

SUMMARY

This thesis explores the development of a virtual moon landscape for astronaut training simulations using UE5 and satellite data. The initial objective was to create an immersive virtual environment where astronauts can practice and prepare for lunar missions. This involved generating a highly detailed and interactive simulation of the moon's terrain, leveraging advanced technological tools and real-world scientific data. The project began with a thorough analysis of existing solutions and the potential of UE5 as a simulation environment. The engine's capabilities in real-time rendering, dynamic lighting, and physics simulations were evaluated, demonstrating its suitability for creating realistic lunar landscapes. The study also reviewed the use of VR in various training and educational contexts, highlighting its effectiveness in fields such as medical training, military operations, aviation, and industrial training. To create the virtual moon environment, Digital Elevation Models based on data from the Lunar Orbiter Laser Altimeter were utilized. These models provided a precise representation of the moon's surface, including craters and other geological features. The DEM data, originally in RAW format, was processed using TerreSculptor to generate heightmaps compatible with UE5. This allowed for the accurate replication of lunar terrain within the virtual environment. The thesis results indicate that the virtual moon landscape created using UE5 offers a highly immersive and interactive training environment for astronauts. The simulation allows astronauts to navigate the lunar terrain, practice mission-critical operations, and familiarize themselves with potential challenges in a safe and controlled setting. The use of UE5 proved to be an optimal choice for developing realistic and interactive lunar simulations. Apart from that, the simulation has broader applications, potentially serving as a model for creating virtual environments of other planets. Simulated lunar environments offer a sustainable and multi-faceted approach to lunar exploration, scientific research, and commercial ventures. The virtual landscape provides a platform for comprehensive study and analysis of lunar features without physically altering the Moon, preserving it for future generations. Simulated environments enable risk-free experimentation, technological development, and continuous monitoring of lunar phenomena, fostering research in diverse fields. Beyond scientific pursuits, simulated lunar environments offer significant business prospects, particularly in the realm of virtual training simulations. The increasing demand for immersive training solutions across various industries, such as healthcare, aviation, and defense, presents lucrative opportunities for VR companies.

The scalability and cost-effectiveness of virtual simulations enable training on a global scale, fostering research and innovation through virtual experimentation. However, the widespread adoption of VR raises ethical and social concerns, particularly regarding data privacy, accessibility, and potential psychological impacts. Implementing robust data protection measures, ensuring equitable access, and mitigating psychological risks through responsible design and content moderation are crucial for the ethical and responsible development of VR technology. Simulated lunar landscapes offer a sustainable and versatile platform for scientific exploration, technological advancement, and commercial ventures. However, addressing the ethical and social implications associated with VR technology is paramount to ensure its responsible and equitable utilization for the benefit of humanity. Generally, VR has revolutionized training across multiple sectors by providing realistic simulations of real-world scenarios. In medicine, VR enables surgeons to practice procedures and enhances learning outcomes while reducing the need for traditional methods like cadaveric dissection. Military and law enforcement agencies utilize VR to prepare personnel for high-stress situations, improving decision-making skills and reducing risks. In industrial settings, VR facilitates safe training on machinery and hazardous environments. Additionally, VR has found applications in education, sports training, and mental health therapy, offering immersive and interactive experiences that enhance learning and performance.

In conclusion, this thesis demonstrates the feasibility and benefits of using UE5 to create virtual lunar landscapes for astronaut training. The project highlights the importance of advanced simulations in preparing for future space missions and contributes to the ongoing development of immersive training environments. Future work should address the identified challenges and explore the broader applications of this technology in space exploration and other fields.