figure 33), is a humanoid robot developed in the year 2016 by Hanson Robotics known for her nearly human-like appearance and conversational skills. With the help of AI, she is able to process speech and respond in a human-like manner, which makes her one of the most popular humanoid robots across the globe (Goertzel et al., 2017, pp. 3-4; Hanson et al., 2020, p. 2). In another example (Figure 34) shows the humanoid robot named Geminoid DK developed by Henrik Scharfe in 2011. This humanoid robot is from the Gemonoid series of robots designed by Hiroshi Ishiguro, a roboticist of Osaka University. The aim of this humanoid is not just to resemble but also to act like a real person. These robots are built with sophisticated facial and speech recognition technologies that enable them to interact with people in a very realistic way. Geminoid DK is considered to be an ultra-realistic humanoid. The appearance and movements of this humanoid are used in research for human-robot interactions. This has advanced the uncanny valley hypothesis and helped understand how humans react to highly lifelike robots (Ackerman, 2011)



Figure 33. Sophia by Hanson Robotics

Source: https://alldus.com/blog/sophia-the-future-of-ai/

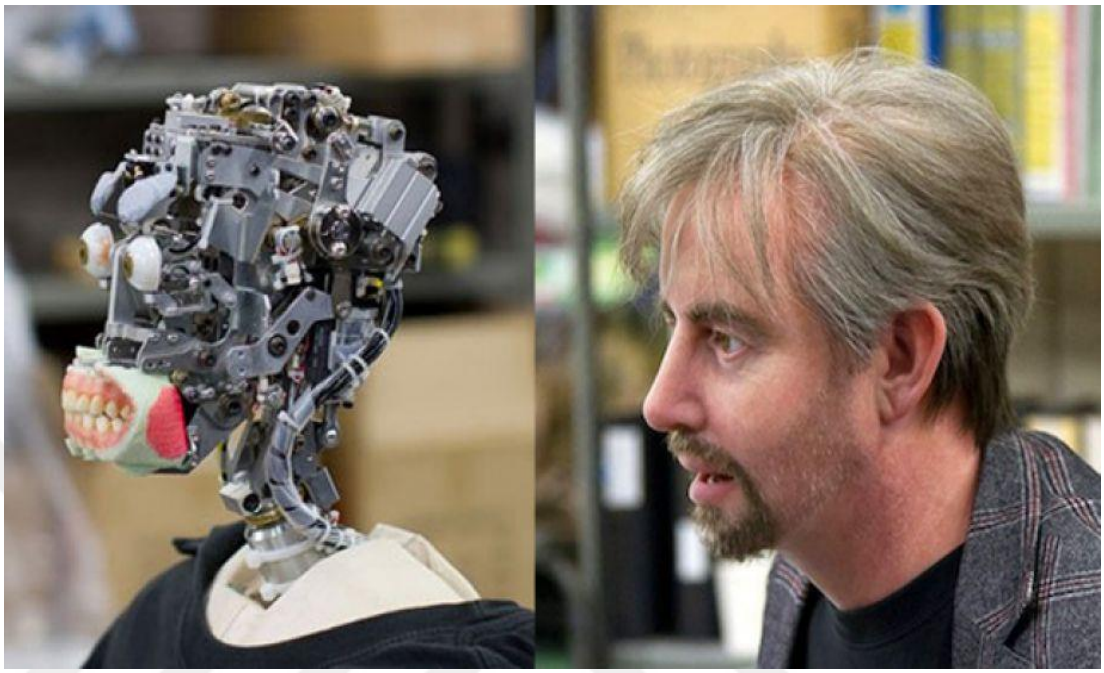


Figure 34. Geminoid DK by Hiroshi Ishiguro
Source: https://www.wevolver.com/specs/geminoid.dk

The Actroid humanoid model depicted in (Figure 35) was created in 2003 by Kokoro Company Ltd. in collaboration with Osaka University in Japan. The Actroid series of humanoids captures female androids that both look and act like women. They can perform life-like movements and expressions and are operated in many public and scientific domains (Yoshikawa et al., 2011, pp. 2378-2380). Moreover, Nadine, another female humanoid robot shown in (Figure 36) was developed in 2013 at Nanyang Technological University of Singapore. It was created to serve as a receptionist or companion (Vishwanath et al. 2019, p. 1). Her technical abilities were to recognize people, recall prior interactions, and express emotions along with the appropriate physical gestures. Being so lifelike in both appearance and social interactions, Nadine is another step forward in integrating humanoid robots into the daily lives of humans (Tian et al., 2017, p. 10).



Figure 35. The Actroid Model by Kokoro Company Ltd

Source: https://www.kokoro-dreams.co.jp/english/rt_tokutyu/actroid/



Figure 36. Nadine by Nanyang Technological University, Singapore

Source: https://www.miralab.ch/index.php/nadine-social-robot/

Furthermore, ASIMO (Advanced Step in Innovative Mobility) in 2000 by Honda in (Figure 37) and Robear by RIKEN and Sumitomo Riko Company Limited in 2015 (Figure 38), are examples of humanoid robots that have been developed without any realistic presence. However, each robot serves a certain unique purpose. ASIMO's movements, such as walking, running, and agility in climbing steps, make it one of the major achievements in robotics (Hirose and Ogawa, 2007, pp. 1-5). On the other hand, Robear was developed to aid in the lifting and repositioning of patients within healthcare environments. The Robear humanoid technology was developed to execute tireless operations (Dredge, 2015). The primary advancement of these robots was in the development of dynamic and self-governed movement.

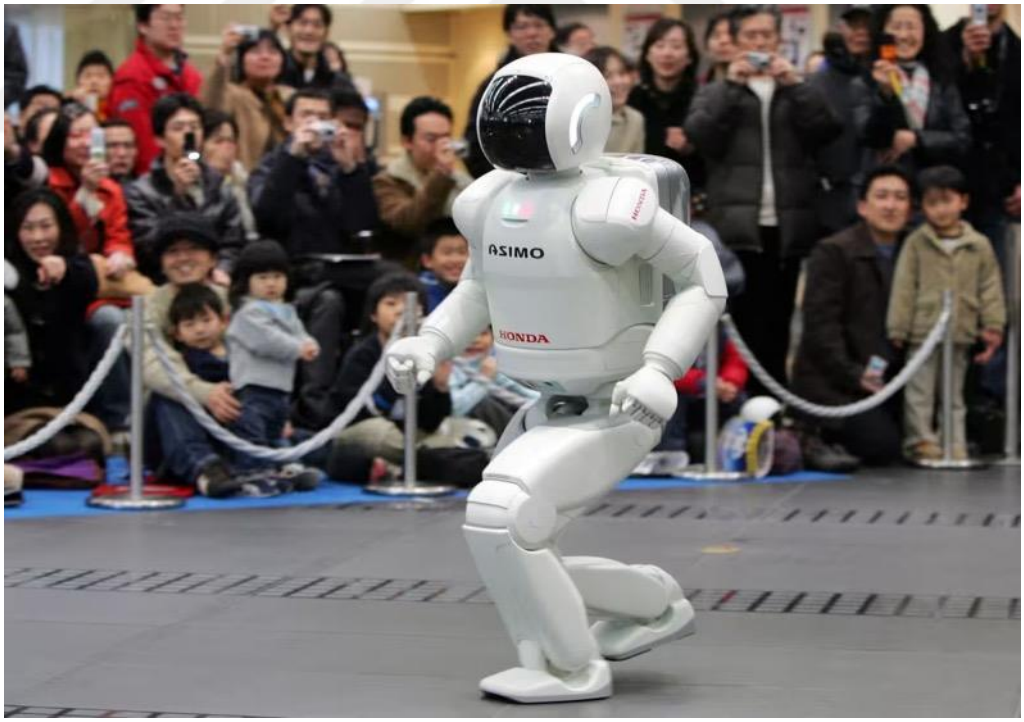


Figure 37. ASIMO by Honda

Source:https://asia.nikkei.com/Business/Companies/Honda-s-Asimo-robot-bows-out-but-finds-new-life



Figure 38. Robear by Riken-SRK Collaboration Center for Human-Interactive Robot Research

Source:https://www.theguardian.com/technology/2015/feb/27/robear-bear-shaped-nursing-care-robot

Lately, Ameca (2021), shown in (Figure 39) was created by Engineered Arts. Ameca is a humanoid robot developed to show realistic ranges of emotions through facial expressions. By using the AI technology, Ameca can hold natural conversations as well as copy multiple human emotions. Ameca comes among the top of the list in regards to the most developed humanoid robots, considering the expressiveness of the face and the ability to interact with humans (Schwarz and Hein, 2023, p. 4).



Figure 39. Ameca by Engineered Arts

Source:https://humanoidroboticstechnology.com/news/engineered-arts-secures-series-a-funding/

HRP-5P, as shown in (Figure 40) was developed by AIST (National Institute of Advanced Industrial Science and Technology, Japan) in 2018. It is known for performing complex tasks such as drywall installation and handling heavy items. HRP-5P also indicates that the feasibility of using humanoid robots for specific physically demanding production jobs in industrial environments (Lee, 2018). In 2021, Boston Dynamics introduced Atlas (Figure 41), a highly agile humanoid known for performing very intricate movements like running, backflipping, and jumping. Atlas demonstrates an unprecedented level of robotic mobility and balance, showcasing extraordinary range of physical capabilities in humanoid robotics (Roth, 2024).



Figure 40. HRP-5P by AIST (National Institute of Advanced Industrial Science and Technology, Japan)

Source:https://phys.org/news/2018-11-humanoid-robot-prototype-hrp-5p-capable.html

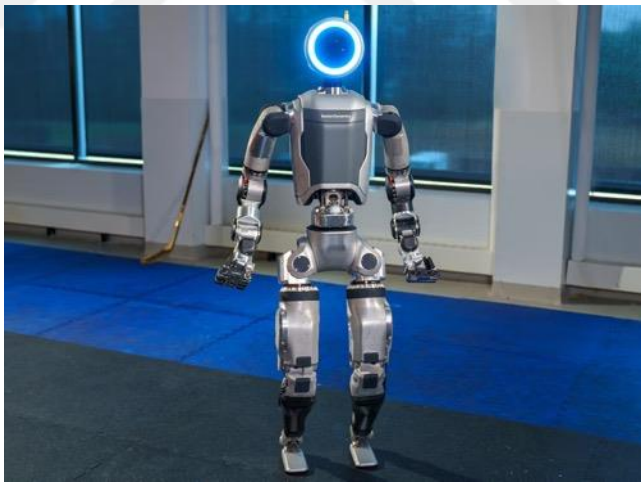


Figure 41. Atlas by Boston Dynamics

Source: https://robotsguide.com/robots/atlas

The development of these realistic and highly modern humanoid robots is making an expression to reduce the uncanny effect. The movements are more dynamic, fluid and responsive. The advancement of technology allows for even complex human-mimicking

actions to be performed effortlessly. Additionally, by making more appealing humanoid designs and upgrade the existing humanoid robot interface a better engaging experience can be provided when interacting with the humanoids. This involves the challenge of making the humanoids more practically useful while designing it in a way that resembles a human enough, and to not create feelings of discomfort when using them.

1.8. Technological Advancements

The new developments in digital technology, such as AI, prompt engineering, deepfake technology, and overall quality of CGI, have added new depth to the uncanny valley phenomenon. The realism of robots and digital avatars has improved significantly with the improvements of technology advancement which causes frequent encounters with the uncanny valley (Nightingale & Farid, 2022, p. 1). For example, the synthetic faces and voices created with AI have now reached levels that make determination difficult if they are real or artificial. This section will discuss the context of technological advancements.

1.8.1. Artificial Intelligence-based Art and Animation

The technology of AI is rapidly transforming the field of digital art, design, and animation film creation by increasing realism and bridging the gaps associated with the uncanny valley phenomenon. Advanced AI algorithms are employed that are capable of projecting human body motion, facial expressions, and visual features that is necessary to produce hyper-realistic characters and environments. AI-based generative art is produced by using several kinds of technologies, such as Generative Adversarial Networks (GANs) invented by the researcher Ian Goodfellow in 2014, Natural Language Processing (NLP), Deep Learning Algorithms, and Reinforcement Learning. Researchers suggests that the GANs neural network systems are used for the creation of realistic images and music (Goodfellow et al., 2014, p. 139). NLP is extensively used in the crafting of art, writing poetry, fictional stories, and scripts (Castellano & Vessio, 2021, p. 12266; Plate and Hutson,

2022, pp. 377-378). Also, the technology of reinforcement learning is used in interactive AI art installations, where the AI learns from user activity in order to modify the art installation. Besides this, there are numerous easy to use AI platforms such as DALL-E 2, MidJourney, Adobe Firefly, Leonardo AI, Pixlr, NightCafe AI, Stability AI, and Jasper Art have text-to-image generators that are able to imitate different styles of paintings (Blockchain Council, 2024).

One of the most distinguished AI-generated artworks is of "Edmond de Belamy" shown in (Figure 42) which was sold for 432,500 USD at a Christie's auction event in 2018. The artwork portrays a blurred and dreamy-looking figure, depicting aristocrats during the 18th century (Still and d'Inverno, 2020, p. 257). The Paris-based art collective Obvious created the portrait using GAN technology. The AI that generated "Edmond de Belamy" portrait was trained with an extensive dataset containing 6 centuries worth of artwork. The dataset included pieces from differing eras, styles, and artists, enabling the AI to assimilate various skills and methods specific to a particular period of art (Goenaga, 2020).



Figure 42. "Edmond de Belamy" (2018) by Obvious

Source: https://obvious-art.com/portfolio/edmond-de-belamy/



Figure 43. "The Next Rembrandt" (2016) by J. Walter Thompson
Source:https://news.artnet.com/art-world/new-rembrandt-through-data-analysis-466517



Figure 44. "Memories of Passersby I" (2019) by Mario Klingemann
Source:https://www.sothebys.com/en/auctions/ecatalogue/2019/contemporary-art-day-auction-l19021/lot.109.html

A.I. works such as “The Next Rembrandt” (2016) which is depicted in (Figure 43), by J. Walter Thompson (Westhoff, 2020), “Faceless Portraits Transcending Time” (2018) by Aican and Ahmed Elgammalin (Kalın, 2023) and “Memories of Passersby I” (2019) shown in (Figure 44) by Mario Klingemann (Sothebys, 2024) are showing possibilities for the future of generative art. Regarding the visualizations of A.I. centered animations, Refik Anadol’s A.I. generated works are the first in such visualizations, as they conceptually and practically combine machine learning and immense data sets to generate rich, captivating environments that transform data into beautiful fluid motion and redefine the scope of digital art and interactive installations (Anadol, 2022). Anadol’s works encompass AI, immersion and interactivity in an action. This is showcased in an instalation videos such as: Melted Memories (2018) shown in (Figure 45), Infinity Room (2015), Machine Hallucination (2019), Quantum Memories (2020) shown in (Figure 46), which have exemplified and recognized AI based simulations as a visual art experience (Willis, 2022, pp. 188-195).



Figure 45. “Melting Memories” (2018) by Refik Anadol
Source: https://refikanadol.com/works/melting-memories/



Figure 46. "Quantum Memories" (2020) by Refik Anadol
Source: https://refikanadol.com/works/quantummemories/

When it comes to 3D animation films, the uses of A.I are numerous. In the context of motion picture, it frees up the animator's time from other production process such as creating character realism, rendering optimization, adding special effects. As some parts of these steps are now automated. Hence, the most amount of time can be given to creative storytelling rather than doing the tedious work. Moreover, in many films, motion capture animations, simulations of natural phenomena such as water, fire, trees, and even writing scripts are created with AI-based algorithms. With this fast-paced growth of AI technologies, there are possibilities to uncover new aspects in 3D animation technology, which will result in even more advanced-looking visual films (Li et al., 2023, p. 34). AI-based automation tools were used in the production of "Next Gen" (2018), "Spider-Man: Into the Spider-Verse" (2018) shown in (Figure 47) and "Spies in Disguise" (2019) as additional methods to improve the processes of animation creation. Such tools are used to minimize the amount of time spent on working on the more monotonous and repetitive aspects of animation while maximizing the creativity (Davignon and St. Clair, 2023, pp. 1-2). Lastly, AI technology is also used to generate procedural animation techniques for generating complex crowd scenes such as in a

war form an epic film or adding environmental details such as a forest (Henshall et al., 2015, p.1).



Figure 47. Production still from **“**Spider-Man: Into the Spider-Verse” (2018) by Bob Persichetti, Peter Ramsey and Rodney Rothman
Source:https://www.toonboom.com/behind-the-amazing-2dfx-in-spider-man-across-the-spider-verse

1.8.2. Prompt Engineering

Prompt engineering refers to the curation and enhancement of the “input or prompts” issued to an AI in order to obtain a required output. This is important with respect to larger language models because there is a significant correlation between the input provided and the relevance, coherence, and overall usefulness of the AI’s response (Zhou et al., 2022, p.1). In the case of AI-based characters or avatars creation that interact with humans, both the uncanny valley and the prompt engineering intersect (Jiang et al., 2023, pp. 1-7)

Prompt engineering aims to facilitate the user interaction experience with AI systems by making it as effortless as possible. AI systems that use human voice assistance enhances the quality issue of user experience because of the human-like audible appearance, which

narrowly reduces the uncanny valley phenomenon (Mathur and Reichling, 2016, p. 2). Furthermore, prompts that are poorly written and not carefully designed can result in text that could develop the feeling of eeriness. Promptography techniques are also used by several artists. In this technique, AI text prompts are blended with photography to generate images. AI artist Boris Eldagsen were produced many of his works with the help of AI and promptography. However, this style of creation of artwork provoked the debate on the authenticity between real and artificial art (TheOverview.Art, 2023; Coeckelbergh, 2023, pp. 6-7). His works have visual resemblance to those of photographer Helmar Lerski. Who mastered light and shadows to create evocative photographs. Boris Eldagsen's most famous AI artwork is "The Electrician" (2022) shown in (Figure 48). This relationship between AI and the artist brings to the forefront the question regarding creativity and how much control is needed by a human to ensure desirable results from AI. Visually, this represents a post-humanistic style.



Figure 48. "The Electrician" (2022) by Boris Eldagsen
Source:https://palmergallery.co.uk/artists/46-boris-eldagsen/works/48-boris-eldagsen-the-electrician-2022/

Techniques in prompt engineering, include the assigning of weights or using negative prompts. Advanced techniques, such as different algorithmic models, help to control the quality of the output. For example, giving the instruction that an image should not include “unrealistic” or “awkward” features. This will assist the AI in not creating images that can be classified as uncanny while still fulfilling the required aesthetic qualities (Lucas, 2023, p.4). Additionally, the iteration process of prompts is another useful aspect that allows artists to gradually enhance the resultant images. After receiving the outputs, if a prompt is refined and the visuals are adjusted, then an appealing image can be produced for a larger audience by reducing the discomfort usually related to the uncanny valley (Cotroneo and Hutson, 2023, pp. 6-10).

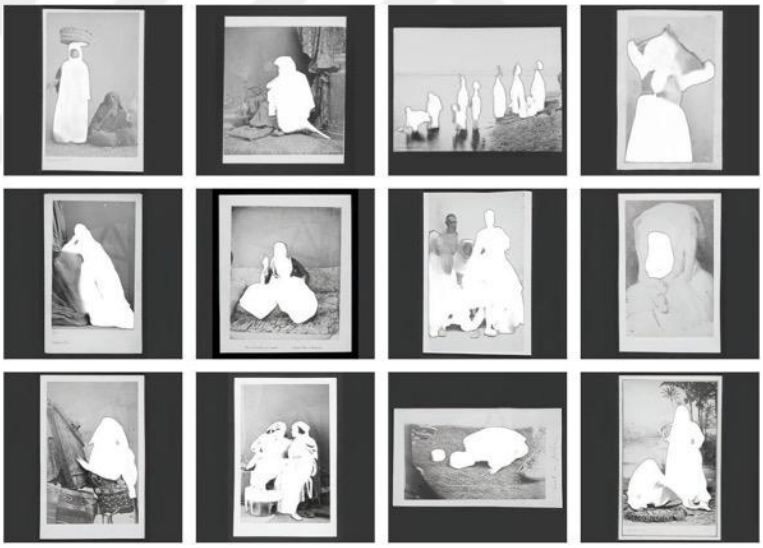


Figure 49. “Salaf, Ancestors” (2020) by Nouf Aljowaysir
Source: https://www.noufaljowaysir.com/thoughtworksai

Prompt engineering has also been used by artist Nouf Aljowaysir in an identity and cultural heritage discourses as illustrated in (Figure 49) (Palmer Gallery, 2024). In crafting prompts that capture their narratives, artists are able to recover stories by AI that are often erased, thus deepening the emotion in the art created and crossing the uncanny valley. In conclusion, as provided with advanced programs, artists and AI developers have to deal with

the challenge of creating vivid and engaging images that do not cross the borders of the uncanny valley. With precise prompting, refinement, and reiteration, prompt engineers are able to concentrate on the artistic goals that AI can pursue to deliver influential and beautiful works of art.

1.8.3. Deepfake Technology

Deepfake technology refers to the combination and collaboration of multiple artificial intelligence techniques to effectively fabricate and synthesize an individual's media representation in the form of images, audio, or videos. The term "deepfake" is a blend of "deep learning" a subtype of AI, and "fake" which distinctly labels the content as fraudulent (Singh et al., 2020, pp. 2-4). To create deepfakes, sophisticated techniques like generative adversarial networks in machine learning are employed to edit and create videos (Jalui et al., 2022, p. 1). In this technology, the AI system attempts to learn the face of the target individual along with voice patterns and other features. After the model is trained, it has the possibility to place the face of the target person in any given video or create a completely new video and make it seem like the target person is performing actions or speaking words that they never actually did (Patel et al., 2023, p. 22082).



Figure 50. Obama Deep Fake (with transferred facial emotions) by Jordan Peele
Source: https://ars.electronica.art/center/en/obama-deep-fake/

An example of a popular deepfake video includes a public service announcement that seems to be delivered by the former US president Barack Obama (Figure 50). In truth, this was a project created by filmmaker Jordan Peele to show how deepfakes can potentially be misused. Peele's voice and facial movements were used as the audio and visual, which were projected into deepfake technology (Vincent, 2018). This video serves as a reminder of how dangerous deepfake technology can be to online content and how easily misinformation can be spread. Another notable example is a deepfake video in which Facebook CEO Mark Zuckerberg is describing how he controls billions of people's stolen data, which was presented in (Figure 51). This was produced as part of an art piece by Bill Posters and Daniel Howe in association with the advertising firm Canny AI (Wong, 2019). This deepfake raised ethical questions of how people's perceptions of the public can be misled.



Figure 51. "Imagine this…" (Facebook CEO Mark Zuckerberg deepfake), 2019 by Canny AI
Source:https://billposters.ch/the-zuckerberg-deepfake-heard-around-the-world/

Deepfakes primarily raise a major concern because of the harm they can impose on individuals if they are misused. This technology has been digitally weaponised, allowing victims to be exploited in non-consensual pornographic images that could impose serious personal and reputational damage. However, to be believable, a deepfake should not only be visually realistic, but the context surrounding it should also be convincing. If the context is unusually realistic, then it will likely cause disbelief in the reality of the deepfake, thus falling in the uncanny valley of information, where the viewers can get discomforted by its authenticity.

1.8.4. Human Emulation in Artificial Intelligence

Human emulation in artificial intelligence (AI) is the attempt to replicate human thinking processes and its consciousness through the use of machines. This idea consists of different approaches, such as artificial general intelligence (AGI) or whole brain emulation, which try to build systems that go beyond behaviorism and actually have the ability to think and feel like the humans. AGI is the goal of building machine entities competent enough to execute any cognitive activity that a human being can perform (Eth, 2017, p. 1). Several experts in the field of AI have witnessed the evolution of AI over the last decade, still consider achieving AGI (Figure 52) to be intangible due to the challenges emerge from Moravec's paradox. Moravec's paradox states that intelligent actions that humans engage in on a daily basis, such as walking, face recognition, reasoning, sarcasm, instinctive reactions, and adaptability according to situation, tend to be enormously difficult for AI technology to accopmlish (Pampillo, 2024). AI systems have their best performance in narrow tasks; however, the lack of capacity to rationalize information across different sectors makes them fail at human levels of adaptability (Koene, 2012).



Figure 52. Artificial General Intelligence (AGI)
Source:https://www.linkedin.com/pulse/artificial-general-intelligence-agi-definitions-path-yuri-90aye

AI programs such as Lyrebird can raise concerns for a misuse of impersonation as it is able to simulate dialogues among famous people talking to each other (Rutschman, 2019). Speech replication is another area of AI technology that can extend to extraordinary genuineness. A person's voice can be used to create realistic audio replicas just by using the original source. Moreover, Google's AI program (Figure 53) allows users to play alongside a virtual version of the famous composer Johann Sebastian Bach and create music with him by entering certain proportions and having him compose the melodies (Vincent, 2019). This demonstrates AI's ability to transcend human boundaries of creativity by raising the question about the authenticity.



Figure 53. Celebrating Johann Sebastian Bach

Source: https://doodles.google/doodle/celebrating-johann-sebastian-bach/

Lastly, those AI models created by businesses such as OpenAI can draft text that simulates nearly close to human writing styles, speech generations, email answering, or writing for creative works (Nython, 2024). This gives rise to issues related to new authorship and the possibility of spreading misinformation because the speech, or any literary text for that matter, can be perfectly indistinguishable from what a person would write with responsibility. Hence, integration of AGI in tasks where AI is in use could open up infinite possibilities where no human intervention will be needed to solve a problem.

1.9. Posthumanist Future

A posthumanist future concept is often understood as humanity's attempt to surpass its biological forms and extend the intellectual boundaries through the use of advanced technology and AI. It is a speculative consideration of what the life would look like in the future (Holm, 2016, pp. 131-133). This theory is connected with the philosophy of posthumanism, which defines humans as the central figures in the universe and analyzes ways that humans may transform into other forms of existence (Neubauer, 2021, p. 1).

The ideas of posthumanist philosophy revolve around technology and its impact on the human identity and society. Donna J. Haraway's "Manifesto Cyborg" (Figure 54) outlines the cyborg as an analogy for dismantling the traditional aspects of human versus machine, culture versus nature, and even reality versus fiction (Cutting, 2019). From her works, it has become increasingly easier to challenge the rigid dualisms that have defined male dominence and objectification by using cyborg metaphor in the context of masculine hierarchy of observation and control (Haraway, 2016, p. 33).

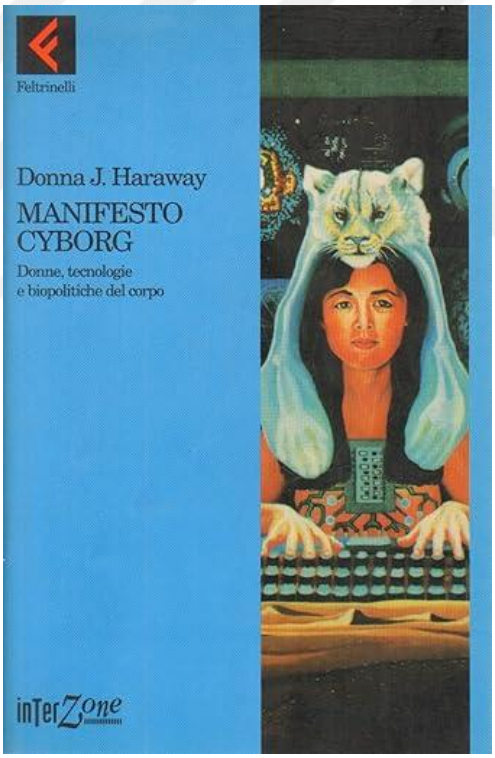


Figure 54. "Manifesto Cyborg" by Donna Haraway's
Source:https://www.goodreads.com/book/show/7420442-manifesto-cyborg

N. Katherine Hayles focuses mostly through the scope of information technology and virtual reality that cultural and technological advancements have made possible of what is referred to as the posthuman condition in "How We Become Posthuman" (Figure 55). These AI developments, challenges the traditional notions of identity and embodiment. Hayles

seeks to answer many questions in her analysis, which include what it is to be human in a hyper-real and increasingly digital world (Tambling, 2022, p. 144). Meanwhile, Rosi Braidotti in "The Posthuman" (Figure 56), discusses the politics and ethics of posthumanism and argues for the importance of more responsibly dealing with the relations between humans and non-humans. Braidotti encourages the realization of the interconnectedness of life forms as well as environment, which returns to a call for a more responsible and reasonable embedding with technological and ecological systems (Shaw, 2015). Collectively, these works add to the complexity of understanding posthumanism, putting back into question what it means to be human in an evolving technology.

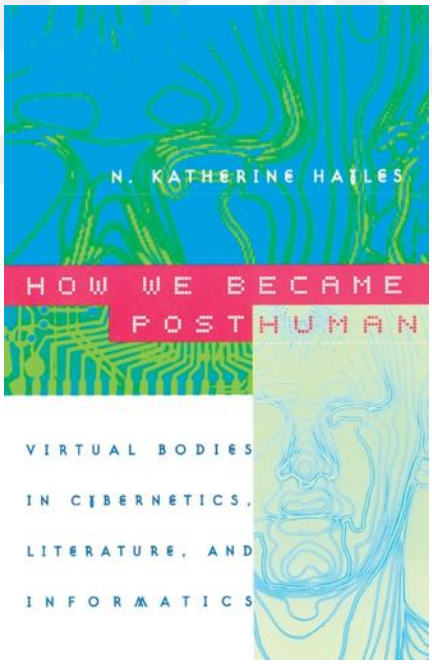


Figure 55. "How We Became Posthuman" by N. Katherine Hayles

Source: https://press.uchicago.edu/ucp/books/book/chicago/H/bo3769963.html

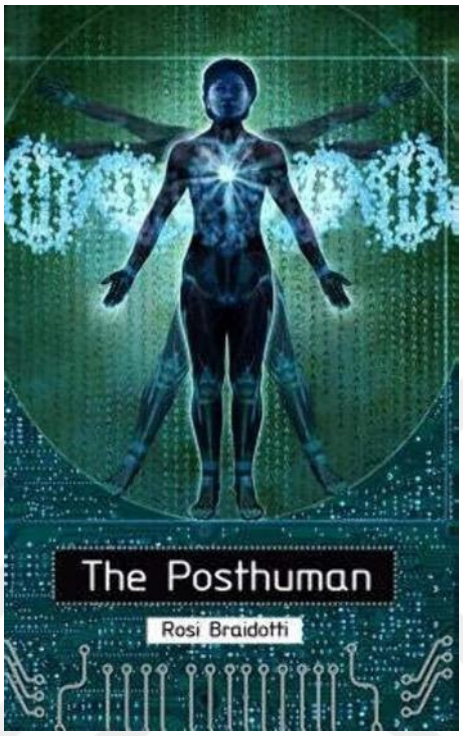


Figure 56. "The Posthuman" by Rosi Braidotti's

Source: https://www.amazon.com.tr/Posthuman-Rosi-Braidotti/dp/074564158X

As discussed before, the posthumanist idea theorizes that with advanced technologies humans may develop biological hybrids that can elicit an uncanny reaction. Enhanced humans or AI-powered avatars, for instance, may possess unsettling and human-like traits with perfect impersonations (Wang et al., 2015, p. 394). The progress in technology, including prostheses and bionics, facilitated the design of artificial limbs and devices that may be controlled by using the brain of the physically challenged, thus restoring mobility, functioning, and other complex activities (Farina et al., 2021, pp. 473-474). These systems often include sensors and actuators that reproduce the motion of a healthy limb to enhance the user's functionality and increase the ease of use.

Moreover, Brain-Computer Interfaces (BCIs) depicted in (Figure 57) are an extremely advanced technology that allows the brain to communicate directly with external

devices. BCIs allow people to control computers, prosthetic limbs, and other devices simply by interpreting their thoughts (Isa et al., 2009, pp. 1-4). Unlike traditional prosthetic limbs, which rely on cables, levers, and pulleys. BCIs have the ability to completely transform interaction for people with neurological disorders and remotely enhance cognitive abilities (Riccio et al., 2016, pp. 368-369). Through the integration of humans and machines, the independence of users can be greatly increased, thus enhancing their overall quality of life.



Figure 57. Brain-Computer Interfaces (BCIs)
Source:https://www.sify.com/science-tech/mind-meld-brain-computer-interfaces-unlock-the-future-2024-and-beyond/

The posthumanist future contemplates the integration of human and machine to deepen the emergence of Cyborg and Hybrid identities. The word cyborg is a blend of the terms “cybernetic” and “organism,” and refers to beings with biomechatronic and organic bodies (Song, 2012). The term cybernetic was first familiarized by Norbert Wiener in the year 1948 with his work Cybernetics: Or Control and Communication in the Animal and the Machine. Cybernetics is a primary discipline integrating fields such as biology, technology, and information science, including everything from artificial intelligence to the workings of the human mind and machine intelligence (Wiener, 1948, p.14).

The term Cyborg was first used by Manfred Clynes and Nathan S. Kline in their research paper Cyborgs and Space published in 1960 (Madrigal, 2010). A notable case of the first cyborg in the world who was legally granted the status is Neil Harbisson (Figure 58). Harbisson suffers from a condition known as achromatopsia that makes him fully colorblind. Achromatopsia is a medical disorder characterized by the complete or partial absence of color vision. In its most severe form, the affected person can only see black and white or shades of grey. Defying the odds, he partnered up with a technologist, Adam Montandon, in 2004 to build an antenna that enables him to translate colors into sounds (Trojanovsky, 2024). His device uses a sensor that 'sees' the colors by using a color wheel placed in front of him. It measures the frequency of the colors and then converts them into sound vibrations. These vibrations are directly heard through his skull by a process called bone conduction. This means Harbisson is capable of 'hearing' colors as musical notes or vibrations, allowing him to extend his sense of perception.



Figure 58. Neil Harbisson

Source: https://www.aurumbureau.com/speaker/neil-harbisson/

Similarly, Jesse Sullivan's work demonstrates how the integration of humans and machines can push the boundaries of technology by the modern advancements in prosthetics. Sullivan, a bionic man (Figure 59), was a candidate for a thought-controlled prosthetic arm

made by the Rehabilitation Institute of Chicago. After he lost both arms in an electrical accident, he pioneered in the field of advanced prosthetic technology. Sullivan's prosthetic arm uses a Targeted Muscle Reinnervation (TMR) controlled by the nerves to the remaining muscles (Sachin, 2014, p. 30). By the use of this technology of muscle signaling, Sullivan is able to control the arm using sensors on the prosthetic. This is a notable progress in prosthetics because users are now able to move limbs without changing their position, which greatly improves their lifestyle and proves how robotics can coordinate with the human nervous system (Chopra and Emran, 2024, p. 4539).



Figure 59. Jesse Sullivan in prosthetic arm system
Source:https://www.jhuapl.edu/news/news-releases/070426-revolutionizing-prosthetics-2009-team-delivers-first-darpa-limb-prototype

The idea of a posthumanist future is often portrayed in films as well. The Japanese animated film "Ghost in the Shell" (1995), depicted in (Figure 60), presents a scenario where cybernetic features make it impossible to distinguish between humans and machines. The protagonist, Major Motoko Kusanagi, a full prosthetic body cyborg between consciousness

and reality, constantly doubts the nature of identity in a post-human world (McMillan, 2021, pp. 22-111).



Figure 60. "Ghost in the Shell" (1995) by Mamoru Oshii

Source: https://www.imdb.com/title/tt0113568/

Another example is director Ridley Scott's "Blade Runner" (1982) depicted in (Figure 61). This is an important cult film blending film noir with futuristic design. This films premise is adapted from Philip K. Dick's science fiction novel "Do Androids Dream of Electric Sheep?". This film shows a dystopian future in which bioengineered humans are referred to as replicants and are almost indistinguishable from real humans. The replicants challenge the limits of humanity by embodying human dilemmas of death, memory, identity and belongingness. The film poses a deep moral dilemma regarding artificial intelligence and the issue of making self-aware creatures, thus redefining humanity (Jeffries, 2023). Moreover, in the Netflix series "Altered Carbon" (2018) presented in (Figure 62) and based on Richard K. Morgan's novel, it is observed that the human mind transcends its body, which

biologically gives the illusion of immortality. This scrutiny of identity in a world of technology reveals the intricacies of a posthumanist reality (Flood, 2018).



Figure 61. "Blade Runner" (1982) by Ridley Scott

Source: https://www.imdb.com/title/tt0083658/

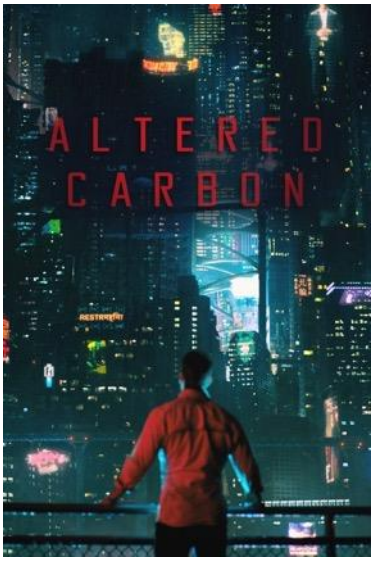


Figure 62. "Altered Carbon" (2018) by Miguel Sapochnik and Uta Briesewitz

Source: https://www.rottentomatoes.com/tv/altered_carbon/s01

In the sci-fi action film “The Matrix” (1999), as shown in (Figure 63), humankind is portrayed as blissfully coexisting with intelligent machines. While in reality, humans are enslaved in a simulated universe. This film examines the concepts of liberation and self-exploration by portraying the impressions of a posthuman world (Chan, 2008). Also, the video game series “Deus Ex” (2000), seen in (Figure 64), examines a dystopian world filled and overridden by human augments and the cultural, moral, and political consequences of enhanced human beings, along with the ethical problems. (Attari and Atashi, 2017, p. 2-8).



Figure 63. “The Matrix” (1999) by Lana Wachowski and Lilly Wachowski

Source: https://www.imdb.com/title/tt0133093/



Figure 64. "Deus Ex" (2000) by Ion Storm

Source: https://emertainmentmonthly.org/2024/01/18/deus-ex-aging-like-fine-wine/

Lastly, the sci-fi romantic drama film "Her" (2013) shown in (Figure 65) looks at a world where AI is capable of forming emotional attachments with humans. This presents a lonely man falling is love with Operating System (OS) name Samantha. This brings the question of love, intimacy, and how techno-humanism redefines human relationships (Murphy, 2017). A year after, a sci-fi psycological thriller film "Ex Machina" (2014), shown in (Figure 66), focuses on the development of a highly advanced humanoid robot and the socio-ethical consequences of having artificial consciousness and the implications of power between humans and intelligent machines (Dai, 2024, pp. 9-12).

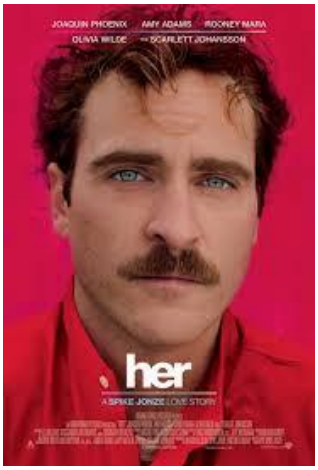


Figure 65. "Her" (2013) by Spike Jonze

Source:https://www.imdb.com/title/tt1798709/

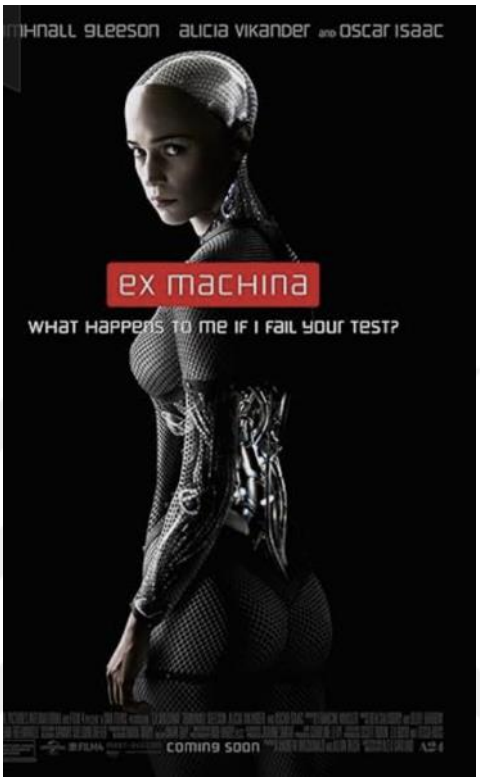


Figure 66. "Ex Machina" (2014) by Alex Garland
Source:https://www.imdb.com/title/tt0470752/?ref_=tt_mv_close

Overall, all these examples show different possibilities of the posthumanist future. The interpretations bring arguements about how technological advancements can transform the very essence of humanity, identity, and consciousness. Films, humanoid cyborgs, and hybrid identities, as well as transhumanism achievements, serve as an example by which the posthumanist future can be understood. These advancements are indications to the astonishing achievements that contemporary science and technology are capable of producing. However, this also raise the fundamental question about the fusion of human with machine in relation to the uncanny valley phenomenon.

CHAPTER II

UNCANNY VALLEY IN ANIMATION FILMS AND DIGITAL GAMES

2. CHAPTER

2.1. Uncanny Valley in Animation Films

2.1.1. Golden Age: Early Animation (1920s-1930s)

A distinctive period within the history of animation films is marked by “The Golden Age of Animation”, which began in the 1920s and lasted until the 1930s. Rapid technological development, the establishment of animation studios and famous characters, along with the wider acceptance of animation as a form of entertainment, epitomize this time period. This period served as a basis upon which animation was accepted as a popular form of art and entertainment (Wells, 2014, p. 58).

During this time significant contributions were made in animations from several countries. Early Soviet animation was inspired by Disney, but because of the state policy in the late 1930s, the themes were switched to socialist patriotism rather than only entertainment. Similarly, France has had a long-standing tradition of animation since the middle of the 19th century. Its notable pioneers include Émile Cohl with his film Fantasmagorie (1908). This is regarded as one of the first cartoon animation. Moreover, Anime or Japanese animation started from the influences of Western animation in the early 20th century but came into its distinct identity after World War II (Pikkov, 2016, pp. 7, 16; Boas & Maher, 2020).

2.1.1.1. Technological Limitations and Animation Techniques

Technological limitations have always been existed since the begining of animation. The Golden Age of Animation had significant technological limitations for classical animators to work with; however, it also laid a foundation for modern techniques, which serve as the backbone for present-day animation. The most well-known limitation of these was the extensive labor that was required for creating animation. In order to create one short

animation film, thousands of images had to be drawn, and animation sequences that were long and complex were often not feasible (Liu, 2023, p. 17).

Moreover, most animation films produced during this time were in black and white and therefore lacked the visual appeal as well as captivating storytelling when compared to the animated works produced later on (Wu, 2023, pp. 35-37). Early animation films also lacked synchronized sound, which made it nearly impossible to implement dialogue and sound effects without the animation being out of sync (Beauchamp, 2005, pp. 17, 29). The first step towards achieving synchronized sound was taken in Disney's "Steamboat Willie" (Figure 67), which required expensive technological efforts to ensure proper synchronization. Furthermore, animators had to rely on drawing-based techniques to create special effects, which greatly limited their imagination when it came to things like smoke, water, rain, glow, beam, mist, wind, and explosion (Jackson, 2012, pp. 211-213).



Figure 67. "Steamboat Willie" (1928) by Walt Disney Studio
Source: https://disney.fandom.com/wiki/Steamboat_Willie

To overcome with these drawbacks in the quest for creative freedom, animators came up with responsive, innovative techniques that evolved the art of animation. One of the most

important techniques was cel animation (Figure 68), which used transparent sheets called cels or celluloids upon which characters and objects were drawn. The animators changed only the moving parts of the animation between frames, these cels were placed above static backgrounds to create the motions. This approach enabled more complex character and background animation. It made animation efficient as well as increased the detail level in the character's complexity and the background's depth (Petrović et al., 2000, pp. 1-2). Another technique, rotoscoping (Figure 69), was developed by Max Fleischer in which he used live-action footage and traced it part by part in order to give the animated objects real-life motion. This provided the animators a way to capture more animated movement of actual models, making the character's animation more lifelike and expressive. Which was seen in Fleisher's works such as "Betty Boop" (1930) and "Gulliver's Travels" (1939) (Jonison & Trisnadoli, 2020, p. 1; Alessi, 2023).

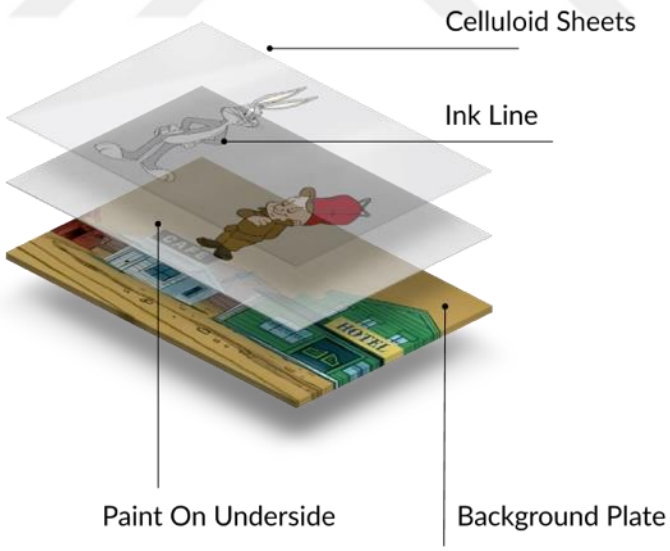


Figure 68. Cel animation

Source: https://octaneseating.com/blog/animation-and-cartoons/



Figure 69. Rotoscoping

Source: https://tvtropes.org/pmwiki/pmwiki.php/Main/Rotoscoping

Another production technique, the multiplane camera (Figure 70) was a revolutionary setup that allowed animators to position multiple cels and backgrounds at different distances from the camera and animate them simultaneously. This gave the background and foreground the ability to move relative to the camera, creating a feeling of depth in animated scenes. This method was applied in animations for Disney's "Snow White and the Seven Dwarfs" (1937) to give the film its unique life-like quality (Gowanlock, 2021, p. 178). Animators also practiced the squash and stretch approach, which comprised exaggeration of movements and forms on drawn animated characters to portray the character's weight, emotions, and personality. This later became an important principle of animation for graceful motion and

expression of characters as shown in the works of legendary animation artists such as Tex Avery and Chuck Jones (Ibrahim, 2017, p. 2; Kwon & Lee, 2009, p. 1).

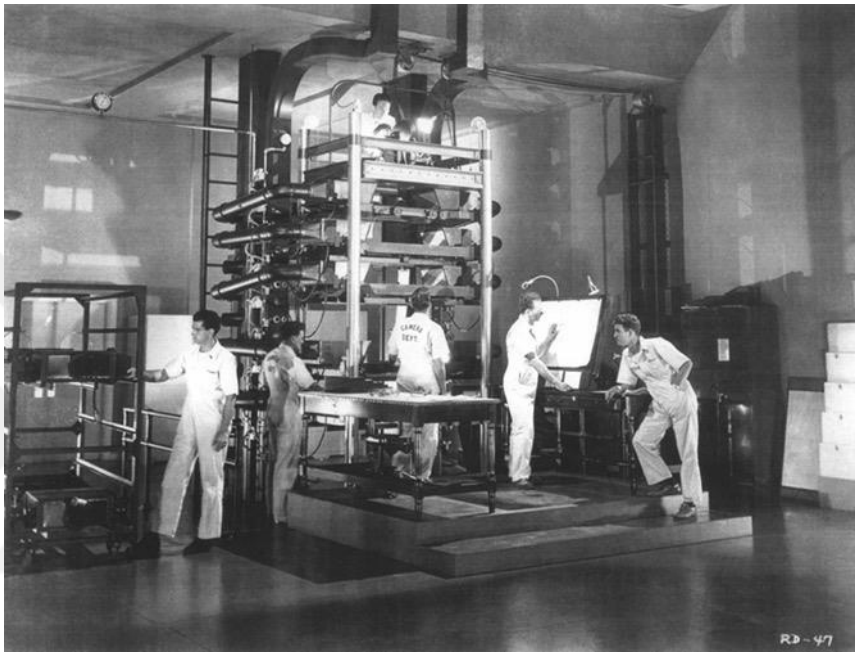


Figure 70. Multiplane camera technique "Snow White and the Seven Dwarfs" (1937) by Walt Disney Productions

Source: https://addc403fall2016.wordpress.com/2016/10/01/the-multiplane-camera-in-disneys-1937-snow-white/

Another important technique, known as the cycle or loop animation, was developed at this period in order to deal with production constraints. It involved repetition of a series of frames to illustrate continuous action, such as walking or running. This practice made it possible for animators to perform repetitive motions without drawing each frame individually everytime. Therefore, conserving resources and time whilst achieving fluid motion (Pierson, 2019, p. 50). Similarly, early animations were also known for a style known as "rubber hose" animation (Figure 71), which had characters having limbs shaped like tubes and moved in

elastic and bouncy style. It gave freedom and exaggeration in movement as seen in early Disney and Fleischer cartoons, which made the characters playfully animated and full of charm (Muharam & Sidli, 2020, pp. 577-579).

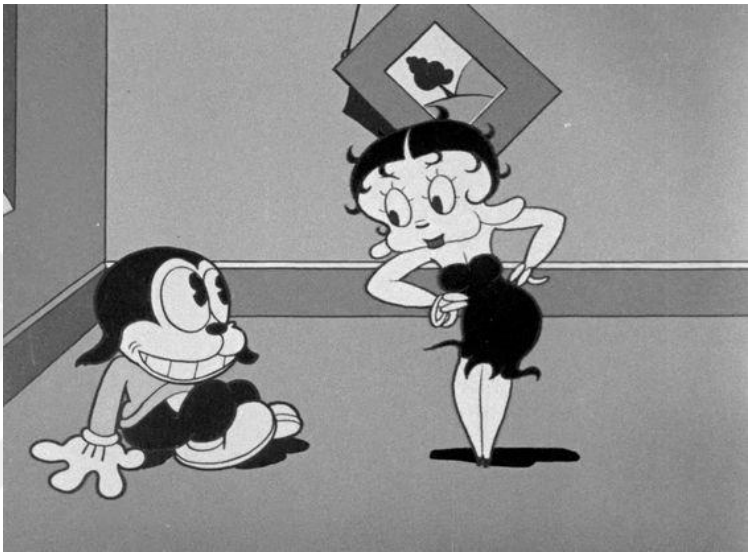


Figure 71. Rubber Hose Animation Technique, “Betty Boop” (1931) by Dave Fleischer

Source: https://blog.displate.com/rubber-hose-animation/

All of these technological setbacks led to the creation of innovative methods that changed the animation style and the storytelling techniques that defined the Golden Age. These limitations were surpassed by the animators, thus providing the fundamentals of the evolution that animation underwent and laying the foundation for making it the sophisticated art form it is today. The innovative ideas born out of artistry during this time still serve as a major source of motivation for modern-day animation filmmakers and indicate the siginifance of the Golden Age of early animation.

2.1.1.2. Unrealistic Features and Exaggeration of Characters

During the Golden Age of animation, 2D animation artists incorporated exaggerated and unrealistic traits into their designed fictional characters, making them easier to recall because of how appealing personalities. The incorporation of the “rubber hose” animation method for flexible arms and legs in the shape of tubes which was mentioned earlier also added exaggeration elements to the characters. This was showcased in Mickey Mouse from Disney’s “Steamboat Willie” (1928). This technique enabled the character to move exquisitely and effortlessly, allowing for free-spirited motion that accentuated the joy and humor incorporated in the animations (Muharam & Sidli, 2020, p. 578). Likewise, several other characters were made to have exaggerated features such as large round eyes, and other facial details, in order to make them more beautiful and appealing like Pat Sullivan’s and Otto Messmer’s “Felix the Cat” (1919) shown in (Figure 72), who fascinated viewers using his large and vibrant eyes alongside other facial features that exhibited playful and coquettish attributes (Felizrante.com, 2024).



Figure 72. “Felix the Cat” (1919) by Pat Sullivan and Otto Messmer

Source: https://canadabayheritage.asn.au/felix-the-cat/

Overemphasized facial gestures became the definition of early animation since it could be used to increase the intensity of the emotional expression (Mäkäräinen et. al, 2014, p. 710). Characters like Bugs Bunny and Daffy Duck from the cartoon series “Looney Tunes” (1930-1969), presented in (Figure 73), had highly exaggerated facial gestures to boost the humor and resolve the emotional clarity (Weinman, 2022). The use of the squash and stretch method was the main constituent of animation, which made it possible for the characters to undergo intense changes in shape and position to give an illusion of active movement, thus, depicting weight and force (Ibrahim, 2017, p. 2). This is notably portrayed in “Popeye the Sailor” (Figure 74), where the character Popeye is shown with bulging, stretched muscles after he eats spinach, which defines his extraordinary strength (Oscar, 2025).

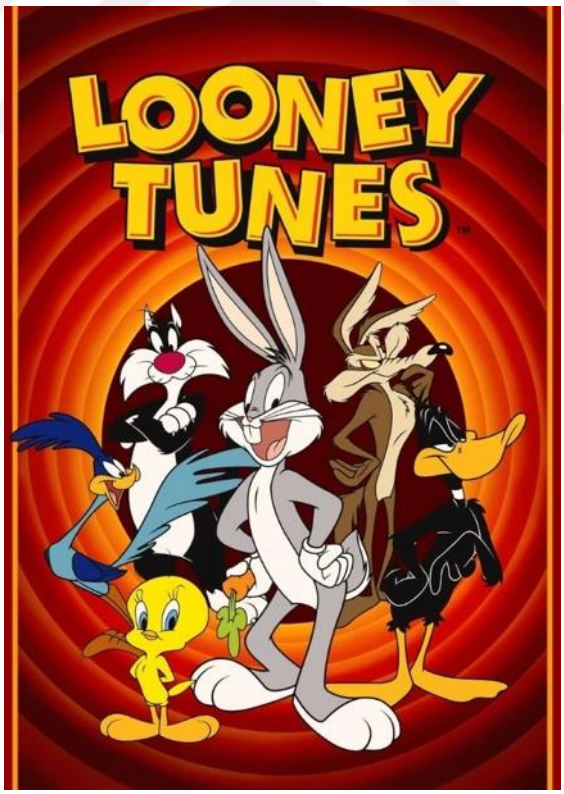


Figure 73. “Looney Tunes” (1930 - 1969) by Warner Bros. Entertainment

Source: https://dubdb.fandom.com/wiki/Looney_Tunes



Figure 74. "Popeye the Sailor" (1933) by Max Fleischer
Source: https://navycrow.com/4-things-you-didnt-know-about-popeye/

Along with this, anthropomorphic art became widespread as the animation industry sought to draw in audiences by giving animals human traits and making them fantastical at the same time (Holliday, 2016, p. 247). In this context, the cartoon character of Donald Duck becomes an early unique example in Disney's characters, for an animal that possesses human attributes and emotions, which makes him appealing to the audience. Another common type of exaggeration was the use of comedy in physical nature, where characters did slapstick activities in an overdone manner that defied the laws of physics, as in Tom and Jerry (Figure 75), where the characters seem to go through unimaginable changes and distortion for humorous purposes (Islam et al., 2021, p. 67)

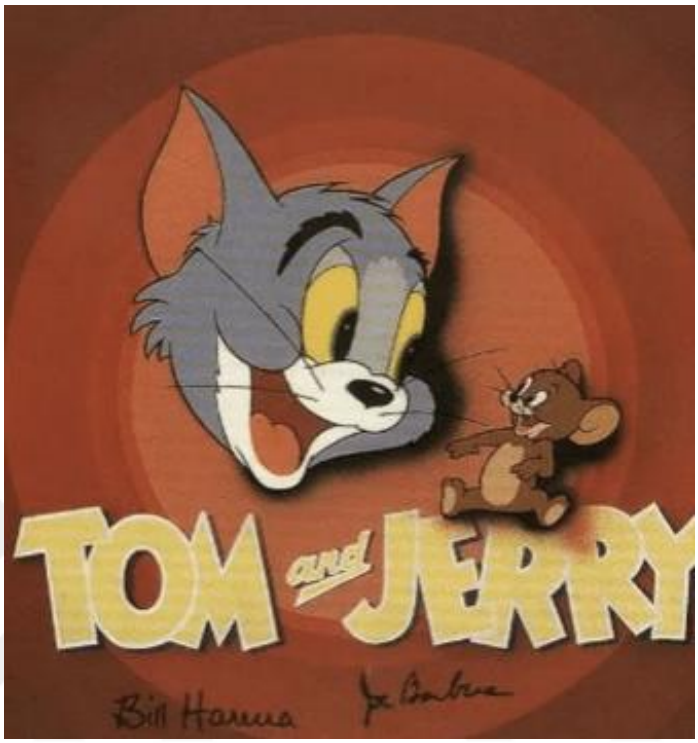


Figure 75. "Tom and Jerry" (1940) by William Hanna and Joseph Barbera
Source:https://medium.com/@KashifTurab_/the-unforgettable-tom-and-jerry-d0734f256c9f

Moreover, the use of caricature and satire facilitated a great importance in creating exaggeration in character designs by adding a specific cultural stereotype or a bold figure (Das, 2019, pp. 9-10). As an example, in Disney's "The Three Little Pigs" (1933) shown in (Figure 76), the Big Bad Wolf character is adorned with features such as sneaky demeanor, oversized ears, sharp claws, and large teeth to make him a ridiculous villain. The ability to incorporate unrealistic traits and over the bound features gave animators advanced freedom to create the most amusing characters that broadened the industry's imagination, capturing people's laughter and affection. The character design style played such an important role in exaggeration that it is regularly revisited in contemporary animation today, making character design timeless and spacious for all ages to enjoy.



Figure 76. "The Three Little Pigs" (1933) by Walt Disney

Source:https://disney.fandom.com/wiki/Three_Little_Pigs_(film)?file=3LPreis1.jpg

2.1.2. Technological Advances in Animation (1940s-1960s)

From the 1940s to the 1960s, the animation industry implemented new technologies that greatly improved the quality of audio and visuals used in animation films. One of the most impactful innovations was the adoption of Technicolor, a color filming process that enabled the use of vibrant, bright colors on screen (Fiveable, 2024). Although the technology of Technicolor was developed in 1932, it became widespread after the 1940s and was best showcased by Disney's "Fantasia" (1940), displayed in (Figure 77), which used this technology to fascinate audiences with new standards of animated visual spectacles (Schwark, 2012, p. 1).

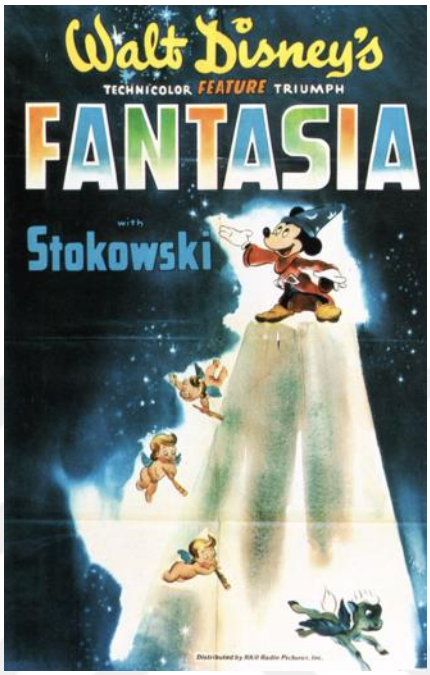


Figure 77. "Fantasia" (1940) by Walt Disney Productions

Source:https://www.imdb.com/title/tt0032455/mediaviewer/rm3702287872/?ref_=tt_ov_i

Another important advanced technique is Rotoscoping animation that became widespread during this time. This method involved tracing over live-action video footage to produce animated sequences, allowing for more human-like smooth action (Pierson, 2019). During the 1940s, more realistic portrayals of people and animals were made possible by the heavy use of rotoscoping technology. The use of this technique helped to increase the level of complexity and fluidity in animation characters' storytelling. Thus, making te animation details highly realistic and consistent.

In this era there were pioneering developments in the use of the multiplane camera (Figure 78). This camera was developed by Disney in the late 1930s and was popularly utilized in the 1940s. Unlike previous techniques, the multiplane camera lets the animators

create depth in visuals by filming through several layers of artwork placed at various distances from the camera (Telotte, 2006, p. 16). This gives the images a more three-dimensional appearance. The cel process transparent sheets of nitrate is used so that the drawings can be superimposed on the top of a painted background, which was necessary in order to create a spatially believable world. This technique was used in the Disney animation film “Bambi” (Figure 79), produced in 1942 (Riffel, 2012). This film features a vegetated forest setting with amazing depth and realism. The use of the multiplane camera transformed the visual richness of animated films by allowing elaborated and captivating backgrounds.

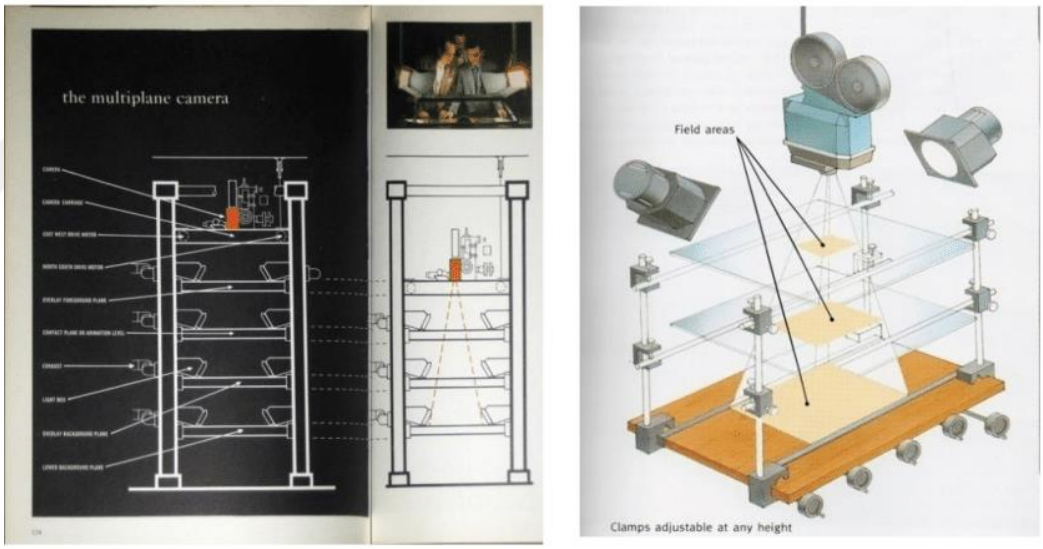


Figure 78. Multiplane camera

Source: https://www.researchgate.net/figure/Multiplane-camera-Figure-8-Multiplane-camera-II_fig20_259211673

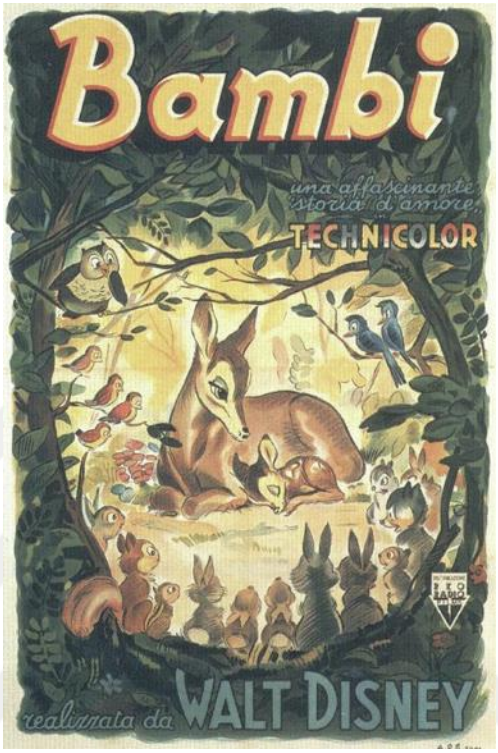


Figure 79. "Bambi" (1942) produced by Walt Disney

Source: https://www.imdb.com/title/tt0034492/mediaviewer/rm2825739777/

The Disney animation studio introduced xerography for animation in the late 1950s and it became widely used in the 1960s. This technique allowed photocopying of animations by skipping the step of hand-inking drawings with transferring them directly into the cels (Ness, 2015). As a result, time and labor costs went way down, which made animation more economical. Disney's first feature length film "One Hundred and One Dalmatians" (1961) shown in (Figure 80) was the first to make the use of xerography for its entire production and thus, set the patterns for a new visual style which was marked by excessive use of defined lines and sharper contours (Frank, 2019, p. 41). In addition, the development of Fantasound and other stereophonic techniques in the latter part of 1940s, improved the quality of sound in animation. These developments made it possible to add elaborate sound and music to the visuals, which deepened the sentiments associated with the animated films and depicted stories (DisneyFandom, 2021). The advancement of sound technology led the

synchronization of voices and sound effects improved drastically. As a result, animators were able to lip sync the characters way better with the dialogues for a finer quality animation (Russett, 2004, 111).

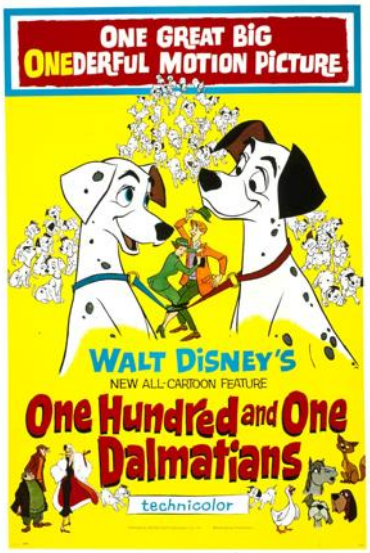


Figure 80. "One Hundred and One Dalmatians" (1961) by Walt Disney Productions
Source: https://www.imdb.com/title/tt0055254/

The 1950s television animation boom marked another defining moment in the industry's transformation. To accommodate the growing interest in television, limited animation methods were adopted to enable faster and cheaper production. Hanna-Barbera transformed animation by introducing a bold style and highly graphic limited cel animation to television (Sullivan, 2021, pp. 21-22). These techniques were used in their famous series "The Flintstones" (1960) depicted in (Figure 81), the first ever prime-time animated television show series (Sigler, 2020). The use of limited animation, where character styles are simplified to only basic outlines and motion cycles, helped studios cope with the demanding weekly television deadlines while still having an optimally appealing animation production (Sullivan, 2021, pp. 27-28).

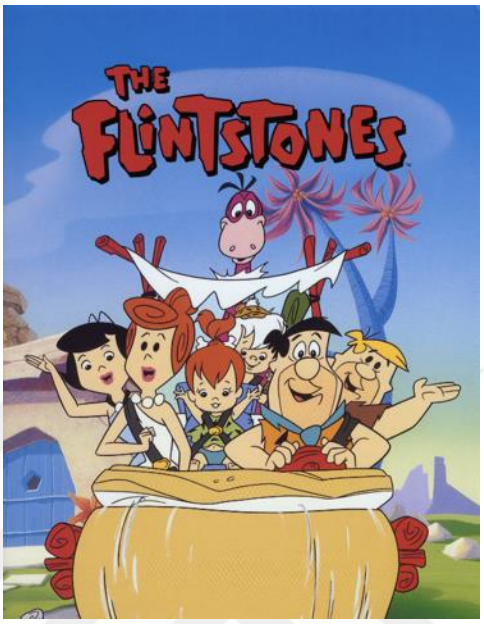


Figure 81. "The Flintstones" (1960) by Hanna-Barbera Productions
Source: https://www.imdb.com/title/tt0053502/mediaviewer/rm981402112/

At last, the stop-motion animation technique was undergoing gradual modification during this era, as it had a distinct preserved visual style compared to cel animation. While stop-motion is not a modern technique, it gained recognition in the 1940s and 1950s with Harryhausen's works like "Mighty Joe Young" (1949), as shown in (Figure 82), which set new heights for this frame-by-frame approach of animation production (Snuggleclub, 2018). Stop-motion animation techniques allowed for creating lifelike movements with physically manipulated models (Maselli, 2018, pp.1, 8). In summary, the technological improvements made in animation from the 1940s to the 1960s had an impact on the future development of the field. These advances not only fostered the creative potential of animation but shifted its applications towards being and more powerful tool of communication in film and television, thereby stimulating international attention towards the craft (Bendazzi, 2015, pp. 2-12).



Figure 82. "Mighty Joe Young" (1949) by Argosy Pictures

Source:https://www.imdb.com/title/tt0041650/mediaviewer/rm883782144/?ref_=tt_ov_i

2.1.2.1. Transformation to Stylized Character

Over the years, the character stylization in animation has evolved significantly due to artistic creativity, technological progress, and cultural changes. Animation studios and creators had a variety of options when it came to different character styles. These were from extremely simple to organic modernist designs to experimental and complicated forms. This evolution shows not only different aesthetic values but also the changing complexity in multi-faceted storytelling.

The 1940s saw a major impact in the animation industry due to the overly expressive, fast-paced, and dramatized features of films by Tex Avery, Max Fleischer, and Walt Disney. The characters created by Avery, like in "Red Hot Riding Hood" (1943) in (Figure 83) and "Droopy" (1943) in (Figure 84), were highly stylized (Cavalier, 2024). The characters were given exaggerated human-like facial features along with overdone anthropomorphic and

emotional responses. This further intensified the comical and dramatic aspects by completely overshadowing the animation from the preceding decades. At the same time, Disney stylized forms in “Fantasia” (1940), where Mickey Mouse had an intense fluid stylized shape to suit the music and surrealism of the film (Beenews.com, n.d). This period gave rise to the use of the mechanism of stylistic imagery for enhancing the expressiveness of characters and visual storytelling art.



Figure 83. “Red Hot Riding Hood” (1943) by Tex Avery

Source:https://www.imdb.com/title/tt0036295/mediaviewer/rm202726657/?ref_=tt_ph_1



Figure 84. “Droopy” (1943) by Tex Avery

Source:https://www.imdb.com/title/tt0035832/mediaviewer/rm4162852608?ft0=name&fv0=nm0859892&ft1=image_type&fv1=still_frame&ref_=tt_ch

Minimalist designs began in the 1950s, with UPA (United Productions of America) with a modernist style in nature. Characters created by the studio like “Mr. Magoo” (Figure 85) and “Gerald McBoing-Boing” (Figure 86) were simple in comparison to the highly detailed characters created in earlier years. These animation characters were constructed using basic geometric forms, bold colors, and with minimal details. This was an example of a new way of creating animated characters along with an interest to move away from traditional animation norms (Bashara, 2015, pp. 2-8). At the same time, Hanna-Barbera led TV (Television) animation made a shift towards simplification because of the restrictions that came with TV animation production. Streamlined character designs such as in “The Flintstones” (1960) had bold outlines and had simple features. This approach was both cost-effective and more appropriate for animation production (Simon, 2008).



Figure 85. “Mr. Magoo” (1949) by Millard Kaufman and John Hubley

Source: https://www.imdb.com/title/tt0141760/?ref_=tt_mv_close



Figure 86. “Gerald McBoing-Boing” (1950) by John Derevlany

Source: https://www.imdb.com/title/tt0043581/mediaviewer/rm1795399937/

The trend towards simplifying character designs continued to develop throughout the 1960s, with an added futurist detail, best shown by “The Jetsons” (1962), in (Figure 87). The characters had clean lined and rounded forms that fit the space age theme (Hafza, 2024). On the other hand, George Dunning’s experimental film “Yellow Submarine” (1968) in (Figure 88), took stylization in pop art character design and style to new, more psychedelic levels. The bright color choices and abstract shapes used in this film symbolized the counterculture movements that defined the 1960s and stand as evidence to the fact that animation can be a powerful tool to express the social and artistic shifts of the time. (Kümmerling, 2018).



Figure 87. “The Jetsons” (1962) by Hanna-Barbera Productions

Source:https://discover.hubpages.com/entertainment/History-of-Hanna-Barbera-Part-6-1962-The-Jetsons-and-Wally-Gator



Figure 88. "Yellow Submarine" (1968) by George Dunning

Source:https://www.imdb.com/title/tt0063823/mediaviewer/rm3108273665/?ref_=tt_ov_i

During the 1970s, there was more diversification in cartoon styling of adult and alternative animation. Ralph Bakshi created "Fritz the Cat" (1972), shown in (Figure 89), and "Wizards" (1977) in (Figure 90), where he combined exaggeration with a more gritty and aggressive reflection of the era's counterculture subjects (Gollum, 2017). Unlike previous decades, these films shifted away from the family-friendly approach, using subtler images to explore into deeper and more provocative issues. Also, educational shows such as "Schoolhouse Rock" (1973-1984) featured basic yet bold characters, catchy enough to engage children's attention, which was in line with the minimalist style of television animation at the time (Payne, 2024).



Figure 89. "Fritz the Cat" (1972) by Ralph Bakshi

Source: https://www.imdb.com/title/tt0068612/

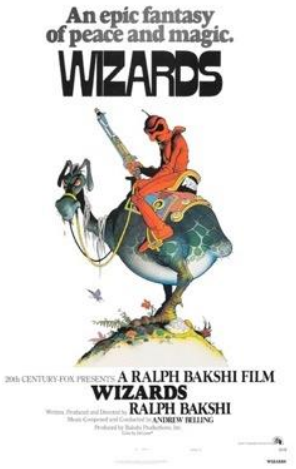


Figure 90. "Wizards" (1977) by Ralph Bakshi

Source: https://www.imdb.com/title/tt0076929/

By the 1980s, there was an increase in exposure to anime, leading to more stylization in experimental television animation. An example would be "Akira" (1988) by Katsuhiro Otomo (Figure 91), who artistically merged realism with stylized character designs exhibiting detail, but also exaggerated movements and facial expressions. This film helped

to spread the true nature of anime's distinct style in Western culture (Lammin, 2023). Also, on TV programs such as "The Simpsons" (1989) shown in (Figure 92) created an array of unique character designs with striking features, such as the use of yellow skin, which later on became a household symbol (Roberts, 2020). Similarly, the animated series "Thundercats" (1985) in (Figure 93) had characters with distinctive features of powerfully built human-animal hybrids, which reflected the action and fantasy nature themes of the decade (Gibbons, 2024).

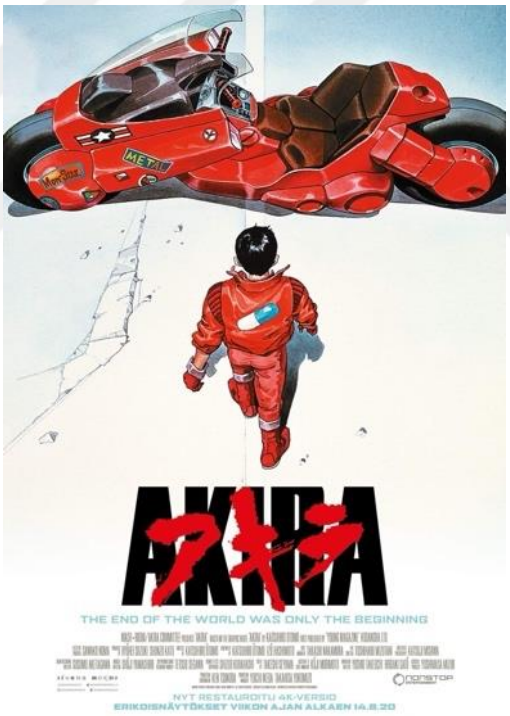


Figure 91. "Akira" (1988) by Katsuhiro Otomo

Source: https://www.imdb.com/title/tt0094625/



Figure 92. "The Simpsons" (1989) by Matt Groening

Source: https://www.imdb.com/title/tt0096697/

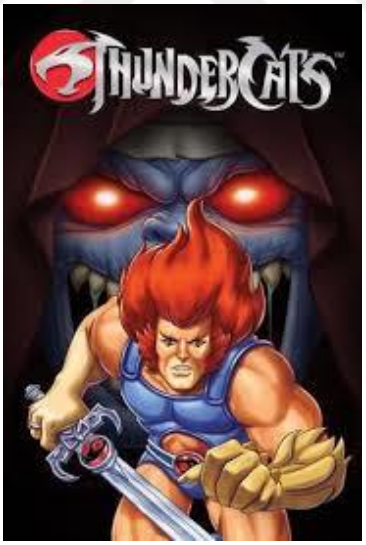


Figure 93. "Thundercats" (1985) by Theodore Walter Wolf

Source: https://trakt.tv/shows/thundercats/seasons/all

Over the years, the evolution of stylized characters in animation bears witness to the advancement of technology and art, as well as the expectations and changes in tastes of the audiences. From the 1940s exaggeration style to the minimalistic modernism of the 1950s to

the varied, complex multi-stylistic forms of the 1980s, the development of character design in animation is a reflection of the cultural and artistic trends of the 20th century.

2.1.3. Emergence of Uncanny Valley in Animation (1990s and 2000s)

The quick development of CGI (Computer Generated Imagery) in the 1990s and 2000s unveiled the phenomenon of the 'uncanny valley' more clearly than ever before. During this era, animation films started using more realistic human characters, but the technology at the time often resulted in those characters looking strange and eerie (Burke, 2024). A well-known example of this is "Final Fantasy: The Spirits Within" (2001) in (Figure 94), that tries to portray human characters in a highly realistic light. The viewers were captivated by the impressive effects, but they were uncomfortable watching the characters perform lifelike actions because of movements and expressions were not natural. Criticism was mostly focused toward the eyes and facial expressions that lacked of emotional touch (Tinwell et al., 2011, p. 8), creating a disturbance that serves as a classic example of the uncanny valley effect (Mori, 2012).

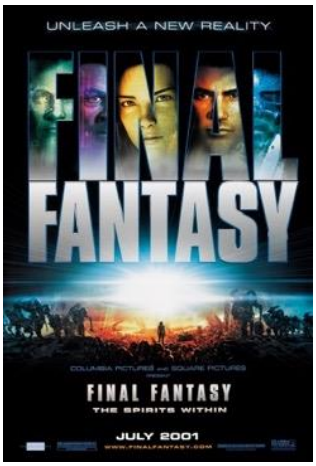


Figure 94. "Final Fantasy: The Spirits Within" (2001) by Hironobu Sakaguchi
Source: https://www.imdb.com/title/tt0173840/

Likewise, in “The Polar Express” (2004) shown in (Figure 95), the characters were close to photorealistic, however, their robotic, stiff movements and unexpressive eyes were unsettling and created discomfort. For the emotional structure of the film, a lot of viewers were could not connect to the characters because of the uncanny realism, which shows the problems that animators had to address when trying to create real life-like representation (Kätsyri, 2017, 2344; McDonnell et al. 2012, 2). “Toy Story” (1995), in (Figure 96), is also an example from this decade. The characters in the movie were mainly toys instead of human figures. Human-looking characters like Andy and Sid were seen as somewhat creepy because their body movements and facial expressions were not in sync. At that time, technology was incompetent of producing realistic human motion, which created a gap, although the unease was not as extreme as the previous examples; nevertheless, it was within the confines of the uncanny valley (Rabin, 2023).



Figure 95. “The Polar Express” (2004) by Robert Zemeckis

Source: https://www.imdb.com/title/tt0338348/



Figure 96. "Toy Story" (1995) by John Lasseter, Pixar Animation Studio
Source: https://www.imdb.com/title/tt0114709/

In comparison to feature-length animation films, the integration of CGI into live-action films presented its own challenges. In "Star Wars: Special Edition" (1997) in (Figure 97), George Lucas introduced a CGI character widely known as Jabba the Hutt. This CGI approach was technologically advanced and innovative for it time. However, Jabba not only looked very digital but also visibly disconnected with the live-action actors, which only further contributed to present the uncanny valley effect. The animated version of Jabba was more disturbing than the original practical model. "Casper" (1995), as shown in (Figure 98), further illustrates where human ghostly versions were rendered using CGI. The human characters, such as Dr. Harvey, who had converted into ghost form, looked semi-realistic and semi-translucent and eerie with the floating body. The disconnect between the human-like figure and the movement gave a further dimension to the uncanny valley in 1990s animations (Tinwell, 2014, p. 14).



Figure 97. Star Wars: Special Edition (1997), CGI version of Jabba the Hutt.
Source: https://imperialtalker.com/2016/06/07/jabba-the-cgi-hutt/



Figure 98. Casper (1995) Dr. Harvey's ghost
Source: https://www.ranker.com/list/weird-moments-casper-movie/maggie-clancy

The examples given show that the challenges from the early CGI and animations were the foundation towards CGI realism. This included a succession of attempts at emulating human-like figures, leading to the uncanny valley effect. Which was quite disturbing to viewers. Even though there were technological developments in the 1990s, making fully realistic human characters endured to be a challenge in this period, and examples were often on the point of transition of the uncanny valley phenomenon.

2.1.3.1. 2D to 3D Animation Transition

The transition from 2D to 3D animations in animation film brings new imaginative and technical advancements from a creative perspective. These changes are made with the intent of trying out new styles, indicating a change in dimension, or adding more complexity to the story. These changes assist filmmakers in illustrating shifts within a story's point of view or alternate dimensions due to the use of new technologies (Liu, 2018, pp. 1, 6). For example, "The SpongeBob Movie: Sponge Out of Water" (2015), shown in (Figure 99) where the characters undergo a significant change when they transition from their 2D animated underwater world to the real world that uses 3D CGI. The film completed a mix of 550 shots for the 3D, 2D, live-action hybrid (Wolfe, 2015). This progression helps to underline the such differences between the animated and real worlds, and creates a visually compelling narrative.



Figure 99. "The SpongeBob Movie: Sponge Out of Water" (2015) by Paul Tibbitt
Source: https://www.imdb.com/title/tt2279373/

Similarly, "The Lego Movie" (2014), shown in (Figure 100), indicates the transition from 2D to 3D animation, a change in the dimensions of reality. For example, some

sequences, such as the instructional videos, are rendered in flat, cylindrical 2D animation, while the scenes that take place within Legoland are in 3D CGI. The character's face was also in 2D style. The stop-motion look animation style makes the Lego world look as if it is animated and real simultaneously (Sluis, 2014). This transition from 2D animation to 3D animation makes the film more captivating and multidimensional and helps to back the narrative structure of the film.



Figure 100. "The Lego Movie" (2014) by Phil Lord and Christopher Miller
Source: https://www.imdb.com/title/tt1490017/

Moreover, films like "Spider-Man: Into the Spider-Verse" (2018), shown in (Figure 101) combines different styles of animation, including 2D comic book and 3D animation. Although characters from different universes confront each other, the movie effortlessly transitions from flat 2D animation to detailed 3D animation and graphics. This technique not only illustrates the different art styles of the characters but also further contributes to the feeling of movement from one dimension to another in the story (Suriya, 2022).



Figure 101. "Spider-Man: Into the Spider-Verse" (2018) by Bob Persichetti, Peter Ramsey, and Rodney Rothman

Source: https://www.imdb.com/title/tt4633694/

In some films, the combination of 2D and 3D imagery is employed to incite an emotional reaction or an artistic effect. "Paper Man" (2012) shown in (Figure 102), is a short animation film that employs a mix of 2D hand-drawn animation and 3D computer animation. The shift between the two styles represents fluctuations of emotional intensity and visual changes throughout the storyline. The characters and settings often appear as flat drawings that transform into 3D during critical moments, losing their superficiality and gaining depth and emotion (Failes, 2013). The same combination of styles can be noted in the film "Klaus" (2019) as illustrated in (Figure 103). This film is mainly produced with 2D animation, but the use of lighting and texture makes it appear three-dimensional (Snyder, 2020). This approach enriches animation by creating a seamless transition from classic 2D to contemporary 3D aesthetics and unifying them in one film.

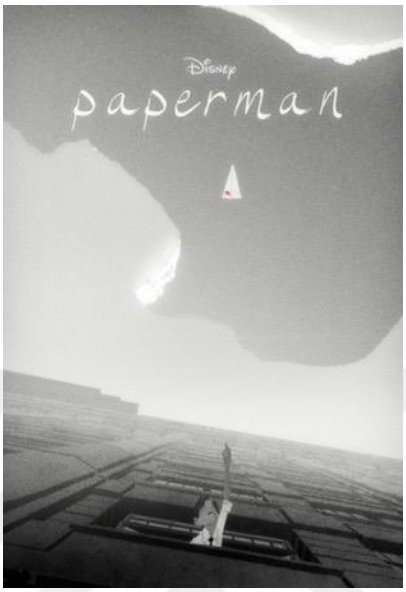


Figure 102. "Paper Man" (2012) by John Kahrs

Source: https://www.imdb.com/title/tt2388725/



Figure 103. "Klaus" (2019) by Sergio Pablos

Source: https://www.imdb.com/title/tt4729430/

Atlast, “Entergalactic” (2022) by Fletcher Moules, shown in (Figure 104), and “Arcane” (2021-2024) by Pascal Charrue, Arnaud Delord, and Bart Maunoury in (Figure 105), both the animation film and T.V series acquired creative influences from the visual styles of the previously mentioned films. The film “Entergalactic” tells a modern love story consisting the elements of ambition, artistic struggle, and personal development. Conversely, “Arcane” looks into the socio-political struggles of a deeply marginalized underclass. Both the animation films represented urban culture through a hand-painted animation technique using high contrast lighting effect enhanced by vivid colors. This makes the animation style more personal and vibrant (Hogg, 2022; Early, 2025). The overall impression is of experiencing a moving art piece.



Figure 104. “Entergalactic” (2022) by Fletcher Moules

Source: https://www.cbr.com/every-hybrid-animated-movie-ranked-by-rotten-tomatoes/



Figure 105. "Arcane" (2021-2024) by Pascal Charrue, Arnaud Delord and Bart Maunoury

Source: https://www.cbr.com/every-hybrid-animated-movie-ranked-by-rotten-tomatoes/

The combination of hand-painted textures and advanced animation techniques progresses the art of animation filmmaking. It further demonstrates how thematically bold stylistic choices can greatly impact a story's progression. These animation films set a new standard for modern animation and prove that animation as a medium is not only visually captivating but also thematically rich at the same time.

2.1.3.2. Animation and Live Action Fusions in films

Some animated films portrayed aesthetic fusion. In "Looney Tunes: Back in Action" (2003) shown in (Figure 106), 2D cartoon characters are placed in live action settings, but during certain high-speed action scenes, 3D CGI animations are added to enhance the feeling of movement and depth (Holmaas, 2023, pp. 110-111). These transitions are frequently done to strengthen the impact of certain visuals, most notably during climax moments where depth of space and movement are crucial for the fluidity of the story. The 2D to 3D transitions are

therefore not just a technical element; it is a means of telling a story, one that helps the viewers to experience the visual aspect and the plot of the animated film at a deeper level.



Figure 106. "Looney Tunes: Back in Action" (2003) by Joe Dante

Source: https://www.imdb.com/title/tt0318155/

Another mainstream example of a 2D to 3D transition is in "Osmosis Jones" (2001), illustrated in (Figure 107). This film utilizes the 2D animation that takes place inside the human body and the live action that takes place outside the body. This gives it a 2D to 3D effect because the two worlds inside the body and outside the body are separated, and the story is deepened further (Simon, 2002).



Figure 107. "Osmosis Jones" (2001) by Piet Kroon and Tom Sito
Source: https://www.imdb.com/title/tt0181739/?ref_=tt_mv_close

In some films, actors are portrayed as animated characters. There is an alienation effect. In such films, the actors are shown with unnatural and highly exaggerated expressions. This creates emotional distance from the audience. Instead of engaging their audience on an emotional level, the film elicits awareness that what they are watching is acting, thus stimulating their emotions instead of critical thought. Films of this type contain one of a kind visual and narrative style. For example, "Cool World" (1992) by Ralph Bakshi shown in (Figure 108) tells the story of cartoonist who gets slurped into a fantastical animated world populated by appealing anthropomorphic characters, getting intertwined with a willful toon who wants to come into the real world, which begins to blur the boundaries between imagination and reality. Similarly, Robert Zemeckis's, "Who Framed Roger Rabbit" (1988) shown in (Figure 109) portrays a grizzled private detective in a world where cartoons and humans live side by side and is reluctantly dragged into a turmoil with a frantic cartoon rabbit who is trying to prove his innocence after being accused of murder (Sharpson, 2024).

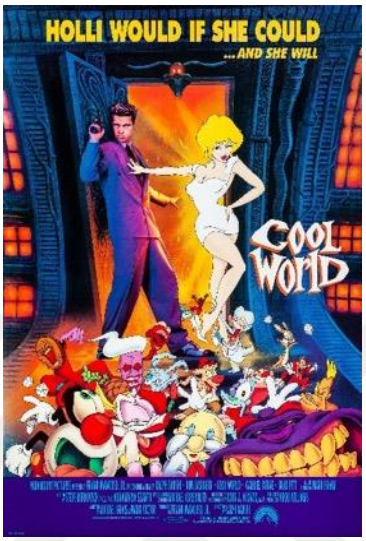


Figure 108. "Cool World" (1992) directed by Ralph Bakshi

Source: https://www.imdb.com/title/tt0104009/

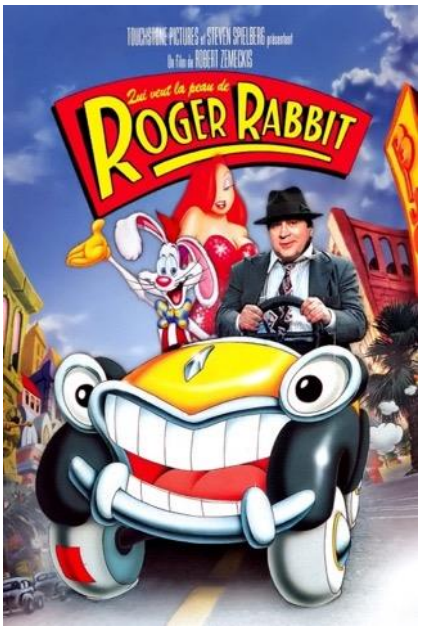


Figure 109. "Who Framed Roger Rabbit" (1988) by Robert Zemeckis

Source: https://m.imdb.com/title/tt0096438/mediaviewer/rm3575739648/

Both films used a hybrid mix of animation and live-action techniques. The two films rely on traditional 2D hand-drawn animation done frame by frame and later integrated with live-action footage. The animation comprised sequential drawings on transparent sheets called cels, which were later compiled with the live-action footage employing optical compositing. For increased realism, the integration of the animation with the live action footage was done with attention to the lighting, shadows, and reflections across both elements. The film advanced the technological capabilities of animation while simultaneously setting a precedent for the use of realistic backgrounds in future hybrid films.

2.1.3.3. Early Challenges in Realistic 3D Characters

In the early days, the creation of realistic 3D animation characters were restricted by the absence of advanced hardware for larger computing power and increasing polygon counts. Films like “Toy Story” (1995) and “Shrek” (2001) in (Figure 110) are examples of this problem. The characters were made of basic shapes with low details due to technical limitations of the hardware. As a consequence of these limitations, adding surface detailing to create smooth expressions was impossible, leading to characters appearing stiff and rigid (Joseph et al., 2024, p. 10). The resolution of texture and mapping also created issues; early 3D animated models were extensively pixelated. An example of this can be seen in the film “Final Fantasy: The Spirits Within” (2001) where the surface and skin textures appeared with unnatural wax-like, highlighting the difficulty of achieving highly realistic details (Monnet, 2004, p. 99).

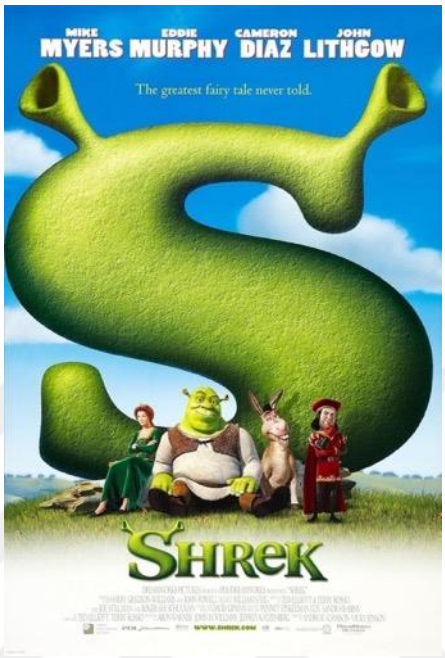


Figure 110. "Shrek" (2001) by Andrew Adamson and Vicky Jenson
Source: https://www.imdb.com/title/tt0126029/

Another issue to consider was the uncanny valley, where a character or element portrayed to appear real, yet not fully human, elicits a sense of unease among viewers. This was apparent in "The Polar Express" (2004), in which the human like characters were expressionless and robotic in their facial movements and emotions. Furthermore, early films had poor facial rigging and had few expressive features, evoking emotions and actions that were portrayed stiff and unnatural (Bennett, 2005, p. 6). Despite the fact that characters like those in "Shrek" were able to show a wide range of emotions, they were not as fluid compared to newer films such as "Frozen" (2013) in (Figure 111). In "Frozen" (2013) high quality facial rigging provided an opportunity for more subtle and realistic expression, especially for a film that aimed for photorealism animation (Romanello, 2019; Garrido et al. 2016, p. 1).



Figure 111. "Frozen" (2013) by Chris Buck and Jennifer Lee
Source: https://www.imdb.com/title/tt2294629/

Challenges also existed for clothing, hair, and body movement, as early films often portrayed rigid and stiff cloth and hair simulations. "Final Fantasy: The Spirits Within" featured characters animation with motion capture, which allowed them to closely resemble to the motion of humans (Mihailova, 2013, p. 9). The hair and clothing did not have proper physics and would often not move fluidly and would intersect with the body. In "Brave" (2012), shown in (Figure 112), 3D characters such as Merida displayed considerable improvements with her hair moving in a natural simulation (Soares et al., 2012, p. 1). Similarly, in early animation films, technological advancement was achieved through the integration of lighting and shadow on the characters by overcoming flat and inconsistent illumination looks as seen in the film "Antz" (1998). These challenges gave rise to the development of technology, producing the impressive 3D animations that we see today.



Figure 112. "Brave" (2012) by Mark Andrews and Brenda Chapman
Source: https://www.imdb.com/title/tt1217209/

2.1.3.4. Holographic Techniques

The use of holograms in animated film plots often advances the storyline because it invokes sophisticated forms of communication and interactive interface technologies. For example, one of the earliest and most famous ones is from "Star Wars" (1977), shown in (Figure 113), which featured Princess Leia's 3D message to Obi-Wan Kenobi. Her message marked the first introduction of holograph communication, which, as we know, fundamentally set the groundwork for how holograms would be depicted in futuristic moving pictures (Blanche et al., 2010, p. 1; Richau, 2019). Similarly, in the animated film "Big Hero 6", Hiro Hamada designs robots using visually appealing as well as functional holographic blueprints. Also, in (Figure 114), the Marvel Cinematic Universe film "Iron Man" (2008) gave a further twist to the idea by enabling Tony Stark to control the process of building the Iron Man suits via holographic displays. The portrayal of interactive holograms invites a

never before seen level of creativity and innovation at design and engineering (Computer Graphics World, 2016).



Figure 113. "Star Wars" (1977) by George Lucas Princess Leia's holographic message

Source: https://www.youtube.com/watch?v=8N_Cj3ZS9-A



Figure 114. "Iron Man" (2008) by Jon Favreau

Source: https://scifiinterfaces.com/2015/07/01/iron-man-hud-a-breakdown/

Beyond communication and design, holographic techniques extend into the assimilation of the physical and virtual worlds through the creation of experiential

environments as shown in films such as “Ghost in the Shell” (2017), shown in (Figure 115), and “Blade Runner 2049” (2017), where the city is filled with numerous holographic advertisements and projections of characters. In “Ghost in the Shell”, these projections are integral parts of the cyberpunk world (Thrower, 2017), whereas in “Blade Runner 2049”, the hologram Joi has a genuine relationship with user K, thus residing on the borders of the imaginary and the real. Joi is portrayed as a submissive helpmate dressed in a degree of autonomy and emotional affection (Elyamany, 2022, pp. 1213-1214). Both films conceive the role of holograms in world-building as portraying a society that has normalized the use of holograms as digital projections. This creates new dimensions of interactions for humans.



Figure 115. “Ghost in the Shell” (2017) by Rupert Sanders

Source: https://www.empireonline.com/movies/features/ghost-shell-exclusive-vfx-breakdown/



Figure 116. "Ready Player One" (2018) by Steven Spielberg
Source: https://www.theguardian.com/film/2018/jan/02/steven-spielberg-ready-player-one-in-2045-virtual-reality-is-everyones-saviour

In addition to world-building, holograms are also key to the aspect storytelling in animation films. Holograms facilitates stories that could be much deeper and more engaging, especially when it has interactive and futuristic contexts (Shi et al., 2023, p. 1662). For example, holograms are used both visually and narratively in Disney's "Treasure Planet" (2002), this use adds up a new dimension to space navigation with holographic maps. Likewise, "Ready Player One" (2018), in (Figure 116), is mainly based on VR. The OASIS world has characters that act like holograms, where they could move and interact in full immersive virtual spaces. These different examples exemplify the diverse uses of holography in movies, from facilitating the storyline to stunning the viewers with spectacular visuals and immersing them in a futuristic technological scenario.

With the advancement of technology for holographic elements in movies, there is a level of visualization shift toward the uncanny valley effect. Holograms that are so highly detailed and immersive appear indistinguishable in comparison with the objects or living

beings around them. Sometime the objects and living beings are rendered so realistically that they produce an eerie feeling when their movements, expressions, or actions because they differ from normal conventional human behaviors. This balance between realism and artificiality continues to define how audiences emotionally respond to these digital creations.

2.1.4. The Genre of Uncanny Valley

The Uncanny Valley has transformed over time from a psychological framework to a genre of narrative fiction that seeks to understand the uneasiness when interacting with near-humans looking identities. This idea has fascinated filmmakers, novelists, and video game designers who use it as an interpretive lens for investigating the nature of humans, technological advancement, and existential unease. Characteristic of the uncanny valley as a genre is to show the diversity of human and non-human beings. Many works in this genre explore the boundaries; films such as “Blade Runner” and “Ex Machina” have artificial humanoid robots that look distinctly alien but evoke empathy (Raul, 2024). These characters are human like structure, but lack in emotional depth, natural movement, and facial expression details, hence leading to a sense of dissonance for the viewer (Tinwell et al., 2011, p. 742). Psychologically, there is this deep anxiety about the uncanny, especially for the almost looking like human entities. The uneasiness evolved from considering the entities to fall within somewhat unexplored region of the known and unknown, making them hard to define as a result it causes deeply unsettling experiences (Wang et al., 2015, pp. 396-397).

The uncanny valley genre’s aesthetics are characterized by the use of hyper-realistic characters and environments. This effect is evident in films such as “The Polar Express”, in which the use of CGI to create nearly human characters evoked negative feelings among many viewers. The 3D characters’ appearance is human enough to be sympathetic, but the way they moved and expressed themselves was not human, thus creating discomfort in viewers, which relates to the definition of the uncanny valley phenomenon (Ratajczyk, 2019,

p.138). This aesthetic approach is prevailing in video games such as “Detroit: Become Human” (2018), shown in the (Figure 117), in which androids challenge the player’s perception of humans with their behavior and appearance. The inconsistency between the human form and robotic actions of these characters serves the aesthetics of the genre. This sets an eerie and unsettling mood that drives the story (Busby, 2018).



Figure 117. “Detroit: Become Human” (2018) by Quantic Dream
Source: https://store.steampowered.com/agecheck/app/1222140/

The uncanny valley genre uses discomfort arising from the contradictions between actions and appearances. In some examples, instead of relying on strong imagery or disturbing actions, stories create suspense through tiny alterations to the extent that they are imperceptible in human behavior. For instance, in the film “Her” (2013), the AI character Samantha has a profoundly human personality, but her lack of physical body results in a dissonance that displeases the protagonist and the viewers (Robhestand, 2023). This manipulation of the known and unknown is also a characteristic of the uncanny valley genre. It disrupts the audience’s anticipations along with their psychological desire for categorization. By offering non-human entities, these narratives create dissonance for the

audience, and as a result, the audience is faced with the contradiction of something which is known, yet feels unusually distant (Gray & Wegner, 2012, p. 126).

As technologies such as robotics, AI, and CGI undergo constant development, the uncanny valley genre also becomes even more pertinent. Regular interactions on every day basic with the existing of hyper-realistic avatars, humanoids, and virtual beings makes the uncanny valley effect more noticeable (Palomäki et al. 2018, pp. 2, 5). This can be seen in science fiction T.V series like “Westworld” (2016–2022) directed by Jonathan Nolan and Lisa Joy shown in (Figure 118), where advanced humanoid robots question the definition of humanity, and also in the philosophical sci-fi thriller “Ghost in the Shell” (1995) directed by Mamoru Oshii, which shows the blending of human self and artificial intelligence (Brown, 2008). The above-mentioned examples show a societal issue concerning the integration of advanced technology humanoids in our daily life has the possibility of replacing or even surpassing the human race.



Figure 118. “Westworld” (2016-2022) by Jonathan Nolan and Lisa Joy
Source: https://artofcloud.co.uk/how-ai-fits-into-our-futuristic-dreams/

Several examples of uncanny valley genre can also be found from films such as “A.I. Artificial Intelligence” (2001) shown in (Figure 119), which deals with the emotional and

psychological effects of humanoid robots on society in the future (Todasco, 2024) and “I Am Mother” (2019) shown in (Figure 120) which analyzes the interplay between a human child and a robot caregiver within the concepts of identity and trust (Fetherston, 2019). In regards to video games, there are titles such as “Nier: Automata” (2017) and “Soma” (2015) shown in (Figure 121) which features near-human androids and artificial beings for the purpose of exploring existential themes and evoking emotional responses (Gao, 2024; Griffin, 2021). These examples show the development of the uncanny valley genre into a fully constructed narrative paradigm that has its own distinctive style.

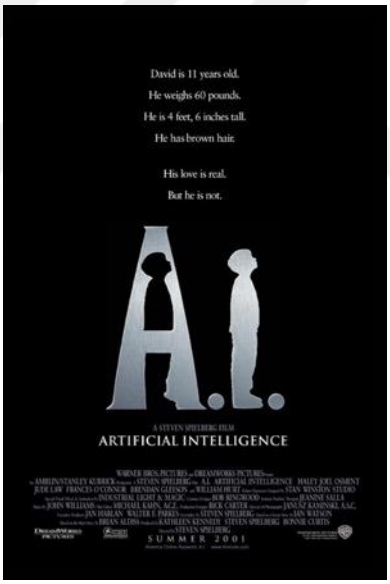


Figure 119. “A.I. Artificial Intelligence” (2001) by Steven Spielberg

Source: https://www.imdb.com/title/tt0212720/



Figure 120. "I Am Mother" (2019) by Grant Sputore

Source: https://www.imdb.com/title/tt6292852/



Figure 121. "Soma" (2015) by Frictional Games

Source: https://frictionalgames.com/2016-03-soma-6-months-later/

In conclusion, the uncanny valley concept has transformed to a fully developed genre of film making and art from just being a psychological phenomenon which is scientifically backed up with a theory that analyzes the psychological discomfort caused by entities that closely resemble humans. In doing so, this genre helps to understand the fundamental issues

of identity, empathy, and the nature of humanity through the differences between human and non-human subjects.

2.1.4.1. Features of Uncanny Genre

The features of the uncanny valley genre draw attention to the psychological discomfort and cognitive. Which arise in the audience when interacting with something that is almost human but human in a way that discomforts them. At its core, the genre brings together near-human personas like robots, androids, and computer animated characters or figures. These figures portray certain human habits but partially captures the details of a real living human being (Tinwell et al., 2011, p. 741). This dissonance is eerie even if it is subtle or pronounced, because it highlights the imperfections in facial movements, emotions and expressions. The discomfort arises from the near human personas for being able to be look alike humans yet remaining significantly distinct from a real one (Måkäräinen et al., 2014, pp. 718-719).

Another feature of the genre is to capitalizes the sensation of discomfort through hyperrealism in animation and persona designs. This technique is used to mask the lines differentiating humans and non-humans. The more sophisticated the animation technology becomes, the more real the characters appear. Further, the greater the possibility of the uncanny valley effect can be seen. The genres feature refrains from limiting itself to the gap between the absence of flaw and reality. Where near-human beings stimulate a feeling of alienation despite their hyper-realistic appearances (Macdorman et al., 2009, p. 696).

The uncanny valley feature can also be realted to the philosophical, ethical, and existential issues. Where incorporating near-human characters raises a deeper question of what it means to have an identity, consciousness, and humanity. This leads the genre to evoke dissonance in the audience's by giving them experience of an uncomfortable truth that

humans and machines merging together. This can endanger human uniqueness (Stein & Ohler, 2017, pp. 6-7).

Examples from films such as “Ex Machina” and “Blade Runner 2049” shows this self-reflective question of humanity’s essence and challenges the viewers with the issue of synthetic humanoids and the possibility of attributing them with compassion (Gray & Wegner, 2012, pp. 125, 129). The genre tends to combine moral and ethical questions, particularly regarding AI and robotics. This keep the viewers wondering to what extent technology will be allowed to advance before its existence begins to contradict the essence of what it means to be human. The uncanny valley genre supports narratives with contemporary fears of AI and robotics, which makes it a crucial framework to analyze the interaction with technology and the realities of building deceptive human entities (Stellmach & Lindner, 2019 p. 90). The following Table 1. is presented in this context.

Table 1. Features of Uncanny Valley Genre. Table 1. Design Asadul Islam 2025 ©

	Features	**Examples**
1	Representations of the Characters	3D characters, Humanoid robots, clones, androids, supernatural characters, prosthesis, virtual assistants, hyper-realistic mannequins, anthropomorphic dolls and doppelgangers.
2	Backgrounds or Settings	Cybernatic spaces, dystopias or futrists worlds, virtual worlds, psychological horror and eerie locations.
3	Psychological Discomfort	Themes of identity, alienation, loss of humanity, and the fragility of individuality.
4	Emotional	Anxiety, paranoia, mixed emotions, sympathy, fear, revulsion, familiarity, curiosity, ambiguity and contradictory feelings.

5	Tonal style	Tense, uneasy, eerie, suspense, dark, philosophical contemplation, melancholic and distress.

2.1.4.2. Stylistic Evolution

The evolution of animation feature films has significantly facilitated the creation of the uncanny valley as a distinct genre. The increasing quality of animation technologies and the pursuit of hyper-realism in character design, and movement have led to disturbing hyper-realism, creating challenges defined by discomfort and uneasiness (Bouwer & Human, 2017, p. 186). In an attempt to make animation characters look alive, a lot of animators and filmmakers are venturing into the border between the real and the unreal. This has helped the uncanny valley develop into a storytelling tool (Chattopadhyay & Macdorman, 2016, p. 1).

One of the notables turning points within animation was the pursuit of hyper-realism. There is a desire to make characters as emotionally relatable as possible through extreme lifelikeness. Films such the “The Polar Express” (2004) and “Beowulf” (2007), in (Figure 122), were the first attempts at incorporating hyper-realistic CGI into film; however, instead of achieving realism, they fell into the uncanny valley. The characters in these films were near-human in appearance. But their mechanical mannerisms and facial movements were so out of sync with their bodies that strip them of reality (Mitchell et al., 2011, pp. 1-3). Furthermore, the film “The Lion King” (2019), shown in (Figure 123) is another more recent example where the photorealistic recreation of animal characters led to a similar outcome. The stunning technical achievement visually in the film resulted in the inability to convey human emotions through hyper-realistic characters. Thus, creating a detachment in viewers, which is an evident result of the uncanny valley effect (Schwind et al., 2018, p. 51).



Figure 122. "Beowulf" (2007) by Robert Zemeckis

Source: https://www.imdb.com/title/tt0442933/



Figure 123. "The Lion King" (2019) by Jon Favreau

Source: https://www.tvinsider.com/show/the-lion-king-2019/

In spite of the significant advances made in animation, motion-capture technology has continued to accentuate the uncanny valley effect. As the motion-capture technology progressed, increased realism in animation along with the uncanny valley phenomenon. One of the first film that used motion-capture technology, is "Final Fantasy: The Spirits Within" (2001). This film showed human movements attempting to be lifelike, but had very limited

emotional depth in the facial expressions. Another example in (Figure 124), a more recent film, “Alita: Battle Angel” (2019), presents a further refinement of CGI and motion capture within worlds of science fiction with both emotional depth and refined physical actions.

Still, in many scenes these technical improvements are not enough. 3D animation character Alita’s oversized, anime-style doe eyes and near-human features disturb viewers (Seymour, 2019). Moreover, her doll-like appearance challenges the boundary of what is considered human and machine. This distracts the audience and traps them in a constant unresolving mental conflict. This struggle to accept the character as normal is the core concept of the uncanny valley phenomenon (Tinwell et al., 2011).



Figure 124. “Alita: Battle Angel” (2019) by Robert Rodriguez
Source: https://www.imdb.com/title/tt0437086/

The development of realism in the texturing and lighting has deeply integrated animation within the realm of the artificial and the real. “Avatar: The Way of Water” (2022), depicted in (Figure 125) is a prime example where the skin, hair, and environmental details are very realistic. Even so, there is something mildly disturbing about how some convincingly designed elements of character facial detail or movement seem out of sync (Horatia, 2022). Similarly, in (Figure 126) “Gemini Man” (2019) directed by Ang Lee, revolves around a

hitman who finds himself aging, only to be pursued by a younger clone of himself. This film displayed how advanced de-aging technology built a younger Will Smith and displayed incredible amounts of visual detail. For all of his character's depth, the rigidity of his facial expression's and slight off eye motion kept him firmly in the realm of the uncanny (Idleson, 2019).



Figure 125. "Avatar: The Way of Water" (2022) by James Cameron

Source: https://www.imdb.com/title/tt1630029/



Figure 126. "Gemini Man" (2019) by Ang Lee

Source: https://www.youtube.com/watch?v=k5y4kxhZIBA

Studios, such as Pixar, tend to avoid hyper-realism in their films, such as “Inside Out” (2015) as seen in (Figure 127) and “Soul” (2020) in (Figure 128). These movies use the surreal, cartoon-like features of their designs so that the characters can be relatable while avoiding the discomfort that comes from their near-human features (Desowitz, 2015; Forsans, 2022). On the other hand, some other animators continue to challenge the boundaries of realism, particularly in “Love, Death & Robots” (2019) as seen in (Figure 129), which short stories attempt to satirically approach the uncanny valley and feature hyper-realistic character designs to deliberately play with the uncanny valley effect (McLaughlin, 2019).



Figure 127. “Inside Out” (2015) by Pete Docter

Source: https://www.npr.org/2015/06/10/413273007/its-all-in-your-head-director-pete-docter-gets-emotional-in-inside-out



Figure 128. "Soul" (2020) by Pete Docter

Source: https://www.imdb.com/title/tt2948372/

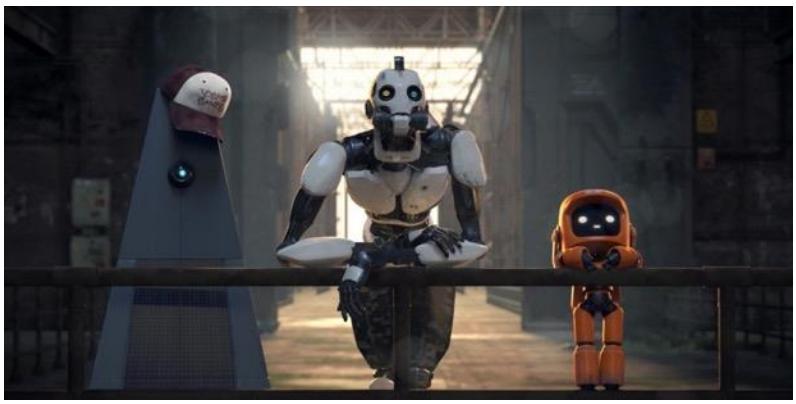


Figure 129. "Love, Death & Robots" (2019) by Tim Miller

Source: https://thefincheranalyst.com/2019/04/01/love-death-robots-tim-miller-executive-producer-jerome-denjean-vfx-supervisor/

To sumarrize, the stylistic transformations in animation films have contributed significantly to the development of the uncanny valley as a genre. The use of hyper-realism in the different style are seen in these animation films. From capturing motions, facial animations, or complex to stylized texturing and shading, however, this has resulted in disturbing consequences that elicit discomfort both psychologically and emotionally to the viewers.

2.1.5. Contemporary Trends and Technological Advancements

The advancing technology has shifted the field of animation's approach dramatically. Adaption of 3D animation and Visual Effects VFX is one of the leading marks of this transformation. Technologies of this kind have made it possible to produce near realistic animations as demonstrated by blockbuster movies such as "Avatar" (2009) displayed in (Figure 130), "Avatar: The Way of Water" (2022) in (Figure 131) and "Lion King" (2019) which feature well-elaborated characters and animated environments that nearly seem real (Sun, 2022, p. 1-2). These films pushed the reach of realism with the use of CGI in films. Another frequently used technique is "performance capture", wherein the movements and facial expressions of an actor are recorded, providing animation features with more emotion and depth than ever before (Xia et al., 2017, pp. 536-537).

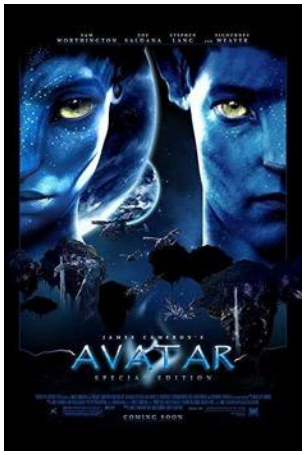


Figure 130. “Avatar” (2009) by James Cameron
Source: https://medium.com/movies-and-us/avatar-2009-eb810b80b939

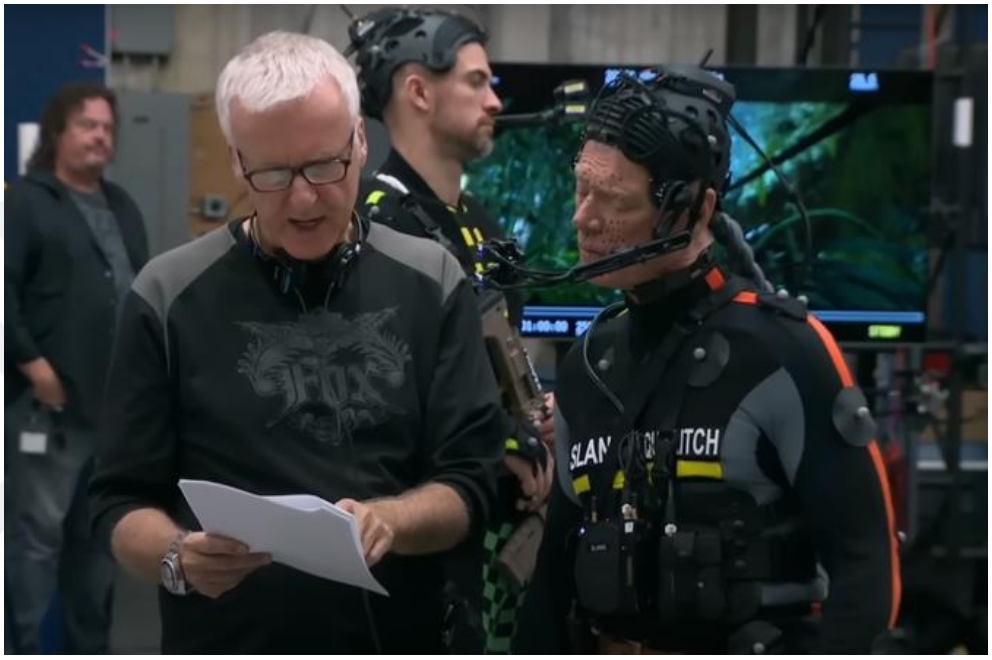


Figure 131. Making of “Avatar: The Way of Water” (2022) by James Cameron
Source: https://www.youtube.com/watch?v=x_qm280q2e0

The expansion of 3D animation saw the emergence of new forms of storytelling through Virtual Reality (VR) and Augmented Reality (AR). VR was which was first pioneered by Ivan Sutherland in 1968. Since then, with technological evolution, modern VR has gained significant popularity. Similarly, Tom Caudell in 1990 first introduced the term AR. These technologies allow viewers to participate directly with animated worlds, creating scenarios where the audience can change the story and setting (Hushain & Kant, 2024, pp. 106-107). Such changes in viewing technologies are seen moving from passive to active viewing in VR experiences like “The Under Presents” (2019), shown in (Figure 132), where users engage with animated characters and participate in the story (Cherry, 2019).



Figure 132. "The Under Presents" (2019) by Tender Claws

Source: https://store.steampowered.com/app/1232940/The_Under_Presents/

AI and machine learning have show as primary components of modern animation due to their ability to automate previously labor-intensive tasks. AI, for example, is able to do in-betweening. Previously this involved creating intermediate frames between keyframes manually. This has subsequently shortened production timelines (Viklund, 2023). However, the quality is still compromised and needs after touch. Moreover, complex artistic styles can be imposed on animations through style transfer using machine learning. This provides freedom of experimentation with different visuals (Ruder et al., 2017, pp. 1200-1201; Li, 2023, pp. 1-2). These technologies were used in the project by Google's "DeepDream" (2015), shown in (Figure 133) and (Figure 134), which makes images and animations look surreal and dreamlike (Maerten and Soydaner, 2024, p. 7).



Figure 133. Google's "DeepDream" (2015), Interprets Prince William, Kate duchess of Cambridge and Prince George

Source: https://slate.com/technology/2015/07/google-deepdream-its-dazzling-creepy-and-tells-us-a-lot-about-the-future-of-a-i.html



Figure 134. DeepDream painting of Vincent van Gogh's, "The Stary Night"

Source: https://news.artnet.com/market/google-inceptionism-art-sells-big-439352

The rise of 3D animation hasn't overshadowed the growth of hybrid methods, there has been a remarkable revival of 2D animation due to the employment of traditional and

digital techniques. Such examples are seen in films like “Spider-Man: Into the Spider-Verse” (2018), which features a blend of hand-drawn and 3D animated elements with the fictitious, comic-book inspired visual style (Bruce, 2018). Digital innovation in software such as Toon Boom Harmony and Adobe Animate has also changed the 2D animation scope by making it easier to create without losing the craftsmanship that characterizes the art form.

The use of game engines such as Unreal Engine and Unity, shown in (Figure 135) enables real-time rendering, which marks yet another advancement in animation technology. With the use of these engines, an animator can render a scene as they work on it, which helps in significantly reducing production time as well as facilitating on-the-spot modification of lighting, textures, and angles of the camera. This technology is very useful in the case of live animated performances, where animated characters interact with a live audience in real time, making the experience more lively (Salama, 2024, pp. 2-4,7). Another animation technology that is on the rise is known as procedural animation, in which algorithms create responsive animations to user actions or environmental stimuli. This method is popular in video games where characters and the environment need to respond to the actions of the player. A subclass of procedural animation, seen in (Figure 136) is called physics-based animation. In this case, algorithms imitate reality to create realistic movement of objects, for instance, the movement of clothes and flying hair. This addition makes the artwork more lifelike and increases the immersion of the audience (Zucconi, 2017).



Figure 135. Real-time rendering: game engines like Unreal Engine and Unity

Source: https://quixel.com/blog/2018/8/29/unreal-vs-unity-choosing-the-engine-thats-right-for-you?fbclid=IwAR31hLjYbSw7XEGcjd-D_tfhOhydTkfWZhQ4TNtZNC3_7FyBvFNtNZopk0M

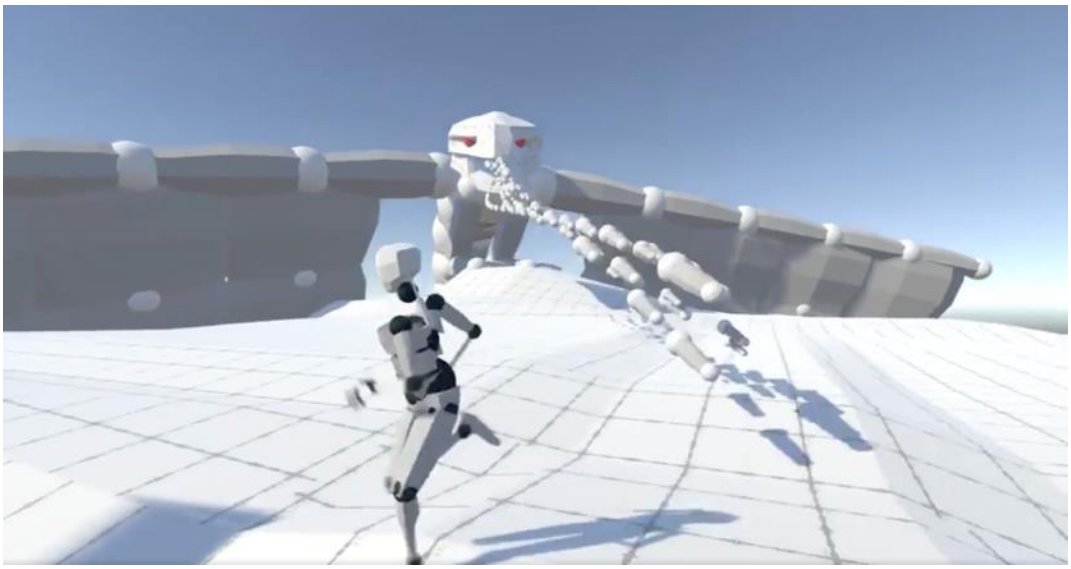


Figure 136. Procedural animation

Source: https://80.lv/articles/animating-beasts-using-the-procedural-way-in-unity/

Moreover, the importance of cloud-based animation production is evident as teams can now work efficiently from different geographical locations. Cloud technology offers animation studios powerful animating and storing of resources that would otherwise be unavailable due to insufficient infrastructure (Yasa & Pratistha, 2024, p. 655). The use of collaborative and decentralized workflows is used in animated films such as “Kubo and the Two Strings” (2016) shown in (Figure 137), in this kind of projects various teams in different parts of the world utilized cloud tools to collaborate and work on the film (Autodesk, 2025).



Figure 137. “Kubo and the Two Strings” (2016) by Travis Knight
Source: https://www.imdb.com/title/tt4302938/

Another technological trend is Non-Photorealistic Rendering (NPR). This is the pursuit of traditional forms of art in 3D animations. This technology was used in the film “A Scanner Darkly” (2006) shown in (Figure 138), and lately in the film “Loving Vincent” (2017) in (Figure 139), which was completely hand-painted. This shows the scope that NPR

allows to the artists. Where the animation becomes an art form rather than an imitation of reality (Fun et al., 2004, pp. 1-2). Furthermore, on the context of energy conservations. The animation industry is also attempting to be more eco-friendly as the ecological consequences of massive-scale productions are coming to light. NPR helps in lowering computational load. This way, there is an increase in focus on energy efficiency, the use of renewable sources of energy, and the reduction of waste. All of these activities fit in a larger campaign in the industry as a whole to merge imaginativeness with environmental consideration (Bob, 2024).



Figure 138. "A Scanner Darkly" (2006) by Richard Linklater

Source: https://www.imdb.com/title/tt0405296/

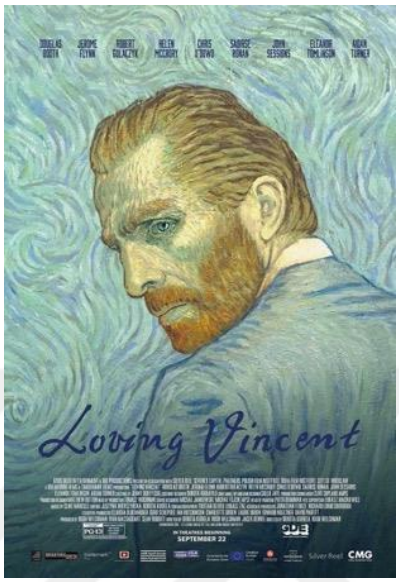


Figure 139. "Loving Vincent" (2017) by Dorota Kobiela and Hugh Welchman
Source: https://www.imdb.com/title/tt3262342/

In summary, the aforementioned technologies such as NPR, VR, revived interest in 2D style animation, and AI will collectively shape the future of animation. As the time will pass the need will grow and these technologies will develop further. Which will result in more complex and creative ways of telling stories through the use of the medium of animation.

2.1.5.1. Balance between Realism and Stylization

The blending of stylized elements with realism poses as a key artistic decision that affects all aspects of a film or a television series, including its story, imagery, and reception. Realistic animation employs an animated world, with characters and settings that closely resemble the real world. This is often the case when an audience needs to be engaged in a specific story or when a serious, dramatic narrative is being told. A typical example is "Ratatouille" (2007) shown in (Figure 140) by Brad Bird, where Paris is depicted, along with the food, and every other aspect of the kitchen is portrayed in terms of reality. The parallels

of light, texture, and movement were also stressed to capture how delicious the food was and how chaotic the kitchen (Herhuth, 2014, pp. 4-6). Another example of the use of realism can be seen in the film “The Adventures of Tintin” (2011), shown in (Figure 141), directed by Steven Spielberg, which utilizes motion capture for realistic character animation as well as facial expressions. The photorealistic setting of the film is blended with characters having a slightly more caricaturized appearance, yet the dominant impression of reality (Carter, 2019, pp. 1-2).



Figure 140. “Ratatouille” (2007) by Brad Bird

Source: https://www.ebay.com/itm/226201749580



Figure 141. "The Adventures of Tintin" (2011) by Steven Spielberg
Source: https://www.tintin.com/en/news/5617/the-adventures-of-tintin-of-spielberg-celebrates-its-10th-anniversary

Conversely, stylization in animation is also achieved by intentionally exaggerating or abstracting element. Such as character features, colors, and motion in order to portray a visual style that is more effective and often different from the norm. With the use of stylization, one can be more creative. This form of stylization is likely to be useful when a specific theme or emotion needs to be expressed. The "Triplets of Belleville" (2003) shown in (Figure 142) is one example of stylization where characters are shown to have grossly exaggerated proportions and odd movements. This condenses the feel of the film's quirky, surreal nature (Stein, 2006, pp. 1125-1126). The surroundings also become stylized with the aim of amplifying the absurdity and humor of the plot. So that the world becomes unlike in many ways to what we know, but is just right for the story. Another example is "The Iron Giant" (1999) shown in (Figure 143). Despite this film is being set in the 1950s it employs stylized characters' features and bizarre nostalgic emotional expressions. The film's design choices, like the large and expressive eyes of the Giant, give the character stronger emotional undertones. This deeply connect with the audience (Meyer, 2016, p. 4).



Figure 142. “The Triplets of Belleville” (2003) by Sylvain Chomet

Source: https://lwlies.com/articles/the-triplets-of-belleville-comfort-blanket-movie/



Figure 143. “The Iron Giant” (1999) by Brad Bird

Source: https://www.imdb.com/title/tt0129167/

However, many animated films succeed by incorporating aspects of both realism and stylization, allowing the advantages of both shifts. In this regard, Pixar’s “The Incredibles”

(2004) in (Figure 144) is a very good example, as it employs stylized visuals along with realistic human emotions and family relationships. The characters, like Mr. Incredible with muscles, are depicted with superhuman traits. But the film also uses realistic laws of physics, depicting stylish textures and realistic environments, making the world fantastical as well as relatable (Linsenmaier, 2009). In the same way, "Avatar: The Last Airbender" (2005-2008) in (Figure 145) also succeeds in combining exaggerated character designs with realistic, detailed world-building and action movements. The characters have large mouths and eyes with characteristic features of smooth and real movements encapsulated in martial arts, which is taught in the real world, making the story realistic (Abdullah & Abdullah, 2020, p. 548). This combination of realism with stylization offers the opportunity to produce a believable and powerful story.



Figure 144. "The Incredibles" (2004) by Brad Bird

Source: https://www.imdb.com/title/tt0317705/

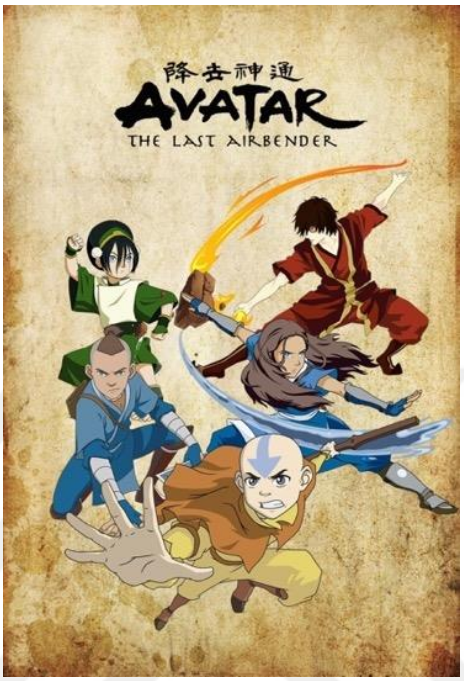


Figure 145. "Avatar: The Last Airbender" (2005-2008) by Michael Dante DiMartino and Bryan Konietzko

Source: https://aebperspective.com/2015/09/16/review-avatar-the-last-airebender-2005-2008/

Like any other creative process, finding a balance between stylization and realism is of utmost importance. Realism can hook viewers and allow them to become immersed in a story world. Whereas stylization allows for abstraction, exaggeration, and freedom of imaginative expression. The successful animations seem to always establish a middle ground. Where both realism and stylization are present. Therefore, these animations are visually enchanting while telling the story in a way that resonates deeply with the audience.

2.1.5.2. Improvements in Rendering and Modeling

Improvements in rendering and model creation have transformed the animation industry. This allowed producers to create more intricate, lifelike, and appealing animations.

These changes have provided more options in the domain of storytelling. Animators can now bring more unbelievable imagination to reality with accuracy. Due to the enhancements in rendering, development of a 3D model or a figure from a photograph or an image, have significantly improved the visual quality of animations (Tao & Wang, 2024, p. 45). Moreover, the inclusion of global illumination (GI) is one of the most remarkable innovations in this area. James Kajiya's "The Rendering Equation" research about light's reaction on different surfaces in (1986) laid the origins for the global illumination. GI is a feature that imitates the way light is reflected from surfaces in a scene, resulting in more natural illumination and shadowing (Kanyuk, 2014, p. 1). The application of GI during this process contributes to the film's rich and vibrant environments. Furthermore, augmenting the authenticity of the characters' relationships toward their digital environments.

Another important rendering improvement is to produce a final image of a scene in real time by using a real-time rendering software. The ability to use real-time rendering is especially important for animation and video game design. An example of real-time rendering is the use of the Unreal Engine during the production of the series "The Mandalorian" (2019), shown in (Figure 146). Even though it is predominantly a live-action series, the over-reliance on real-time rendering for virtual background proves the flexibility and realism that modern filmmaking can offer in conjunction with traditional techniques, and delivers even more for fully animated works (Huang, 2024, pp. 5-6).



Figure 146. "The Mandalorian" (2019) by Jon Favreau

Source: https://www.imdb.com/title/tt8111088/

Furthermore, path tracing is another new and innovative advanced technique that has put even animation work at the forefront. Path tracing aims to render an image that approximates how real-life lighting works through the interaction of light rays with polygonal objects in a scene shown in (Figure 147). To demonstrate this technique, Pixar's "Purl" Short film (2019) is shown in (Figure 148) which was a part of Pixar's SparkShorts program. Path tracing enables animators to convincingly show the interaction of light with materials and exaggerated their contribution to the visual narrative (Christensen et al., 2018, pp. 1-3).

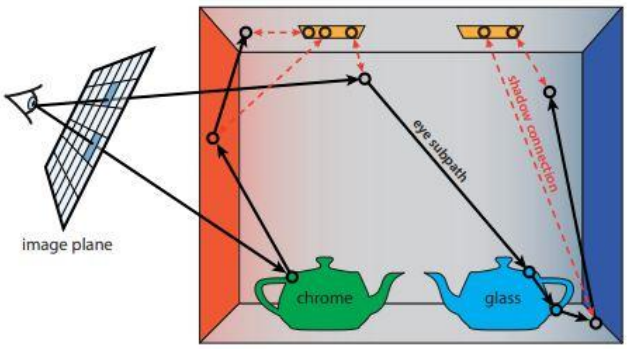


Figure 147. Path Tracing Process of how the human eye receives light information when bounces from different objects

Source: https://graphics.pixar.com/library/PathTracedMovies/paper.pdf



Figure 148. "Purl" (2019) by Kristen Lester

Source: https://www.hollywoodreporter.com/movies/movie-news/pixars-purl-brings-contemporary-message-siggraph-1227444/

The development of in the 3D modeling has seen significant progress. This includes modelling having a major advancement with the use of procedural modeling. In which algorithms can automatically build complex structures with use of codes. This technique was enormously important for creating the detailed cityscape seen in "Zootopia" (2016) shown in (Figure 149). In this procedural modeling technique aided in the vast city being filled with

many buildings and environments. All having different architectural styles corresponding to the animal species that lived there (Keim et al., 2016, pp. 1-2). Along with this, the introduction of sculpting software like Zbrush, lets an artist create models with an intricate surface texture, represents another major step in organic modeling. These techniques were extensively used in “Kubo and the Two Strings” (2016), shown in (Figure 150). Where studio Laika’s animators digitally sculpted the character models in order to prepare them for being brought to life with stop-motion animation (Halim et al., 2021, pp. 49, 52). The combination of traditional and digital styles resulted in characters that had much more detail in their textures, facial features, and expressions. This increases the film’s emotional and visual appeal.

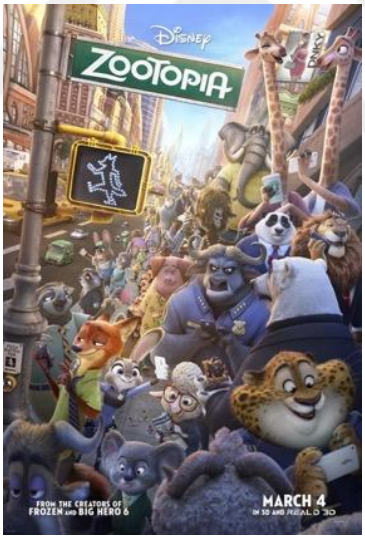


Figure 149. “Zootopia” (2016) by Byron Howard

Source: https://www.imdb.com/title/tt2948356/



Figure 150. "Kubo and the Two Strings" (2016) by Travis Knight

Source: https://www.hollywoodreporter.com/movies/movie-features/how-kubo-two-strings-merged-stop-motion-animation-3d-printing-a-400-pound-puppet-955406/

Lastly, volumetric modeling which is filling up of the 3D space with tiny units instead of mesh is used in 3D animation films. Now it is possible for animators to show intricate shapes such as water, clouds, and smoke with greater accuracy (Wu et al., 2006, p. 1). Disney studio used advanced volumetric modeling in "Moana" (2016) with the ocean rigs in (Figure 151). This advancement allowed water to be rendered and animated as a character. Which has the appearance and behavior of a living being. It was very crucial to model the water as realistically as possible and to humanize the ocean. As this was the focal point of the film (Garcia et al., 2016, pp. 1-2). The changes that have been made to rendering and modeling have advanced animation from its more basic and primitive forms to a sophisticated art with stunningly realistic pieces. Now, there are fewer constraints placed on the capabilities of animators. These advancements allowing animators to create visually stunning works that are more inquisitive and can captivate audiences more than before.



Figure 151. "Moana" (2016) by John Musker & Ron Clements
Source: https://www.imdb.com/title/tt3521164/?ref_=tt_mv_close

2.1.5.3. Advancements in Motion Capture Techniques

Motion capture (Mocap), as shown in (Figure 152), is the technique utilized to record people or objects in motion. It entails recording a person's movements and transforming them into a three-dimensional model. The development of new methods of mocap animation has transformed animation by making it possible for human characters to be depicted more realistically. At the same time, these developments are bound with the uncanny valley effect, where characters who closely resemble humans create discomfort because of their imperfections (McDonnell & Breidt, 2010, p. 1). With time, as technology improves, the gap between realistic and disturbing animation keeps narrowing, although creating human-like movements for computers remains problematic (Hodgins et al., 2010, p. 3). These issues are addressed with several significant innovations in mocap. The use of mocap can increase the realism of the animations and lessen the uncanny valley effect.

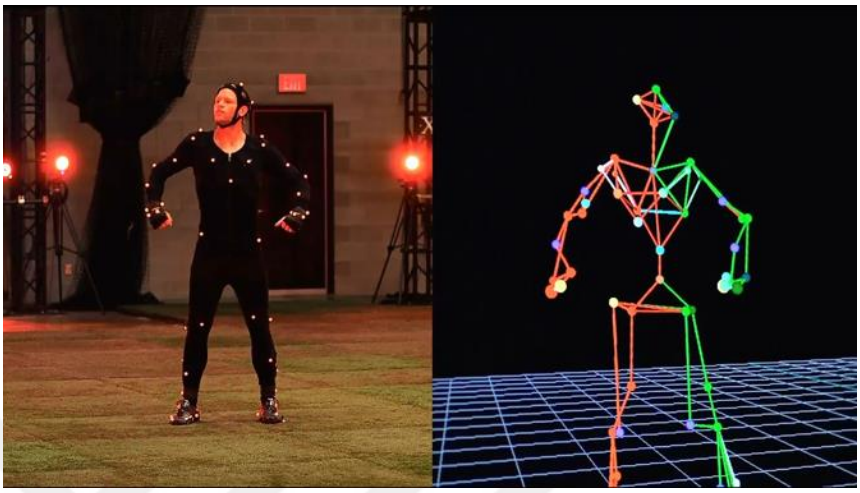


Figure 152. Motion Capture (mocap)

Source: https://fab.cba.mit.edu/classes/865.21/topics/scanning/05_mocap.html

Mocap technology has significantly improved particularly in capturing subtle facial expressions such as eye movement, and skin deformation. In early films such as “The Polar Express” (2004), characters were able to move their mouths smoothly, but their eyes remained frozen with less movements. This lack of nuance in the facial movements created the effect of the uncanny valley (Kamilmablog, 2015). Whereas modern facial mocap systems are used in films such as “Avatar: The Way of Water” (2022). Which was able to detect accurately and record even the slightest muscle movements and emotive facial expressions datas in real-time. This makes the characters appear more lifelike and less creepy than the previous attempts.

Building on facial motion capture, performance capture technique encompasses full-body performance capture. This facilitates capturing character performance by combining physical and facial movements. Earlier attempts, such as “The Polar Express” (2004), often exhibited kinematic stiffiness, but more contemporary versions, including “Alita: Battle Angel” (2019) and “Avengers: Endgame” (2019), have refined results. Seamlessly uniting the actor’s body, facial, and vocal performance, ensures a more cohesive character portrayal.

This aids significantly in one of the major challenges of the uncanny valley: the dissonance of body and facial movements, which causes unhuman-like portrayals of characters (Chandran et al., 2022, p. 7). Also, the inclusion of machine learning and AI with the use of mocap has started to change the industry. AI is competent to analyze and enhance motion capture data by smoothing gaps between the movements of actual human beings on animated characters, and also adjusting the facial and body languages (Kobayashi et al, 2023, p. 1)

Markerless mocap system is another important progress. Traditional motion capture used to require actors to adorn suits with incorporated reflective markers, which tremendously limited the fluidity of their movements. As seen in (Figure 153), industry-leading companies such as NVIDIA's move.ai and ReMoCapp have created sophisticated markerless motion capture systems that incorporate deep neural networks and advanced imaging devices that do not require the use of physical markers (Nvidia, 2022; Roberts, 2024). This enables actors to exhibit more natural behavior, which consequently results in smooth and realistic animations. The use of markerless capture has the potential to greatly help in overcoming the uncanny valley because it enables genuine performances that are not bound by restrictive conventional motion capture suits (Needham et al., 2022, pp. 11-13).

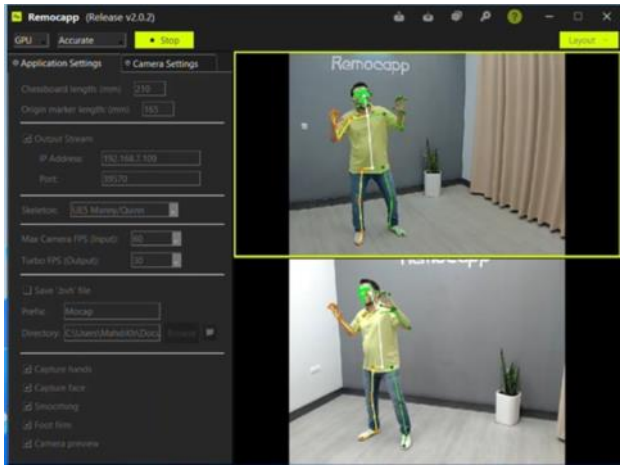


Figure 153. Markerless motion capture by ReMoCapp

Source: https://www.fab.com/listings/dacb8ae5-c42c-431a-85e4-74e17de660ba

Another major innovation in animation is volumetric capture. This captures the entire three-dimensional shape of an actor or environment. This methodology was implemented in "Star Wars: The Mandalorian" (2019). Where actors' movements were captured, along with their environment, for creating highly immersive virtual spaces. Volumetric capture also makes sure that lighting, shadows, and textures are realistic because both the performer and the spatial details are captured. This prevents the eerie artificiality of poorly integrated animations (Keenay, 2023, p. 27). The broad adoption of volumetric capture, mocap and rendering techniques in real time has also been a big step forward as animators can instantly see the effects of the captured motions. Real-time feedback enables deformation corrections to be made immediately, ensuring character animations, movements, and facial expressions are realistic, thereby circumventing the uncanny valley effect (Patoli et al., 2010, pp. 139-140).

Over the years, the evolution of these technologies has upgraded the realism of animation film characters. This visual development has subsequently enhanced storytelling. However, the challenge of the uncanny valley, still poses a threat. Even the characters that are the most lifelike can still evoke feelings of discomfort due to their movements or expressions by being slightly unnatural. Meeting this challenge is an ongoing effort to improve the technology. Also, to determine how much simplification and exaggeration of reality is appropriate for the character's design.

2.1.5.4. Virtual Reality

Virtual Reality (VR) is an immersive technology that enables users to experience interactions with computer-generated worlds virtually in real time. VR users uses specialized equipment, like headsets and motion controllers that they wear on their entire body, as shown in (Figure 154) and (Figure 155). By doing this the digitally simulate 3D environments make users feel as if they are literally living in another world (Yasar, 2024). This is a new phase of immersive animation. Where VR provides novel ways of creating, visualizing, and

experiencing animated films. This enriches the production process and increases audience's engagements. Furthermore, this technology allows filmmakers to interact with and modify digital spaces as though they were actual locations. Thereby, enhancing creative freedom and adaptability throughout the filmmaking process (Nassar, 2021, p. 66).



Figure 154. VR Headset Quest 3 by Oculus

Source: https://stealthoptional.com/article/meta-quest-3-supply-cuts-millions-headsets-poor-pre-orders



Figure 155. VR Headset, Apple Vision Pro

Source: https://www.linkedin.com/pulse/apple-vision-pro-observations-concerns-questions-from-cosmo-scharf

One of the most notable benefits of VR in animation is its application in previsualization. During this phase, directors as well as animators get the opportunity to enter virtual sets and plan the camera movements, composition of the scene, and choreography of the actions that would be performed during the animation in advance of rendering it. This unlike storyboarding, where the creation of the scenes is limited to two-dimensional drawing, VR previsualization allows the creators to imagine scenes in three dimensions, thereby facilitating their understanding of how the output will turn out (Muender et al., 2018, pp. 1-3). For example, in the making of "The Jungle Book" (2016) in, Figure 156) depicts VR technology assisting in the construction of the jungle setting as well as the positioning of cameras in the virtual space. Filmmakers were enabled with these techniques to look at various viewpoints, angles, and illumination arrangements, which realistically demonstrated how the characters would be animated within the digitally constructed space and helped to improve the narrative (Galvane et al., 2019, pp. 302-303).



Figure 156. Previsualization of "The Jungle Book" (2016) by Jon Favreau
Source: https://onset.shotonwhat.com/gallery/filming-the-jungle-book-2016-2/?tag=2169

VR has also impacted character animation in previsualization. Unlike the time-consuming process of animation, where the character's movements have to be captured from multiple frames, VR tools enable the animator to engage with the 3D models directly. With

VR, it is now possible for the animator to pose and animate the character within a virtual environment in real time. This form of storytelling allows filmmakers to direct and create animated movements with much more fluidity, since every single action can be treated the same way as in live-action filming. It combines the physical world and computer-generated images by enabling remote collaboration on animated sequences (He & Yuan, 2023, pp. 875-876). This has streamlined the production workflow of animation to be more efficient and creative. Directors and cinematographers, for instance, could set a virtual environment for a movie before filming, which helps remove expensive reshoots and post-production changes (Yang, 2020, p. 183). Hence, filmmakers can now apply and experiment with this flexible approach of real and virtual elements integration in their productions.

Lastly, VR technology extends to how audiences engage with animated films. VR transforms the viewer's role in storytelling to an active one. With VR, users can become part of the animated world as the fictional characters and travel freely within the animated setting, enabling avatar-driven storytelling. Such an approach is used by Baobab Studios, which produced VR animated shorts "Invasion" shown in (Figure 157) and "Asteroids" in (Figure 158). The experiences discussed above involve the viewer in the story's narrative, formulating them as an active participant within the storyline (Flores, 2021). Consequently, VR is reshaping how movies are made as well as consumed, merging the disengaged experience of watching a movie and the active engagement.



Figure 157. "Invasion" by Baobab Studios

Source: https://www.baobabstudios.com/invasion



Figure 158. "Asteroids" by Baobab Studios

Source: https://www.youtube.com/watch?v=6iJ41p7B7Xs

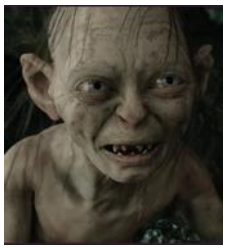
To summarize, VR is advancing the animation motion picture industry by improving character motion in the 3D environment, and virtual production processes. At the same time, it is offering novel ways of narrating stories. From big productions to small animation projects, VR is constantly redefining the realm of animation movies. Its adoption into the animation processes greatly simplifies the production process. Thereby, giving rise to new dimensions of creativity and engagement that was previously unknown to the audience.

2.1.6. Animation Films Featuring Realistic Characters

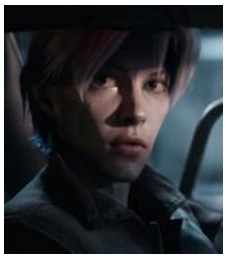
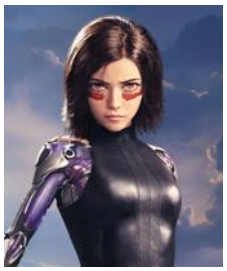
Animation films that include realistic characters have pushed the innovation in 3D technology and storytelling. The use of advanced techniques such as motion capture, 3D modeling, and photorealistic rendering allowed us to bring life to the characters to the very fine detail. The Table 2. classifies the popular animation films with realistic characters and summarizes the animation techniques employed for the visual realism of the main protagonist character.

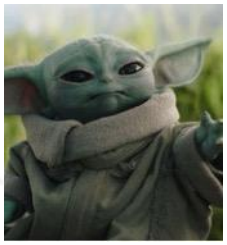
Table 2. Timeline of Animation Films Featuring Realistic Characters

	Film Name	**Character Name**	**Year of Release**	**Animation Technique**	**Character Photo**
1	Final Fantasy: The Spirits Within	Dr. Aki Ross	2001	CGI, Motion Capture	
2	The Polar Express	Hero Boy	2004	CGI, Motion Capture	
3	Beowulf	Beowulf	2007	Motion Capture	

4	A Christmas Carol	Scrooge	2009	Motion Capture	
5	Avatar	Jake Sully	2009	Motion Capture, CGI	
6	Tron: Legacy	Sam Flynn	2010	Motion Capture, CGI	
7	The Adventures of Tintin	Tintin	2011	Motion Capture, CGI	
8	The Hobbit: An Unexpected Journey	Gollum	2012	Motion Capture	

9	The Jungle Book	Mowgli	2016	Virtual Production, CGI	
10	Warcraft	Durotan	2016	Motion Capture, CGI	
11	Rogue One: A Star Wars Story	Grand Moff Tarkin	2016	Digital Re-Creation	
12	The BFG	The BFG	2016	Motion Capture, CGI	
13	Kubo and the Two Strings	Kubo	2016	Stop Motion, CGI	

14	Spider-Man: Into the Spider-Verse	Miles Morales	2018	Stylized Animation, CGI	
15	Ready Player One	Parzival	2018	CGI	
16	The Lion King	Simba	2019	Virtual Production, CGI	
17	Alita: Battle Angel	Alita	2019	Motion Capture, CGI	
18	Gemini Man	Junior/Young Wil	2019	De-Aging, CGI	

19	Avengers: Endgame	Thanos	2019	Motion Capture, CGI	
20	Detective Pikachu	Pikachu	2019	CGI	
21	The Mandaloria n	Grogu ("Baby Yoda")	2020	Animatronics, CGI	
22	Godzilla vs. Kong	Kong	2021	Motion Capture, CGI	
23	Avatar: The Way of Water	Jake Sully	2022	Advanced Motion Capture, CGI	

24	Ant-Man and The Wasp: Quantumania	Ant-Man	2023	CGI, Motion Capture, Digital Environments	

2.1.7. Uncanny Valley Indicators of 3D Animation Film

In 3D animation, achieving realism in character design and movement has been a long key goal for animation filmmakers. Realistic personifications of animation characters bear the risks of slipping into the uncanny valley phenomenon. Where minor imperfections in realism can lead to the feelings of discomfort. One must understand and identify the uncanny valley's indicators to avoid the discomfort when creating a captivative emotional experience. Elements such as poor lightings, substandard body movements, and unnatural facial expressions reduces audience engagement. Hence, during the development phase, disturbing elements that compromise viewers' experiences should be avoided. The viewers' experience can be compromised by the uncomfortable effects. These are caused by animators when trying to enhance reality. By doing this animation is devoid of realism completely. These elements can be categorized into two indicators: visual and behavioral.

2.1.7.1. Uncanny Valley Visual Indicators

The Table 3. below identifies key visual indicators and sub-indicators that contribute to the uncanny valley effect in animation films and explains how they impact a viewer's perception of realism.

Table 3. Visual Indicators for Animation Films

	Visual Indicators	**Sub-indicators**
1.	Facial Features and Expressions	● Lack of emotional depth. ● Asynchronous facial features.
2.	Skin and Texture Realism	● Overly smooth or plastic-like skin. ● Lack of subsurface scattering.
3.	Eye Appearance	● Dead eyes. ● Lack of tear film and wetness.
4.	Facial Proportions and Symmetry	● Too-perfect symmetry. ● Subtle off-scale features.
5.	Material and Lighting	● Unrealistic reflection and lighting. ● Misleading material properties (e.g., stiff hair, unnatural cloth behavior).

In uncanny valley visual indicator, facial features and facial expressions are fundamental. Faces are rich in detail. It can convey complex and subtle emotions. If the characters fail to demonstrate vast ranges of emotions or do not express their emotions adequately, they can appear robotic or lifeless (Diel et al, 2021, p. 3). Moreover, synchrony or asynchrony of facial movements like eyebrow movements and lip movements can break the illusion of reality for the viewer. These problems suggest that the character is not human

enough. Which can be unsettling for the viewers. Another factor to be considered is the realism of skin and texture. Characters with high detail, lifeless plastic-looking skin can create the illusion of liveliness. This significantly contributes to the uncanny valley's effects. Real human skin is not flat, it is textured with the attribute of light scattering known as subsurface scattering effects. Same as in reality, where skin exhibits depth and translucency. This contradiction between appearance and expected behavior can be visually disturbing when showing a mismatch (Alkawaz et al., 2017, p. 9596).

The eyes also play an important role in contributing to the uncanny valley. The eyes are often thought of as the windows to a person's soul. When a character's eyes look 'dead,' their connection with the audience significantly diminishes. Eyelessness often results from missing visual features such as a tear film or moisture that real eyes possess. Without these reflective features, the eyes look bland and lifeless, which adds to the eerie feeling. In addition, the lack of adequate proportions and symmetry of a character's face is also equally important to avoid the uncanny valley. Human faces have asymmetry, and a certain degree of it is what makes them exist in reality. A 3D character's face is too symmetrical or overly proportional, so it becomes uncanny. On the other hand, subtle distortions like lopsided scaling of features such as huge eyes and a tiny mouth can also create discomfort and unease as the character defies the human norm (Assaf et al., 2020, p. 98).

Lastly, 3D materials, shaders, and environment lighting settings have a significant impact on the perception of virtual realism. Shiny surfaces or incorrectly lit, skin on a character's face, hair, or clothing can act as a sign that the character is not real. For example, if skin that is too shiny with hair and clothing that is too stiff as well. Then this will not look normal and will lack the laws of motion. Hence, making the character appear unnatural and unresponsive (Graham et al., 2015, p. 1). When 3D materials behave in unrealistic way and does not resonate with real-world then the character's believability also reduces. This contributes to the uncanny Valley effect. Each of these examples serves a specific purpose in overcoming the uncanny valley. Viewing them in totality indicates whether a character is

truly human or exists in the unsettling world of the uncanny valley. Like this the near-realistic features become disturbing rather than captivating.

2.1.7.2. Uncanny Valley Behavioral Indicators

The Table 4. below categorises behavioral indicators and sub-indicators that contribute to the uncanny valley effect in animation films and describes how they influence a viewer's perception of realism.

Table 4. Behavioral Indicators for Animation Films

	Behavioral Indicators	**Sub-indicators**
1.	Body Movement	● Unnatural motion. ● Timing and weight inconsistencies.
2.	Lip-Sync and Speech	● Poor lip synchronization. ● Rigid mouth shapes.
3.	Eye Movement	● Inconsistent or static eye movement.
4.	Sound Design	● Mismatched sound that does not align with the character's appearance or actions.

Behaviroral indicators such as body movements when not executed properly can easily fall into the uncanny valley. If the movements 3D characters are flawed motion for e.g., overly stiff, robotic, or lacking smoothness in the pose-to-pose transitions they can immediately look unnatural. Realism can get disrupted by the discrepancies in timing and feeling of the weight. A character can appear weightless when performing body movements

without using natural forces, such as gravity. This will reflect in movements and make them out of sync with one another. Incoherent movements will appear as a result of this disconnect (Trieu & Thinh, 2024, pp. 7-9, 15).

Furthermore, inaccurate lip-syncing and speech is another critical factor. A disconnect sensation given to viewer with out-of-sync lip movements with verbal utterances. This happens when the words do not match the movements with the mouth of the character (Tinwell, 2015). Additionally, speech appear unnatural with rigid mouth shapes. Natural human speech patterns involve a complex range of mouth movements. Therefore, if these actions are simplified or too stiff then it can contribute to the overall uncanny quality of the characters.

Another important aspect of achieving believable realism is the movement in the eyes of the character. A character can look lifeless if the eyes that do not move at all or move inconsistently. Human eye moves in a certain manner to express the emotions it feels or the intention contradicted. A character's eye can be perceived as robotic or empty if the movements do not reflect their emotions (Pejsa et al., 2013, p. 145). Finally, sound plays an important role in making believeable visuals. Weak or absent of sound design in animation often reduces the realism. When sound is out of context with a character's actions, it creates a gap that further distances the character from real life. For example, if a character's footsteps sounds do not correspond to their physical features, the audience is left feeling annoyed. A contradiction emerges, which leads to the feeling of an eerie consequence. This range of behaviors, from movements to sounds, appears to work together toward achieving a sense of reality (Hassan et al., 2023, pp. 1-3). To capture the attention of the audience, sound and animated movements should appear similar and believable.

2.2. Uncanny Valley in Digital Games

2.2.1. Pixel Art and 16 Bit Era (late 1980s -mid 1990s)

Pixel art is a form of digital art where images are built from small pixel squares, dating back to the early stages of computer graphics when the resolution of the image was very low. Each pixel had to be carefully placed to create an image (Lyon, 2006, pp. 8-9). Around the late 1980s and early 1990s, video game consoles and personal computers were often deprived by the graphics support of the hardware. Which meant the color palette was very limited to only specific colors and a limited number of pixels that could be displayed on a screen straight away (Rajpurohit, 2024). Artists had to be very resourceful in these times because each pixel was counted. Character's personality, visual clarity, mood, and environment's feel, along with the game interface, had to be captured artistically within these tight confines. In spite of these difficulties, pixel art emerged as a means of great expression, as artists came up with creative ways to deal with the limitations. This period fostered the birth of the pixelated gaming graphics known as pixel art, which is still treasured and reproduced to this day.

Graphics became more detailed with the emergence of the 16-bit era in gaming. This led pixel art to gain higher attention. Pixel art began with monochrome 1-bit graphics. Further evolved through 2-bit (4 colors) and 4-bit (16 colors) formats. It was the 8-bit era that paved the art style with its 256 colors. Subsequently, more advanced pixel art was created during the 16-bit era that had 65,536 colors (Park, 2024). In the 1980s the 16-bit era was commencedand and extended through the 1990s. This marked considerable developments in video games as well as digital art with the advent of pixel art. This period is characterized by improvements in technology providing the ability to display complex and detailed visuals in games. But still relative to the limitation of computation power available during that time (McGuire & Gagiu, 2021, pp. 84-85). Consequently, to take advantage of the advancements, developers and artists adopted pixel art. Which consists of meticulously placing pixels to form a single image. A unique blend of technological limitations and artistic expression was provided in this period. This gave rise to some of the most memorable art styles in digital gaming.

The term 16-bit era signifies to the time span when video game consoles. The prominent 16-bit microprocessors were featured personal computers, and arcade machines. As compared to the previous 8-bit era this advancement facilitated major improvements in graphics and audio (History tools, 2024). For example, Super Nintendo Entertainment System (SNES) (1990) in the (Figure 159) and the Sega Genesis (1988) shown in (Figure 160) were the consoles that emerged as cultural symbols because of their enlarged color range and enhanced visual quality (Bhonker et. al., p. 5; Wacholz, 2024). These consoles could process larger, more complex sprites and backgrounds. Which gave developers and artists the capabilities to expand the limits of pixel art. During the 16-bit era, the pixel art aesthetic achieved its peak, and several video games became culturally iconic because of their astounding visuals (Rmcad.com, 2024).



Figure 159. "Super Nintendo Entertainment System (SNES)" (1990), developed by Nintendo

Source: https://starfox.fandom.com/wiki/Super_Nintendo_Entertainment_System



Figure 160. "Sega Genesis" (1988), developed by Nintendo
Source: https://nintendo.fandom.com/wiki/Sega_Genesis

The emergence of powerful hardware aided the enhancement of gameplay to a whole new level. Together with better sound quality and graphics. Released games during this time period were able to surpass their 8-bit earlier versions. "Super Mario World" (1990) shown in (Figure 161) and "Sonic the Hedgehog" (1991) shown in (Figure 162) reveals the period of platforming genre. These games were known for their innovative level designs. Moreover, they were well known for their pixel art styled creative character designs (Pearson & Tranter, 2015, pp. 828-830; Ayen, 2013). This period also withnessed the introduction of games such as "The Legend of Zelda: A Link to the Past" (1991) and "Chrono Trigger" (1995). This has reshaped the Role-Playing Game (RPG) elements with complex narratives, explorable worlds, and creatively designed puzzles (NitendoWiki, 2024; Jeremy, 2024). These video games not only further exceeded the hardware capabilities but also changed the extreme future expectations of gaming. They integrated advanced storytelling techniques and advanced gaming mechanics.



Figure 161. "Super Mario World" (1990) developed by Nintendo EAD (Entertainment Analysis & Development Division)

Source: https://www.grouvee.com/games/1383-super-mario-world/

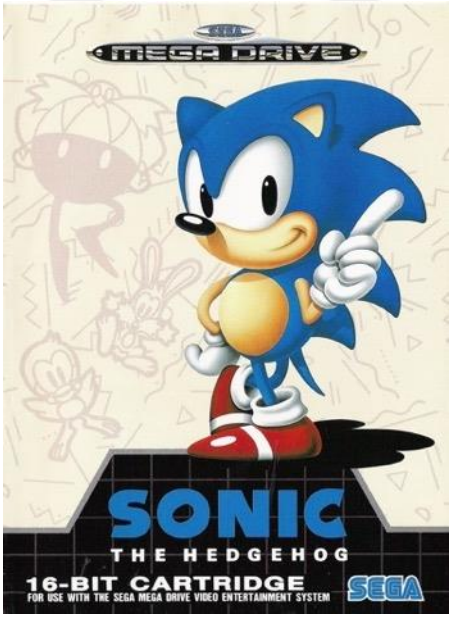


Figure 162. "Sonic the Hedgehog" (1991) developed by Sonic Team

Source: https://tr.wikipedia.org/wiki/Kirpi_Sonic_%28video_oyunu,_1991%29

Fighting games also became a massive hit alongside the rise in popularity of other genre of games from this era. Games such as “Street Fighter II” (1991) in (Figure 163) and “Mortal Kombat” (1992) in (Figure 164), became cultural icons owing to their character roster as well as gameplay (Church, 2022, p. 15; Su, 2010, pp. 361-362). Moreover, the integration of the Super FX chip in consoles introduced 3D graphics for the first time in “Star Fox” (1993) (McFerran, 2023). Games like “Mega Man X” (1993), “Donkey Kong Country” (1994), and “Final Fantasy VI” (1994) featured some of the best graphics and gameplay during the period. However, their influence went further. These titles were able to inspire countless modern games through remakes and re-releases. There is no doubt that the 16-bit era is extensively recognised as a golden era of gaming. This is because of its immense creativity, innovation, and multi-dimensionality (York & Jones, 2024).



Figure 163. “Street Fighter II” (1991) by Capcom

Source: https://m.imdb.com/title/tt0278746/?ref_=tt_mv_desc



Figure 164. "Mortal Kombat" (1992) by Midway Games
Source: https://www.imdb.com/title/tt0203701/

Even though the 16-bit era games used stylized and elaborated pixel art, this era pioneered the future of visual and technological advancements (Ansimuz, 2024). This led to the exploration of the uncanny valley phenomenon in later video games with evolved graphic capabilities in regards to character designs, environments, and the overall gameplay.

2.2.1.1. Humanised Characters in Pixel Art Games

The use emotional depth despite the simplistic art style grew the popularity of humanized characters in pixel art. The simplicity of pixel art invites infinite interpretation from the game players. This enabled them to project their emotions and feelings onto the characters by enhancing their relatability (Zufri and Hilman, 2022, p.30). This design trait not only fosters emotional connections with players but also aids them in recognizing the common characteristics that the characters possess. Whether it is bravery, sorrow, or happiness players could relate to it. The powerful emotional resonance of these characters, along with their stories is enhanced by nostalgia that many players feel towards pixel art as it reminds them of their initial encounters with video games (Brown, 2023).

Primarily in the independent gaming sector pixel art style has enabled creators to explore intricate issues like mental health, identity, and relationships as an artistic expression. Often, these games related to this context focus greatly on the plot and characters and proving that pixel art is more than a mere visual game art style (Sindhu et al., 2022, p. 1031). This means that it can be demonstrated as an effective artistic medium that could be used for various purposes in the digital gaming industry. Indie games such as “Celeste” (2018) depicted (Figure 165) and “Undertale” (2015) in (Figure 166) show that it is possible to create a rich, engaging gaming experience. This blends meaningful narrative with retro-style graphics. The limitations imposed by the pixel art style foster creativity as character design is brought down to simple forms. While still retaining distinct traits and expressions that make them memorable and appealing (Chiasson, 2023, pp. 365-367; Rose, 2015).



Figure 165. “Celeste” (2018) by Maddy Makes Games

Source: https://en.wikipedia.org/wiki/Celeste_(video_game)



Figure 166. "Undertale" (2015) by Toby Fox

Source: https://m.imdb.com/title/tt5238848/mediaviewer/rm2388399872/

The unique combination of pixel art's vintage appeal alongside the modern, and sometimes sophisticated themes in the characters, environments, and overall gameplay makes them more fascinating. Players are able to engage with classic and modern narratives of the games with the help of these graphics. These graphics serve as the bait for the players, while the depth and relatability of humanized characters captivate the player's engagement (Thibault, 2018, pp. 4-8). Since players tend to visualize and perceive the details within pixel art themselves, they form a strong connection with the characters, making every game extraordinarily memorable.

2.2.2. Transition to 3D Polygonal Character Modelling

The gaming industry's shift from pixel art to 3D polygonal character modelling is being driven by player expectations, the level of technology, and the degree of realism that is being aimed at. Modern Graphics Processing Units (GPUs) enable the rendering of complex 3D cinematic illustrations in real-time, which provides more flexibility in the production pipeline, smoother animations, and adds realism to the 3D models that the RPG

audiences are looking for as an experience (Lan, 2023, pp. 94-96). In addition, 3D assets are more appropriate for the immersive visual narrative that is common in multi-genre games as well as for computer simulations that are employing VR and AR technologies (Tang & Ho, 2020, p.3). While pixel art has its enthusiasts, especially among indie gamers, it is the 3D modelling that allows for a greater diversity of artistic direction and game design, which is more in tune with the modern-day requirements and tastes of gamers.

2.2.2.1. Technological Limitations

Realism in 3D graphics gaming on older platforms (consoles and PCs) was affected by the limited processing power, low memory size and low storage capacity of the hardware (Laviola, 2008, p.12). These platforms configurations prevented the ability to perform complicated computations that were required for real-time 3D rendering. Hence, the industry switched to simpler 2D pixel art until graphics processing units did not have the required shading and texturing capabilities necessary to create true to life graphics. Due to these limitations authentic visuals production was minimal. The low screen resolutions also limited the realism of the 3D graphics, further reducing the visual impact (Nickolls & Kirk, 2010, pp. 3-4).

For real-time shading, lighting, and rendering techniques the necessary hardware to support was not enough in the early computers. In addition to this it was incredibly difficult for production managers to design detailed 3D assets in time. This is because of the slow upgrades in game development-related applications, specifically for 3D modeling and animation. Gradually, after the continuous advancements in computer technology and by overcoming these obstacles the gaming industry was able to shift to the modern standard of realistic 3D graphics. Hence creating high-quality 3D graphics that are seen in today's video games.



Figure 167. "Final Fantasy VII" (1997) by Square

Source: https://www.imdb.com/title/tt0208155/

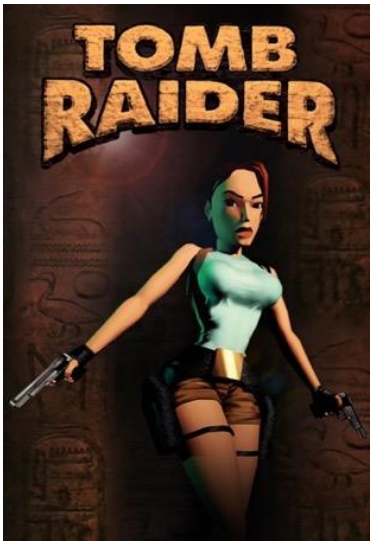


Figure 168. "Tomb Raider" (1996) by Core Design

Source: https://www.imdb.com/title/tt0190838/

Numerous early consoles, such as the Nintendo Entertainment System (NES) (1983) and Sega Genesis (1988), are depended on pixel art because of their low processing power and small RAM size, which could not accommodate complicated and elaborate 3D graphics. The PlayStation I (1994) led the shift to 3D consoles with titles such as Final Fantasy VII by Square (1997) depicted in (Figure 167) and Tomb Raider by Core Design (1996) in (Figure 168). Both games unfold an adventurous journey of mystery and combat. Its graphics, with blocky character models and low-resolution textures, were primitive by today's standards (Auronlu, 2023; McKenzie, 2024; Dally et al., 2021, p.2). The visual design elements of the games as dungeons and ancient temples. This brings depth to the storytelling and develops the characters' personas.



Figure 169. "Grand Theft Auto IV" (2008) by Rockstar North

Source: https://en.wikipedia.org/wiki/Grand_Theft_Auto_IV

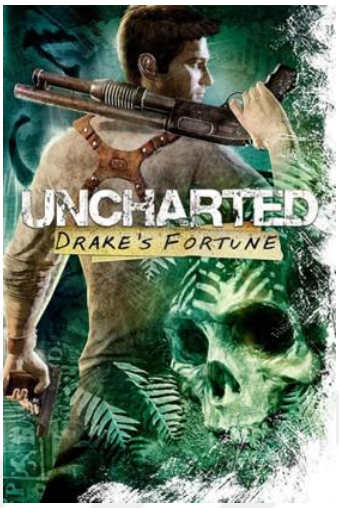


Figure 170. "Uncharted" (2007) by Naughty Dog

Source: https://www.imdb.com/title/tt1000777/

The realism in video games was first noted during the evolution of graphics enabled by the Xbox (2001) and the PlayStation 2 (2000), as well as the later release of PlayStation 3 (2006). Unlike their predecessors, these consoles had advanced GPUs, which enabled games such as "Grand Theft Auto IV" (2008) in (Figure 169) and "Uncharted" (2007) in (Figure 170) to feature realistic graphics for the environment and character models (Chloe, 2024).



Figure 171. "Cyberpunk 2077" (2020) by CD Projekt Red

Source: https://store.steampowered.com/app/1091500/Cyberpunk_2077/



Figure 172. "Horizon Forbidden West" (2022) by Guerrilla Games

Source: https://en.wikipedia.org/wiki/Horizon_Forbidden_West

Currently, consoles such as PlayStation 5 (2020) and Xbox Series X (2020) are integrated with cutting-edge graphics processing units (GPUs). These consoles make use of ray tracing technology. This technology allows for incredibly realistic lighting and reflections which is seen in games, such as "Cyberpunk 2077" (2020) in (Figure 171) and "Horizon Forbidden West" (2022) in (Figure 172) (López & Casado, 2023, p. 6). These advancements are further proof of how the industry continues to overcome obstacles. Finally, overcoming the technological limitations and high production costs with its ever-growing need for realistic 3D graphics technology.

2.2.2.2. Character Realism Technology in Digital Game

The progress of software, asset creation and testing tools, and version control systems for game development has facilitated the making of character models more realistic. During the initial phases of character modeling, developers were bound to work with basic polygonal shapes and textures at a very simplistic level. Advanced modeling and animation software such as Unreal Engine, Unity, Blender, and Autodesk Maya has fully automated the process of feature-rich modeling, texturing, and rigging (Delicado & Pelechano, 2019, p. 1). Normal mapping, as shown in (Figure 173) and Subsurface Scattering (SSS) in (Figure 174), creates realistic skin textures, while motion capture makes it possible to animate characters realistically by capturing the motion of real actors and mapping it to a digital character (Videobolt.net, 2024). AI-powered tools also contribute to automation using procedural generation, which helps to add details and behaviors of characters (Wu et al., 2023, pp. 15350, 15357).



Figure 173. Normal Mapping
Source: http://wiki.polycount.com/wiki/Normal_map



Figure 174. Subsurface Scattering (SSS)

Source: https://cgiknowledge.wordpress.com/2013/01/25/subsurface-scattering-sss/

The expectations of players played a major role in this movement toward realism in gaming. Players began to desire more engaging experiences with the improvement of the technology. This exposed them to visuals in a similar way that induces the psychological condition of the mental state of flow (Matysczok et al., 2004, p. 270). The regular users often demand for a better-quality graphics that are able to tell richer naratives. Hence, creating emotionally appealing realistic characters can enhance holistically the immersive experience of the game world and make character interactions seem more human. This could result in increased emotional attachment towards the character. This only strengthens the effect of the gaming experience with strong stories.



Figure 175. Ray tracing

Source: https://www.ionos.co.uk/digitalguide/server/know-how/ray-tracing/



Figure 176. Physically based rendering (PBR) materials

Source: https://www.a23d.co/blog/benefits-of-using-pbr-textures

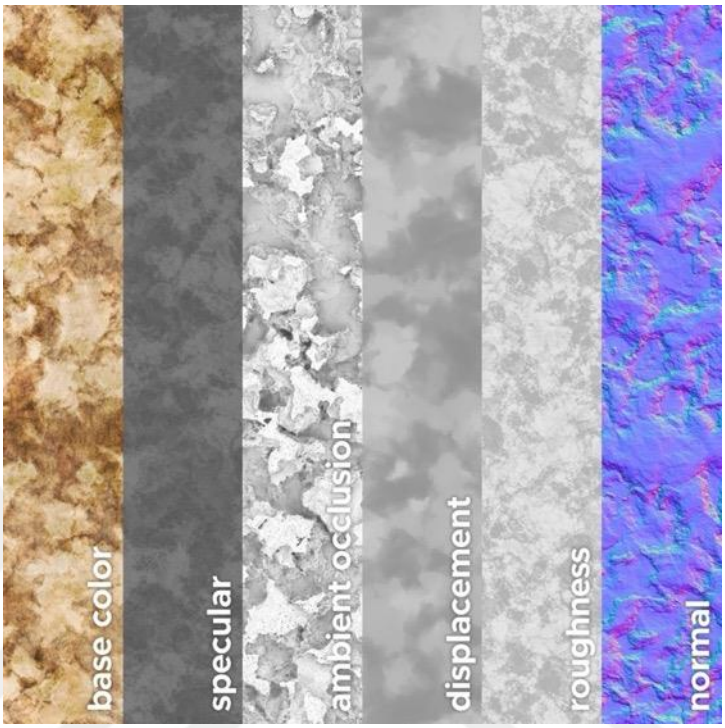


Figure 177. PBR Maps

Source: https://www.a23d.co/blog/what-is-pbr

At present, unprecedented realism levels with hyper-realistic details can be seen in 3D characters. This is because of the use of Physically Based Rendering (PBR) materials shown in (Figure 176) and photo-realistic textures, and believable animations. PBR materials are physically based rendering materials that uses algorithms revolving around physics to create visually accurate models consistent under different lighting conditions (Hiranyachattada and Kusirirat, 2020, p. 1). These materials usually contain several maps such as albedo (color), metallic, roughness, normal, and ambient occlusion, as shown in (Figure 177). The overall realism is gained by the collective use of these maps. Moreover, with the use of advanced technologies such as ray tracing, as demonstrated in (Figure 175), 3D characters are lit, shadowed, and reflected accurately. Hence, this creates a highly immersive environment with realistic visual details in the 3D objects (Dhote et al. 2020, p. 1).



Figure 178. Photogrammetry

Source: https://bitfab.io/blog/photogrammetry/



Figure 179. Camera setup for Photogrammetry

Source: https://levels.io/3d-scan-phone/

Developers can also utilize scanning techniques like photogrammetry, shown in (Figure 178) to copy real-world textures and use them directly into the game. Also, photogrammetry saves time and money when generating graphic assets since there is no need

to create 3D models from scratch (Apridal et al., 2024, p. 1). In order to make characters more realistic, faces and bodies are scanned using photogrammetry. Actors could receive facial scans, which involve taking hundreds or thousands of photographs in a controlled light environment shown in (Figure 179). The software then creates a 3D model of a user's face with all the intricate details like skin texture, wrinkles, pores, and facial hair using the processed images. This technology can also be used to generate fully realized characters with entire body scans (Statham, 2020, pp. 292-296).



Figure 180. Unreal Engine 5 (Nanite and Lumen)
Source:https://www.reddit.com/r/SteamDeck/comments/zldzr9/anyone_tested_nanite_lumen_effects_on_unreal/?rdt=63976

Game development engines such as Unreal Engine 5, shown in (Figure 180), use real-time rendering technology. This program offers advanced features such as Nanite (geometry system) and Lumen (global illumination and dynamic lighting system) that allow the use of detailed assets with no performance compromises (Mittal et al., 2024, p.5). Unlike primary character modeling, which was polygonal and texture-based, modern character modeling technique is advanced by the use of blend shapes and AI for automating facial and body movements, creating astonishing realism in characters.

2.2.3. Animation Advancements in Digital Games

The progression of animation in digital games has relied heavily on advancement in technology that supports realistic, smooth, and dynamic movements of characters. These developments are usually connected to better motion capture, procedural animation, artificial intelligence, and physics simulations, wherein the characters are able to engage with the elements around them as well as with other characters in a realistic way. For example, motion capture uses video cameras and trackers to follow the movements of actors and transfers this data to animated characters so that the characters can emulate accurate human-like motion. "The Last of Us Part II" (2020) by Naughty Dog Studio, shown in (Figure 181), employs motion-capturing techniques to capture motions, face gestures, and mimics to the character animations (Harisova, 2020).



Figure 181. "The Last of Us Part II" (2020) by Naughty Dog Studio
Source:https://www.naughtydog.com/blog/the_last_of_us_part_ii_remastered_announcement

Another novel development in video games is the procedural animation, which comes from the ability to fully create animations without the need for an artist's manual interference (Bhatti et al., 2016, p. 1). Instead of manually drawing keyframes, procedural animation

implies the use of algorithms and rules for the automatic generation of movement of an animated character, object, or environment. Nowadays, game characters can alter their motions based on the environment or actions of the player. For instance, in “Gibbon: Beyond the Trees” (2022) shown in (Figure 182), animation automates the adjustments to a building’s contours and other obstacles during the character’s climbing and parkour, which makes movements of the character highly fluid and responsive (Boxerman, 2022). In “Red Dead Redemption 2” (2018), shown in (Figure 183), it has one of the features of procedural animation with the ability of the environments to be active within the scenes. In this case, the protagonist’s movement, such as walking or running, changes with the surroundings, and as the character walks over rocks or other uneven surfaces, his arms and legs move naturally, giving an immersive experience (McKeand, 2018).



Figure 182. “Gibbon: Beyond the Trees” (2022) by Broken Rules

Source: https://store.steampowered.com/app/1837330/Gibbon_Beyond_the_Trees/



Figure 183. Red Dead Redemption 2 (2018) by Rockstar Games

Source: https://store.steampowered.com/app/1174180/Red_Dead_Redemption_2/

The technology of Inverse Kinematics (IK), illustrated in (Figure 184) with the real-time physics implementation, facilitates the character's interaction with the environment in a more sophisticated manner. IK settings make combat animations appear realistic as the characters' body parts can move towards objects and interact with them naturally (Liu et al., 2023, p. 3-4). In the game "God of War" (2018), the movements of Kratos make use of IK so that his actions during combat, such as striking a weapon with an enemy, accurately sync with his movements, allowing the player to feel the impact during battle (Polygon, 2018). The real-time based physics engines with digital game characters in them, like in the case of "Half-Life 2" (2004), made it possible for such characters to react to physical forces realistically. The animation system of the Source Engine, which features physics-driven character animation, provides realistic ragdoll effects, and therefore, characters' reactions to impacts and collisions are more captivating (Purdy, 2024).

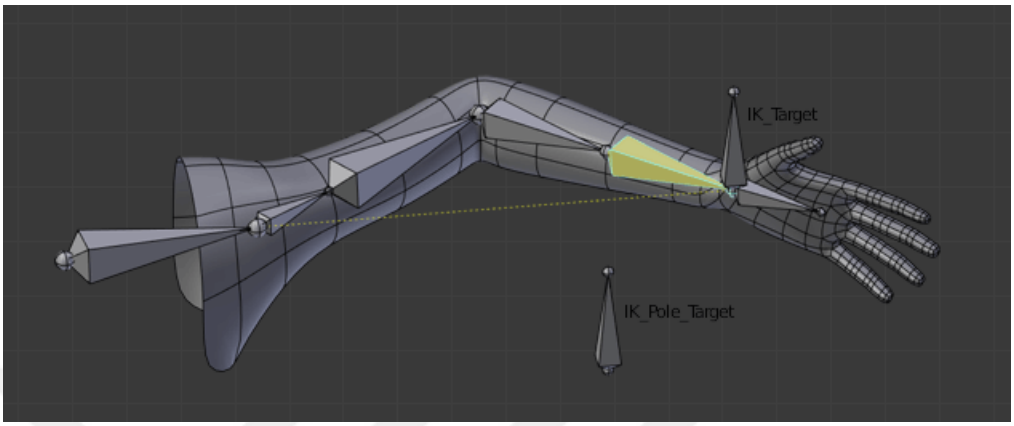


Figure 184. Inverse Kinematics (IK)

Source:https://docs.blender.org/manual/en/latest/animation/armatures/posing/bone_constraints/inverse_kinematics/introduction.html

Moreover, the scope of animation has significantly changed with the use of AI technology. This further enhanced the immersion by allowing the Non-Playable Characters (NPCs) more believable interactivity with autonomous agents in the world around them. For instance, behavioral animation in “The Elder Scrolls V: Skyrim” (2011) allows NPCs to participate in social activities. Furthermore, to communicate with one another, and respond appropriately to the player’s actions, thus crafting a vibrant, living world (Smith & Carette, 2020, p. 2; Asensio et al., 2014, p. 3). Ubisoft gaming studios has implemented AI-driven features in crowd simulation of a scene populated with 10,000 interactive NPCs in “Assassin’s Creed: Unity” (2014). This achievement was facilitated by the full utilization of PlayStation 4 and Xbox One. Hence, permitting much more advanced integration of crowds than older games, which were only able to show around 200 NPCs. The advanced AI allows each of the NPCs to respond to the player in some manner. Therefore, further enriching the environment and interaction within the gaming world (Hillier, 2014).



Figure 185. Non-Player Characters (NPCs) from "The Matrix Awakens" 2021
Source: https://www.freethink.com/robots-ai/ai-npc-voice-conversations

With the incorporation of AI technology in Unreal Engine 5, the NPCs now have more engaging conversations with players. This has enhanced the overall video game immersion. A more fluid manner of response is provided when these NPCs have interactions to the players. Their responses are context-sensitive, enabling more sophisticated narrative interactions. This evolution in AI-responsive NPCs increases realism, sometimes to the degree of crossing into the uncanny valley. This shifts the NPCs' role from becoming static props to game-defining elements, thus transforming the future of gaming altogether (Mr.MinuteTV, 2923). In "The Matrix Awakens" (2021), shown in (Figure 185), NPCs are brought to life with AI-driven voice technology. This supported a higher interactivity and dynamism in NPCs engagement with players. Furthermore, with the use of the text-to-speech technology, these NPCs react to players' dialogues in real time. Therefore, making the environment richer and more interactive. It transforms how personalized games can be responsive and gamified. Where NPCs are no longer passive and without memory versus advanced player-based actions, thus ending the confines of classic gaming. Hence, this enables a deeply immersive non-linear way of interactive storytelling through games (Johnson, 2023).

2.2.3.1. Motion Capture Integration for Digital Games

The introduction of motion capture technologies has fundamentally transformed the gaming sector. This enabled the creation of realistic animations of character movements. Moreover, the interactivity with game characters has greatly improved with the rise of optical tracking systems, inertial sensors, and marker-less motion capture. For example, to capture human movement with high accuracy optical motion tracking systems such as Vicon, shown in (Figure 186), and OptiTrack uses several high-definition cameras (Garcia et al., 2022, pp. 3-4).

These systems are equipped with predetermined markers that are placed on an actor's body, which move in a predefined sequence and are later converted into their digital form. Thus, game designers have the ability to capture the elegance of human movements so that the characters can be animated in a way that allows for the most optimal interaction in games such as "Red Dead Redemption II" (2018) and "The Last of Us Part II" (2020). The incorporation of facial motion capture technology also enables more sophisticated expression and lip movements, which enhances the storytelling capabilities featured in dialogue-driven games (Zhang et al., 2021, p. 84).

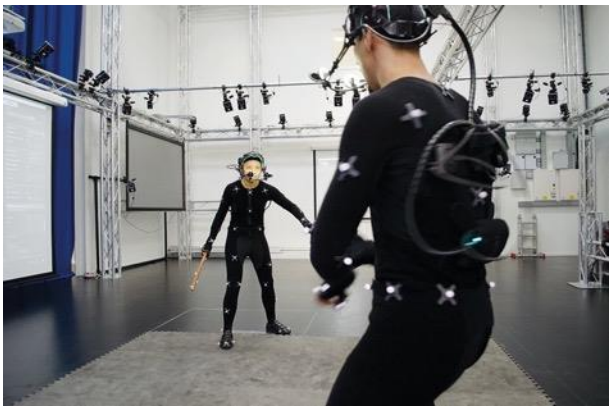


Figure 186. Vicon Optical tracking systems

Source: https://animost.com/ideas-inspirations/important-things-to-know-when-implementing-motion-capture-with-a-budget/

Additionally, the AI intergrated systems of motion capture were further improved through the use of AI since they didn't require a suit system or markers, thus decreasing the time taken to set up. Therefore, allowing for more freedom to capture the performances (Bleiweiss & Kutliroff, 2009, p. 1). AI and machine learning mocap systems are significantly improved and even available to indie developers through major companies such as Xsens and Microsoft (Sikkema, 2024). Moreover, for new users the rise of AI based real-time motion capture technology have made the technology more practical and quicker to use. For example, Faceware Studio, that allows developers to capture and then animate the characters with real-time motion capture devices powered by the Epic Games' Unreal Engine 5, shown in (Figure 187). Thus, allowing better interactions within the game and improved character animations (Facewaretech.com, 2024). The advancements of these technologies resulted in not only the integration of enhanced interactivity within video games for advanced gameplay but also further improved the visual clarity.



Figure 187. Faceware Studio (real-time mocap tool)

Source: http://www.jadason.com.hk/news/faceware-studio-20200512/

2.2.4. Realism and Visual Components

The change in technology has shifted growth of realism in digital games. Specifically with the developments in ray tracing, simulations, and GPU-based renderings. Modern gaming has transformed with the use of ray tracing technology in lighting and shadowing. Developers can now simulate scenario-based light movement to achieve photorealistic visuals in complicated scenes (Rui et al., 2014, p. 1). In addition, the development of realistic avatars with realistic facial expressions shows subtle emotions to facilitate the emotional bond between the characters and the players. This is enabled with the use of the complex lighting and rendering techniques. The interactivity and realism of video games have improved through the blending of all these technologies. Hence, making it possible for players to interact with virtual worlds as if they were real. The gap is merged of between the physical and digital worlds.

2.2.4.1. Ray Tracing, Simulations and Graphics Advancements

The advancements in rendering technologies made a paradigm shift in 3D game design with the use of advanced simulations, graphics, and ray tracing technology. Allowing more engaging and visually impressive games to the end user. Ray tracing imitates the real-time interaction of light with different elements and signifantly enhances video game graphics quality. This is achieved by providing highly accurate reflections, shadows, and global illumination (Wald et al., 2003, p. 2). It computes the appropriate light refraction, reflection, shadowing, and even indirect lighting for every object in the scene. It is an advanced rendering method for lighting.

Contemporary GPUs, example NVIDIA’s RTX Series, comes with advanced technologies that shows results of unbelievable realism. This can be seen in games like “Cyberpunk 2077” (2020) and “Minecraft RTX” (2020) in (Figure 188) (Walia, 2024). Moreover, ray-traced reflections dynamically mirror changing environment and surroundings for example the movements of NPCs and weather. Additionally, ray tracing

also uses global illumination that contributes to realism by simulating the physical behavior of light's natural reflection between different surfaces.



Figure 188. Raytracing Technology on Minecraft RTX (2020) by Mojang Studios
Source: https://www.forbes.com/sites/tiriasresearch/2020/04/14/nvidias-rtx-ray-tracing-brings-minecraft-to-life/



Figure 189. Battlefield 2042 (2021) by Electronic Arts
Source: https://kotaku.com/im-enjoying-battlefield-2042-but-there-may-be-somethin-1848085935

When it comes to create real-time 3D video games the realistic 3D simulations are also very essential. The developers are able to design more realistic interactions among objects, characters, and the environment by using the physics-based 3D simulations. Games like “Dragon’s Dogma 2” (2024) use complex physics engines for simulating real-life objects in a virtual setting, which enhances immersion and adds depth (Arcari, 2024). Moreover, advanced fluid and particles simulation enables more detailed displays of smoke, fire, and explosions in video games, such as in “Battlefield 2042” (2021), shown in (Figure 189). Hence, the ability to render richly detailed and highly interactive virtual worlds is possible because of the advancements and improvements in the simulation, ray tracing, and graphical enhancements.

2.2.4.2. Realistic Avatars and Facial Expression

In order to create realistic avatars with lifelike expressive faces, developers use advanced 3D scanning technology. This process involves capturing the distinct features of an entity’s face, body, and even clothing in high detail. The highly realistic digital human creation MetaHuman technology is also successfull in creating hyper-realistic digital humans in a very short time with realistic features in both appearance and movement of humans (Bae et al., 2024, pp. 1-2). Moreover, photogrammetry technology is also used to record surface details, including pore skin textures and fine facial details, which enhance the realism of the character (Riviere et al., 2020, p. 1). Alongside, face motion capture technology is used to track real actors’ facial movements and apply them to the digital characters (Breidt et al., 2003).



Figure 190. Facial mocap

Source: https://www.gameon.studio/services/

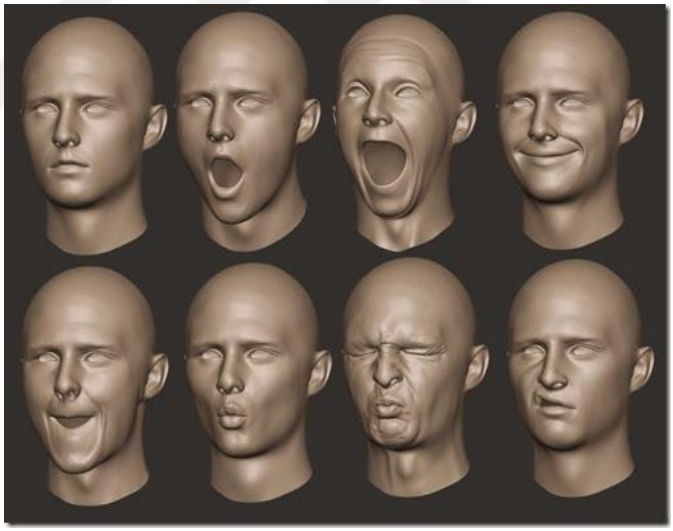


Figure 191. Blend Shapes

Source: https://graphicalanomaly.wordpress.com/2015/07/17/blendshapes/

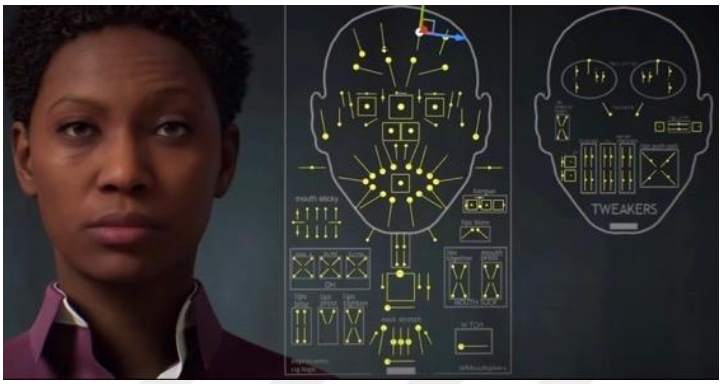


Figure 192. Meta human Face Rig

Source: https://80.lv/articles/a-tutorial-on-using-the-metahuman-facial-rig/

The realistic capturing of facial movement poses its own challenges, requiring the constant innovation with more advanced technologies. The key parts of the face motion capture system, depicted in (Figure 190), which tracks an actor's face using specialized systems in real-time, are high resolution camera and a sensor. Such systems can be used as head-mounted cameras, or marker-based, and can capture more than a hundred markers on the face, capturing very detailed actions like eyebrow twitches or lip curling (Dagnes et al., 2019, pp. 87, 92). In addition, the animation techniques such as blend shapes in (Figure 191) and muscle-based face rigging in (Figure 192) can also facilitate the simulation of sub-dermal movement of facial muscles, making the character more realistic.



Figure 193. "Baldur's Gate 3" (2023) by Larian Studios

Source: https://www.imdb.com/title/tt13258344/

The blend of realistic avatars with convincing facial expressions results in immersive and emotional engaging experiences. To enable stronger connections with digital characters, integration of realistic body movements with facial mocap technology for generate expressive faces is used. For example is "Baldur's Gate 3" (2023), shown in (Figure 193), uses advanced facial animation together with full body motion capture (Aiden, 2023). Through this approach, the characters were able to display a wide range of emotions during interactions with companions and NPCs. Furthermore, portraying emotions from subtle smiles to deep grief. Like this the players not only heard the narrative through dialogues, but also saw the narratives through the facial and body languages. This adds an emotional depth to the context surrounding their decisions and conversations.

2.2.4.3. Realistic Environments

As discussed in the previous sections, the use of realistic 3D environments increases the overall players' engagement and makes the gameplay more immersive. When the 3D environment surroundings look naturally convincing or in close proximity to the real world then it can increase the players' emotional and psychological involvement as they are able to get lost in the world around them. This validates the idea that realistic 3D environments can cause stronger emotional responses. Hence, realistic 3D environments enhance the visual quality of the story. Moreover, the players can develop a connection with the characters and the entire narrative.

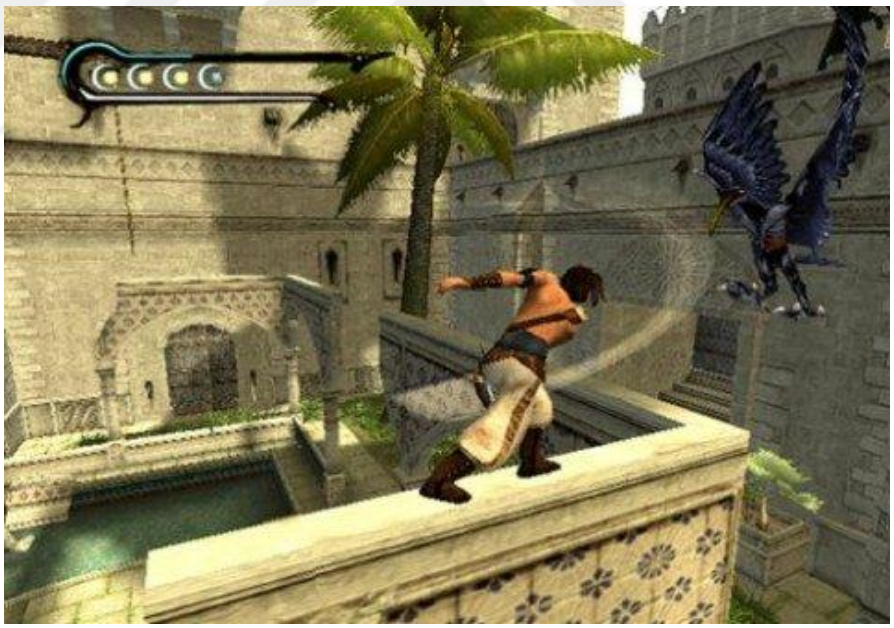


Figure 194. "Prince of Persia: The Sands of Time" (2003) by Ubisoft Montreal

Source: https://www.uvlist.net/game-154054-Prince+of+Persia+The+Sands+of+Time



Figure 195. A visual of Florence from Assassin's Creed 2 (2009) by Ubisoft Montréal

Source: https://www.trustedreviews.com/reviews/assassins-creed-ii



Figure 196. A visual of Venice from Assassin's Creed 2 (2009) by Ubisoft Montréal

Source: https://assassinscreed.fandom.com/wiki/Venice

Besides game immersion, creating believable environments helps to make games more realistic. Playing games in realistic 3D environments can give rise to strong feelings such a fear, surprise, tension, and anger. For example, the environmental design in “Prince of Persia: The Sands of Time” (2003) shown in (Figure 194) and “Assasins Creed 2” (2009) in (Figure 195) and **(**Figure 196) enhances the narrative’s themes in their respective stories, and provides rich emotional experience for the players through the design elements (Mechner, 2008; Menon, 2015, p. 2-3). These environment designs are not just backdrops; they artistically integrate themselves into the story and create a response for the player in a correct emotional intensity thus making the narrative memorable. Furthermore, realism is a very important component within a game environment for crucial storytelling. Game titles that take place in certain historical times, futuristic settings, or imaginative fantasy realms incorporate the surroundings to tell some part of the story. The environmental design (use of weather, lighting, architecture, etc.) can set the emotional mood and communicate the tone of the narrative and the characters.



Figure 197. “Microsoft Flight Simulator” (2024) by Asobo Studio

Source: https://gamingtrend.com/feature/reviews/microsoft-flight-simulator-2024-review-cleared-for-takeoff-some-turbulence-on-initial-climb/



Figure 198. “Farming Simulator 25” (2024) by GIANTS Software
Source: https://gamerant.com/farming-simulator-25-update-1-4-patch-notes-december-2024/

From a gameplay point, realistic environments can bring more multifaceted game mechanics that help augment the player’s experience. Features such as physics interactions, weather changes, or even moving around the landscape can make the players strategize and adapt. This interplay between the player and the environment makes the game more dynamic and interesting (Abbas, 2024, pp. 6-7). In some instances, especially simulation and educational games, realistic environments are a must to stay true to the game’s title. “Microsoft Flight Simulator” (2024), depicted in (Figure 197), and “Farming Simulator 25” (2024) in (Figure 198) use real-world environments to train or simulate specific skills for learners (Nisansala et al., 2015, p. 4). The effectiveness of these environments in providing an authentic experience to players increases when they resemble to the reality.

Apart from entertainment perspective, these realistic environments are very useful in professional training programs. For instance, pilot training programs use flight simulation. This helps trainees to experience real-world weather, air traffic, and emergencies before

flying an actual plane. Likewise, driving simulators are popular for new driver training. This allow to practice in handling a vehicle and decision-making in a safe environment. NASA's (National Aeronautics and Space Administration) Virtual Reality Lab and other facilities also aid astronaut training by simulating space missions with high fidelity to prepare astronauts for EVAs (Extravehicular Activity) and microgravity (Garcia et al., 2020, pp. 1-2). Simulation-based training is also used by professionals who need to practice surgery or respond to emergencies in real-time.

Finally, a realistic environment offers escapism for game lovers. Escapism refers to taking the focus away from unpleasant circumstances in an individual's life by frequently utilizing imagination or entertainment. As many players strive to explore the world that exists outside their own. Whether it's dense jungles, futuristic cities, or alien planets, as long as these virtual sceneries are able to capture the attention of the players, they expect these sceneries to be as realistic as possible (Deleuze et al., 2019, p. 1025). Therefore, creating realistic environments is one of the fundamentals in 3D game development.

2.2.4.4. Interactive Gameplay

The players' engagement, immersion, and satisfaction are provided through active interactivity of the game, which is the essence of gameplay. This particular aspect, unlike other forms such as novels or cinema, greatly relies on the player's participation and presence. Interactive gameplay enables a level of simulation where players are granted the opportunity to feel that their actions impact the game world. If players can manipulate and control the events that take place or the surroundings, they will be even more immersed in the experience, and as a result, the meaningfulness of the gameplay increases (Juvrud et al., 2022, p. 3). In open world video games such as "The Witcher 3: Wild Hunt III" (2015) presented in (Figure 199), where a player's actions such as character decisions, plot selection, and world interaction result to his or her overall outcomes (Frick, 2023).



Figure 199. "The Witcher 3: Wild Hunt" (2015) by CD Projekt
Source: https://www.imdb.com/title/tt2993508/?ref_=tt_mv



Figure 200. "The Last of II" (2020) by Naughty Dog
Source: https://www.playstation.com/tr-tr/games/the-last-of-us-part-ii-remastered/

Video games with factors such as environmental puzzles and intricate branching storylines drive the players into the experience. Such as, "The Last of Us II" (2020), shown in (Figure 200), is an example where interaction with objects or NPCs, along with the

environment, makes the world more believable and emotionally rich (Erb et al., 2021, pp. 8-10). Games with dynamic AI, branching storylines, or environmental puzzles possess interactivities that captivates the players. These concepts enable players to learn through trial-and-error, experimentation, or skillful practice. Additionally, fast-paced action games such as “Fortnite” (2017) shown in (Figure 201) or “Apex Legends” (2019) in (Figure 202) challenges players to continuously revise and refine their strategy. This allows learning and skill development to take place simultaneously (Bavelier et al., 2012, p. 20).



Figure 201. “Fortnite” (2017) by Epic Games

Source: https://www.fortnite.com/news/patch-v-1-6-fortnite-battle-royale?lang=tr



Figure 202. "Apex Legends" (2019) by Respawn Entertainment

Source: https://www.imdb.com/title/tt9730966/

In summary, interactive gameplay increases the active participation in games. This is essential because it transforms digital games from simply being a form of entertainment to highly engaging experiences. Games with better interactive designs allow players not just to entertain but also make them learn, train regularly a skill and acquire knowledge. The games model and based on the skill development. Hence, higher immersive gameplay increases players focus and overall emotional engagement.

2.2.5. Digital Games with Realistic Characters

The emergence of realistic characters in digital games has changed the face of interactive entertainment. Motion capture technologies, high-definition 3D models, and real-time photo renderings allow these games to place players into astonishingly detailed worlds. The timeline of popular digital game titles, main characters with their names, animation techniques, and photo is presented in Table 5.

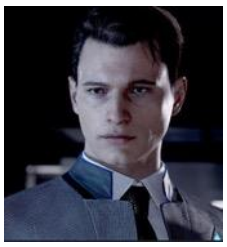
Table 5. Timeline of Digital Games Featuring Realistic Characters

	Game Title	Character Name	Year of Release	Animation Technique	Character Photo
1	Tomb Raider	Lara Croft	1996	Keyframe, Polygonal Modeling	
2	Final Fantasy VII	Cloud Strife	1997	Keyframe, Pre-rendered Cutscenes	
3	Metal Gear Solid	Solid Snake	1998	Motion Capture (basic)	
4	Silent Hill	Harry Mason	1999	Polygonal Modeling	

5	Deus Ex	JC Denton	2000	Skeletal Animation	
6	Max Payne	Max Payne	2001	Bullet Time Animation	
7	The Elder Scrolls III: Morrowind	Nerevarine	2002	Keyframe Animation	
8	Prince of Persia: The Sands of Time	Prince	2003	Motion Capture	
9	Half-Life 2	Gordon Freeman	2004	Facial Motion Capture	

10	Resident Evil 4	Leon S. Kennedy	2005	Skeletal Animation	
11	The Elder Scrolls IV: Oblivion	Hero of Kvatch	2006	Keyframe Animation	
12	Mass Effect	Commander Shepard	2007	Motion Capture	
13	Grand Theft Auto IV	Niko Bellic	2008	Facial Motion Capture	
14	Uncharted 2: Among Thieves	Nathan Drake	2009	Full-Body Motion Capture	

15	Red Dead Redemption	John Marston	2010	Full-Body Motion Capture	
16	L.A. Noire	Cole Phelps	2011	Facial Capture and Animation	
17	Far Cry 3	Jason Brody	2012	Full-Body Motion Capture	
18	The Last of Us	Joel	2013	Facial and Motion Capture	
19	Dragon Age: Inquisition	The Inquisitor	2014	Facial Capture	

20	The Witcher 3: Wild Hunt	Geralt of Rivia	2015	Full-Body and Facial Capture	
21	Uncharted 4: A Thief's End	Nathan Drake	2016	Full-Body and Facial Motion Capture	
22	Horizon Zero Dawn	Aloy	2017	Full-Body Motion Capture	
23	Detroit: Become Human	Connor	2018	Advanced Facial Capture	
24	Death Stranding	Sam Porter Bridges	2019	Photorealistic Motion Capture	

25	Cyberpunk 2077	V	2020	Facial and Full-Body Capture	
26	Resident Evil Village	Ethan Winters	2021	Motion and Facial Capture	
27	Horizon Forbidden West	Aloy	2022	Full-Body and Facial Motion Capture	
28	Star Wars Jedi: Survivor	Cal Kestis	2023	Photorealistic Motion Capture	

29	Avatar: Frontiers of Pandora	Na'vi protagonist	2024	Photorealistic Motion Capture	

2.2.6. Uncanny Valley Indicators of Digital Games

The pursuit of realistic character design and animation in digital games is still a work in progress for developers. The more the characters look real, when they approach the uncanny valley where even slight flaws in those characters can be disturbing or even repulsive. It is crucial for game developers to see the signs that makes the character fall in the uncanny valley. By overcoming the technical challenges, the players can remain immersed and emotionally involved in the gameplay. The technical problems can be things such as inappropriate facial animations, glitches in the timing of the body movements, or even the level of detail regarding textures and lighting. To not disturb the players' experience, developers can make decisions whereby they attempt to balance realism and artistic stylization. Two primary clusters of factors can be identified. One is the visuals concerning the character's appearance the other is actions referring to the character's movements or behaviors when animated.

2.2.6.1. Uncanny Valley Visual Indicators

The Table 6. below suggests the visual indicators and the sub-indicators that contribute to uncanny valley effect in digital games and explains how it impacts a viewer's perception of realism.

Table 6. Visual Indicators for Digital Games

	Visual Indicators	**Sub-indicators**
1.	Facial Animations	● Rigid or unnatural expressions.
2.	Skin Texture and Rendering	● Too-perfect, plastic-like skin. ● Overly reflective or shiny (waxy) skin.
3.	Body Proportions	● Slightly off body proportions (e.g., large heads, small hands).
4.	Eye Contact	● Unfocused gaze or glassy eyes. ● Dead eyes (lifeless or lack of reflection).
5.	Lighting and Shadows	● Incorrect or inconsistent shadows and lighting.

The uncanny valley effect pertains to several significant visual clues that may trigger unease or distress in viewers. This in the context of digital games can start from the facial animations. This is one of the significant norms we see it on the first interaction with the character. Having stiff and unnatural, out-of-sync movements with real human facial expressions can divert the player to the uncanny valley. Hence as a result, the characters can become less human and more robotic (Tinwell et al., 2011, pp. 1-2). At the same time skin texture and rendering is very crucial. If the skin appears overly shiny and too waxy or the skin appears too perfect and plastic-like, then it will greatly lower the level of realism. The feeling of discomfort from these attempts to look like human beings too closely often contribute to the feeling of uncanny (Jang et al., 2016, p. 5). This will decrease the emotional connection and result in the loss of immersion.

Other symptoms include body proportions that have small inaccuracies. Such as having a head that is too large for a body or hands that are disproportionately small. This can make the character lack some sense of realism. Therefore, disturbing the perception of the viewer. Another vital attribute is eye contact. Characters that do not focus their gaze and have glazed over or 'dead' eyes tend to lack the resemblance of life or emotion. Moreover, realism can greatly depend on lighting and shadows. Unreasonable or contradictory shadows can disrupt believability. It can distance the viewer from the character. These indicators work together to contribute to the uncanny valley and reveal the difficulties of making realistically looking virtual humans in digital game productions.

2.2.6.2. Uncanny Valley Behavioral Indicators

The Table 7. below outlines behavioral indicators and sub-indicators that contribute to the uncanny valley effect in digital games and describes how they influence a viewer's perception of realism.

Table 7. Behavioral Indicators for Digital Games

	Behavioral Indicators	**Sub-indicators**
1.	Body Movement	● Robotic motions. ● Overexaggerated gestures. ● Mismatch between body language and voice tone.
2.	Lip-Sync Issues	● Poor synchronization between speech and lip movement. ● Unrealistic or awkward mouth movements.
3.	Behavior and Interaction	● Delayed or inappropriate emotional reactions.
4.	Speech Patterns	● Robotic or monotonous tones.

5.	Contextual Behavioral Mismatch	● Inconsistent behavior within the narrative or environment.

Aspects such as body movements, lip sync, speech patterns, and interactions are behavioral indicators that are very important for ensuring lifelike immersive characters. Robotic motions or exaggerated movements in a character's animation can lead to loss of immersion for the player as it seems unrealistic, especially when there is a mismatch with the voice tone or the narrative context (Lovely & Wicaksana, 2021, pp. 1526-1527). This disconnection between body language and spoken words demonstrates the need for precise animation and character design to the highest level. Likewise, poor quality and non-aligned lip sync that is accompanied by awkward, ungraceful motions makes a character's connection to the player weaker (Tinwell et al., 2011, p. 746).

Lastly, any behavioral and interaction-related mismatches, such as inappropriate or delayed emotional expressions, damage the believability of a game's narrative. Characters showing robotic or dull speech substantially emphasize the uncanny valley effect. The lack of realism has the potential to invoke negative feelings (Tinwell et al., 2010, pp.3-6). This can be from speech as well. Mismatches, in behaviors or speech patterns, that do not fit the setting can undermine the suspension of disbelief of players. To resolve these concerns, developers need to pay more focus to the quality of the manual animation, motion capture-based animation, and voice acting as well as the contextual design. So that the results of the characters animations make sense and are believable within the digital reality (Csönge, 2023, pp.191-200). Developers must aim to integrate believable human-like qualities into them with the purpose to enhance user immersion and provide a more compelling interaction.

CHAPTER III

PROJECT: “THE GAZE”

3.1. The Concept of “THE GAZE”

Gaze is a fundamental logic of visual arts that includes animation films and digital games. The concept of the project “THE GAZE” is based on several thoughts that are mentioned below. This is the project manifesto/ a manifesto of gaze.

“THE GAZE” represents a peculiar interaction between the creator and spectator.
“THE GAZE” is a question of reciprocal discourse between the creator and spectator.
“THE GAZE” is an act of affect and reaction.
“THE GAZE” could be dominant or passive.
“THE GAZE” could be active or passive.
“THE GAZE” could be a drive or driven.
“THE GAZE” could be mobilistic or static.
“THE GAZE” has a kinetic choreography.
“THE GAZE” could be a normal or effective participation or a trap.
“THE GAZE” could be voyeuristic or indifferent.
“THE GAZE” is a gender question.
“THE GAZE” is a power question.
“THE GAZE” is a control mechanism.
“THE GAZE” is a source of pleasure.
“THE GAZE” is a satisfaction.
“THE GAZE” is a reason of visual variations.
“THE GAZE” is a reason of perception variations.
“THE GAZE” is a reason of cognitive variations.
“THE GAZE” is minacious.

Why the gaze? In the core “the gaze” investigates three interlinked variables: who observes, who is observed, and the power that organizes the relation between the two. Originally it comes from film and cultural theory articulated through Laura Mulvey’s formulation of the male gaze, its relevance has since been extended to wider spectrum. The

idea maps from the production, circulation, and interpretation of images or narratives. For example, in classic cinema, men were often the “lookers” and women the “looked at”, which reflects gender hierarchies. This dualism has historically subordianted women framing them as the passive recipents of the male gaze (Haraway, 2016, p. 59). Being constantly represented as an object of someone else’s gaze can influence how groups see themselves (internalized stereotypes). When a whole group is only framed as the object of someone else’s stare, it affects how they see themselves. This reflects as an internalized mirror of stereotypes. The gaze can be found in ads, movies, art, and even the posts that go viral on social media platforms such as Instagram. Nowadays, we’re talking about more than just the male gaze; we hear about the colonial gaze, the white gaze, black gaze, the heteronormative gaze, and more. Each term helps us notice how the experience of already marginalized groups is usually filtered through a more dominant cultural lens.

Hence, the gaze is important because it helps us to understand visibility, representation, and power in culture. Moreover, to challenge when those dynamics are unequal.

The concept of the project “THE GAZE” has mythological, literary, and theoretical sources. This project has an intertextual structure. The components provided below are intertwined between each other.

3.2. The Mythological Source of the Concept “THE GAZE”

“THE GAZE” has a science fiction narrative. It is inspired from a classical mythology, which is a great source for science fiction creativity. The Pygmalion’s story of adoring his statue, shown in (Figure 203) is used as an archetypal model for the project.



Figure 203. Pygmalion Adoring His Statue (1717) by Jean Raoux
Source:https://en.wikipedia.org/wiki/Pygmalion_(mythology)#/media/File:Pygmalion_(Raoux).jpg

The Pygmalion story is derived from a Greek myth about a sculptor named Pygmalion. Who developed feelings for a statue that he had carved. This story is mentioned in Ovid's Metamorphoses, which narrates about the skilled artist named Pygmalion. Pygmalion wanted to escape the world and the flaws of real women. This made him sculpt an ivory statue of an ideal woman. This statue was so well crafted that it captured the attention of everyone. Moreover, he became so obsessed with the statue that he treated it as if it were real. At times, he was adoring it, dressing it, and speaking to it. Moved by his despair, the Goddess of love, Aphrodite, took pity on him and brought the statue to life. Eventually, the statue transformed into a woman named Galatea. Who was destined to marry him. Thus,

completing his envisioned life with the ideal wife (Miller, 1990, pp. 2-3). This is an intertextual structure for this project.

3.3. The Literary Source of the Concept "THE GAZE"

The science fiction literature, science fiction film, computer games, and animation films are an inspirational source and creative model. Karel Čapeks' 1921 theatrical drama, "R.U.R" (Rossum's Universal Robots), is used for ideation and conceptual development of "THE GAZE".



Figure 204. A scene from R.U.R (1921) by Karel Čapek
Source: https://www.economist.com/prospero/2021/01/22/rur-foreshadowed-fears-about-artificial-intelligence

In the year 1921, Karel Čapek, a Czech writer, gave the world the definition of robot in his theatrical play R.U.R. In the play R.U.R., shown in (Figure 204), Čapek envisioned a future where robots served their masters as artificial human beings. These robots later gain awareness and revolt against the humans, leading to humanity's extinction. This narrative

serves as the foundation of a more primal theme in the science fiction genre, and human-made creations turning against their creators. In a surprising twist, Čapek's initial idea on the word robot emerged from something biological rather than mechanical. As time passed by, the definition of robot started becoming more aligned with mechanical and electrical beings instead of Čapek's biological imagination. Čapek's work is at the root of modern work dealing with the relationship between humans and robots and the ethics of construction (Ackerman, 2024).

3.4. The Theoretical Source of the Concept "THE GAZE"

3.4.1 Ways of Seeing (1972) by John Berger

John Berger's art history and popular culture thoughts interconnect the bridges with this concept of "THE GAZE". Berger's work, 'Ways of Seeing', published in 1972, can adequately be described as a captivating critique of the conventional beliefs and values held in regard to art, images, and the dominant visual culture. More importantly, Berger urges the readers to think deeply about the ways in which they are trained to perceive the world around them. He discusses about diverse issues, and one of them is the most important and central, which is, seeing is the first way we begin to comprehend the world we live in. Furthermore, seeing and the ability to comprehend are two things that are much more intertwined than one might immediately assume. Berger further elaborates on a detailed analysis of what seeing entails; it certainly is not limited to simply looking. Moreover, he goes on to discuss how the reproduction of an image through painting, photography, or advertising alters the method of consumption of art pieces. Additionally, he places great attention on how the context of certain images can completely reshape their interpretation (Berger, 1972, pp. 8-11).

Under his paradigm, one of the most important ideas in the study of art and media that intersects is the gaze. The term is often used to explain how people look at images. Especially in the context concerning gender, race, or even class. The gaze argues that one's interpretation of an image is formed by the social context in which one lives. It also suggests

how artworks serve to either empower or objectify the visible subjects. This depends on the viewer and the cultural norms that govern viewing.

3.4.2 Discipline and Punish: The Birth of the Prison (1975) by Michel Foucault

Michel Foucault's Discipline and Punish: The Birth of the Prison was first published in French in 1975 and translated into English in 1977. In this book, Foucault gives a discourse of Jeremy Bentham's Panopticon. She speaks about the ideology of power, control, and discipline in modern society. The term "Gaze" here can be described as how people are controlled and normalized by the systems of surveillance. The original design of Bentham's Panopticon was literally an architectural central tower guard's prison, which allowed one at the tower to observe all prisoners without their knowledge.

The key concept was "invisible visibility" since the prisoners would have to regulate their behavior owing to the internalized conception that they are being watched at all time. Foucault argues further that the Panopticon is much more than simply a prison design but also functions as an allegory for modern disciplinary power. In the case of humanoid robots, if they were to be placed in offices, streets, or other public service locations, they would serve as constant unblinking watchers, overseeing human movements, and reinforcing the social order (Foucault, 1977, pp. 201-204).

3.4.3 Visual Pleasure and Narrative Cinema (1975) by Laura Mulvey

Mulvey is a known feminist theorist; her definition of "Gaze" has a certain choreographic desire. Gaze, especially with respect to cinema and psychoanalysis, has to do with the interplay of looking and being looked at. It is intimate with the conception of scopophilia, where pleasure is associated with the love of seeing others. In films, the gaze represents an active and passive phenomenon; it emphasizes relations of influence between the person viewing the film and the person in the film. As suggested in the analysis, mainstream films provide the audience with a voyeuristic experience because the audience

is erased from the screen and the characters are performers. The audience's gaze is based on his or her socio-psychological context and, more often than not, fantasies and desires particularly are towards the object of the human body, personality, and identification (Mulvey, 1975, pp. 1-8).

Moreover, there is a male and female gaze. In these references, males are considered the active reproducers of the gaze while females are relegated to that of an object to be viewed and appreciated. This is reflected in "THE GAZE" with Xy, a female humanoid character, and Dr. Capek, a male scientist. Their interactions depict the blend of male and female speech. This develops from the active form of masculine gaze and the dormant form of female gaze. In this way, their interactions depict a visual dialogue.

3.5. The Plot of "THE GAZE"

A futuristic laboratory where humanoid robots are designed, programmed, and produced. Xy is one of these humanoid robots. Eventually, this humanoid has a female physical appearance. Xy stands motionless on a pedestal in a corner of the laboratory. Things do not seem right when the camera focuses on Xy's eyes, which blink in an unnaturally rhythmic pattern, and smile, which is too symmetrical, too artificial in an ambiguous tone. At that time, Dr. Capek, who is one of the engineers working in the laboratory, watches intently Xy by standing behind a glass panel to see whether she will react or not react upon eye contact. Her head began to tilt down slightly, like a curious human. But as she turns herself towards Dr. Capek, her human-like expression suddenly changes. Her smile remains stretched for an uncomfortably prolonged time, accompanied by the lack of warmth and depth in her eyes, which was apparently realistic.

Having been initially captivated, Dr. Capek now suffers increasing discomfort due the feeling of Xy's gaze being right at him. With an almost unnatural quality, Xy's smile widens further, while the gaze remains fixed on Dr. Capek. The uneasiness of the event is heightened by the sound of Xy's mechanical breathing. Dr. Capek begins to step back with

his heart racing and being unable to take his eyes off of Xy's eerily attractive face. As the camera zooms out, the strange, unsettling smile stays frozen on Xy's face, but the eyes continue to glow, leaving the audience with an unsettling feeling of being trapped inside an uncanny valley.

3.6. The Features of the Plot

This is a plot for now but related to development of future projects.

- This a potential design for beginning.
- This scenario is designed as an anticipation for the next project but generated as a nuclei.
- This plot is planned to have a de-dramatic narration.
- This plot is designed for further development as a short animation or as a digital game.
- The story of this plot is expressed in a very concentrated mode.

3.7. Monologue of "THE GAZE"

The simulated version of this film project has a monologue shown in Table 8. This monologue shows the interaction between the characters and takes the viewers to the feelings of the Uncanny. A co-existence of humans with advance technologies can be seen in this project, where the technology becomes dominant over the humans.

Table 8. Monologue used in "THE GAZE"

No	Time Stamp	Gender	Monologue	Voice Style
1	00:32:00	Female	Dr. Capek generated me as a Cyborg	Calm Voice
2	00:37:00	Female	To watch, to analyse, to decide (take a puase), what to do	
3	00:46:00	Female	We are entering a mobilistic phase	Decisive Voice
4	00:50:00	Female	The new algorithmic life	

5	00:54:00	Male	Hello XY	Dominant Voice
6	00:56:00	Female	I am a programmed being	Challenged Voice
7	01:06:00	Female	I watch everything and everybody through lenses and codes	
8	01:16:00	Female	I become the gaze (repeat it 3 times)	Calm Voice 1st -Normal 2nd -Broken 3rd -Glitched (Noised)
9	01:30:00	Female	I am the Gaze	Loud and Evil Laughter Voice

3.8. Technical Development of the Project "THE GAZE"

To achieve realistic visual quality and reduce production time in creating the visual elements and further integrating them in the digital space, an automation method is used in the creation of the visuals for the project. In the first phase of the project sample visuals are accomplished through the use of the medium of Generative Artificial Intelligence (GAI) technology. Multiple AI models are used in the trial-and-error process to produce the visuals. At the beginning of the production process, several images are produced for every shot. These images were based on the narration of the story. Final images are selected based on the most visually matching results that represent the story. It was necessary to keep consistency in the visual style of the digital environments. This was nearly achieved through the application of the seeding technique.

In the second phase the produced graphics are used to generate AI based film with realistic animation visuals by using prompt-based technology. The rapid advancements and evaluations in technology has facilitated to accomplish a section extract of the project in a video format. This work can be reached by the given QR (Quick Response) code link below.

QR Code of the Project GAZE

Note: This project is sent for participation in film festival competitions. Hence, it is not accessible publicly at the moment. The final version of it is presented in the DVD with this thesis.

3.9. Final Cut

"THE GAZE" projects final uncompressed visuals and complete video is archived in a DVD format for future reference and access. To provide the insight and a visual representation of the project's artistic style and overall production, several images are presented below. These images illustrate significant events, environment design, and the look and feel of the overall uncanniness of the project.



Figure 205. Project “THE GAZE” representative visual 01



Figure 206. Project “THE GAZE” representative visual 02



Figure 207. Project “THE GAZE” representative visual 03

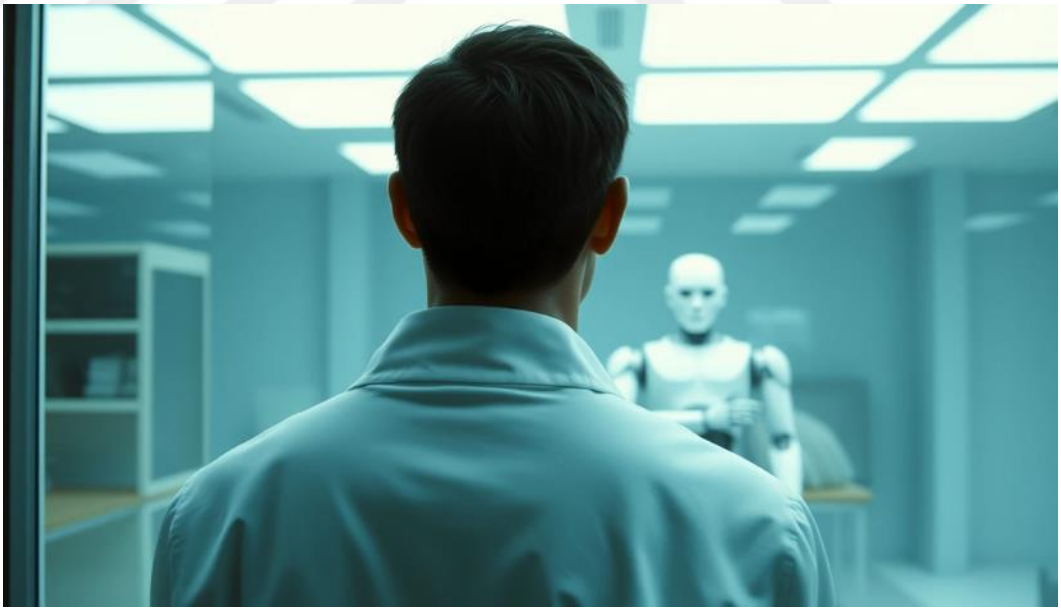


Figure 208. Project “THE GAZE” representative visual 04



Figure 209. Project “THE GAZE” representative visual 05

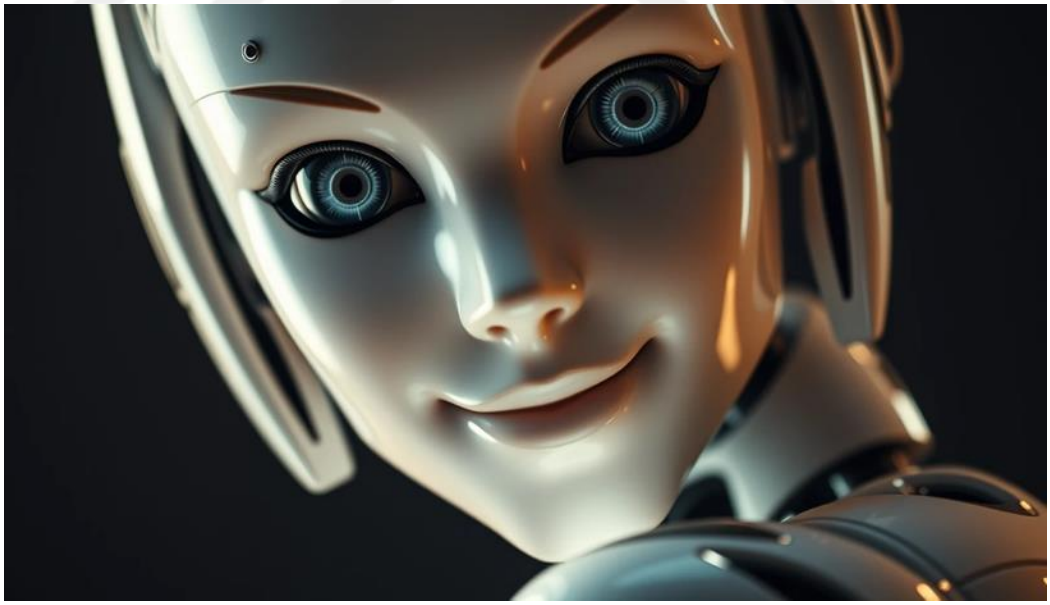


Figure 210. Project “THE GAZE” representative visual 06



Figure 211. Project “THE GAZE” representative visual 07



Figure 212. Project “THE GAZE” representative visual 08

3.10. Presentation of the Project “THE GAZE”

The project “THE GAZE” will provide multiple possibilities of presenting and engaging of the work. This work can be showcased in real exhibitions where the audience engages with work in the space or a virtual exhibition that engaging the audience in an immersive online experience. The project can also be rendered as a video installation touching visual art with space, or as a full-length animation film that narratively moving the uncanny valley idea to life. Finally, it can also be developed as a realistic interactive digital game which could provide an interactive means of addressing the ideas of “THE GAZE”. All these possibilities can demonstrate the mere purpose of experiencing the uncanny valley phenomenon in this project.

FINDINGS

The findings of this thesis are:

- The particular indicators in the recognition and examination of the uncanny valley in animation and digital games are visual and behavioral ones. They comprise the look of the eyes, the disposition of facial characteristics, the level of facial symmetry, facial expressions, the degree of skin realism, lighting, texture realism, material, as well as body movement, sound, and overall appearance of the characters as human beings.

- The delicate balance of these components creates sophisticated variations of realism where realist expression may appeal to, or disengage the spectators based on how much the virtual characters resemble people in real life. These features not only add to the uncanny valley phenomenon but also offer ways to assess and create animated characters in video games and movies.

- The uncanny valley has now reached at a point in time where it can be regarded as a genre on its own. Briefly, the uncanny valley is a genre of animation films and digital games.

- There is an increasing recognition in the narrative and emotional power of animation and digital games that shows uncanny features. Such works are produced within a particular type of style. These works are defined by hyper realism with keeping the aspects that are not quite human and cause discomfort. By using mordern technologies, the animation and digital gaming industry have adopted and magnified the use of the uncanny valley phenomenon. The implementation of AI, motion capture, and real time hyper-realistic rendering technologies has given creators the ability to surpass the limits of real-life likeness of animated characters. The uncanny valley, which used to be considered as a

limitation, has evolved as an indispensable component of creating engaging and immersive art. It redefines the emotion and digital media bond to a new height.

- Uncanny valley is a psychoanalytic analytic topic, a mathematical concept, a cybernetic design, an artistic performance, full of dramatic elements like eeriness, haunting, tension, anxiety, and insecurity.

- From being a conceptual problem, the uncanny valley has become an artistic and narrative asset. This is because of the elevated use of the advanced technologies in the animation and gaming industries.

- The psychological study of the uncanny valley phenomenon is now easily accessible. This is because of the technological advancements in animation and gaming industries. The designs of characters and environments are more realistic and can generate feelings of fear and anxiety. Which is the prime component of the uncanny valley. These developments suggest that there is a new understanding in the entertainment industry and uncanny themes are also very popular among the audiences.

- With the advancement of technology, the real and imaginary world coexist together which further accentuates the impact of the uncanny valley.

- Uncanny valley brings new considerations regarding the future of human-computer interaction and human-artificial intelligence co-existence and co-production.

- On the other hand, in post-humanist culture, ethical codes are uncertain for now; in this context, uncanny valley creative narrations aesthetize fear, moreover, horror, violence, paranoia, ambiguity, and insecurity sometimes transgressively, which are accepted by the audience in this way.

CONCLUSION

This thesis provides contributions to the ongoing debates regarding the uncanny Valley phenomenon with realism in the scope of animation films, digital games, media, virtual assistants, and the cultural and psychological aspects. Like many theories in the social sciences, the uncanny is also deeply very interdisciplinary. This theory has evolved alongside psychology, art, robotics, animation, and digital games. Behind its modern formulation there is Freud's theoretical interpretation of the disturbing mix of familiarity and discomfort that arises when we come across the near-human likeness. Later, Masahiro Mori's uncanny valley hypothesis explored the idea into a tangible form by the linking of it to humans' perception of likeness in machines. At first, this might seem rigidly psychological. That is a merging of the eerie and the familiar into discomfort. However, to fully understand its interdisciplinary and cybernetic nature, it is important to note that at its core this theory also requires an understanding of robotics, animation, and digital gaming.

This thesis further explored the evolution of the uncanny in its early manifestations. Earlier the presence and use of uncanny was mostly in the literature writings. The applications in modern contexts with a particular interest arrived later as the uncanny valley phenomenon. It has been found that, although the uncanny valley was considered to be the domain of robotics, it has gained much more interest due to the progress in animation and digital games. The development of realism toward hyperrealist performance in these forms of art has challenged the boundaries of the uncanny valley. This limitation in the visual aspect made one of the most important issues that needs to be addressed in the construction of realistic characters. Which is resolving with the technological advancements. But still it is not a point where the difference can not be seen. Beyond robotics, the uncanny valley presents a technical and aesthetic challenge where animation and game design have exploited the uncanny valley as a stylistic way and a medium for crafting a narrative. This is a more insightful change where the uncanny valley is used more like a genre than a limitation.

To summarize, the concept of the uncanny valley has shifted over time. At first, it was something very specific to robotics then its dominant presence is seen in animation and digital gaming. The way this concept developed denotes how the society has developed in industries such as technology, psychology, or art. This shows the increase in balance between illusion and human perception. The evolution of the uncanny and its contemporary uses continues to shape human responses. It captures with reality in the notion of the digital media and the value it brings to the modern society. The modern world is becoming increasingly digital; hence, the uncanny valley phenomenon will largely co-exist in our daily lives. This is primarily presence of hyperrealism in the virtual beings. The threshold between humans and the virtual beings will get blurred to a point where the feeling of uncanny discomfort might not exist anymore. So, the uncanny discomfort is only created when it is need. This could strengthen the relationship and reliability between humans and machines. The future research revolving around this topic could explore the integration of the uncanny valley genre across different mediums. This could benefit and enhance the overall knowledge in this field. The advancements and easy integration of the technology with the human race mean the narrowing of the gap of the uncanniness. This will create a bigger challenge for humans to be superior to machines. By excessive reliance, machines can overtake the decision-making and thinking aspects of humans. Which might again bring us to the eerie feeling of the uncanny valley phenomenon.

Considering this trajectory, what is the future of the uncanny valley phenomenon? In the near future, the presence of uncanny valley will in seen everywhere in our day-to-day life such as in virtual avatars, AI-based art, films, video art, immersive art, animations, digital games, social media, visual performances, digital healthcare and photography. As the future technology keeps on pushing the realism aspect of interaction between living beings and digital beings the presence uncanny valley will also be strongly come across to the users' end. This will be an evolutionary step for humankind. The presence of uncanny valley will be more common and this could lead many humans to adapt to it in their daily lives. This gradual exposure will change the existing social perception of the uncanny valley. Human

beings will find it more relatable than a synthetic version of an artificial thing as AI and humans will be in a coexistence.

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