DATABASES IN VIRTUAL REALITY SYSTEMS

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ABSTRACT

This paper explores modeling and databases for virtual environments. Object-oriented and graph-based modeling are combined to capture the complexity of these environments, while the use of graph-oriented DBMSs and high-speed networks ensures responsiveness and real-time interaction. The implementation requires suitable technologies and optimizations, with minimum requirements of robust hardware and load balancing to ensure high scalability and performance, resulting in immersive and responsive virtual reality environments.

Keywords: *Virtual Reality; Virtual Environments; Database.*

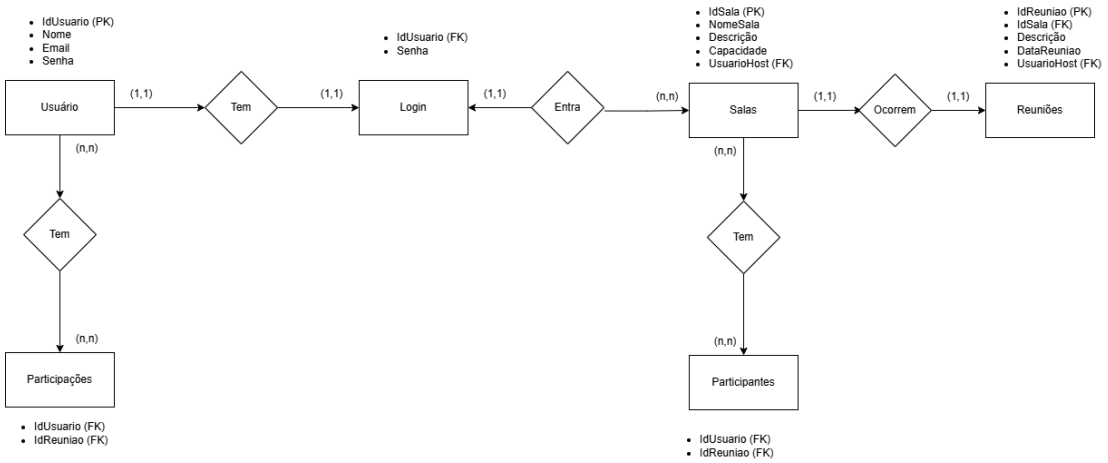
1. Introduction

Data modeling in virtual reality systems is crucial for creating immersive and interactive environments, especially in sectors like entertainment and training. This study investigates the application of techniques that combine object-oriented and graph-based modeling to optimize the development of scalable and flexible systems, aligning with the demands of virtual reality developers and project managers. The proposal aims to enrich the virtual environment in terms of efficiency, interoperability, and user experience.

2. Materials and Methods

The project uses object-oriented modeling along with graph modeling, which enables both the representation of individual properties and the dynamic relationships between objects. Standards such as the Entity-Component-System (ECS) are adopted for modularity, following best practices from references like Gamma [1] and Robinson [4]. 3D object tools, such as glTF and COLLADA, ensure compatibility with virtual reality platforms.

Diagrama Entidade Relacionamento



3. Development

Object-oriented modeling organizes the characteristics and behaviors of virtual elements, while graph modeling efficiently maps complex connections, such as proximity and hierarchies. Examples include representing a "Person" with its own attributes and its relationships with other objects, like a nearby "Vehicle," processed quickly through graphs [2]. Graph-oriented databases, such as Neo4j, were chosen for their ability to manage intricate relationships, while high-speed networks and protocols like WebSocket ensure continuous, low-latency communication [6].

4. Final Considerations

The combined use of object-oriented and graph modeling proved effective in creating scalable and interactive virtual reality systems. The study indicates that this integration not only meets current demands but also enables a more flexible and responsive virtual environment. Future research can explore the use of machine learning to further enhance real-time interactions, expanding the possibilities of realistic and dynamic virtual environments. For the future project, we aim to refine our prototype and create a more interactive environment with a pre-programmed guided experience.

References:

[1]. Gamma, E.; Helm, R.; Johnson, R.; Vlissides, J. (1994). *Design Patterns: Elements of Reusable Object-Oriented Software*. Addison-Wesley.

[2]. Burdea, G. C.; Coiffet, P. (2003). *Virtual Reality Technology* (2ª ed.). Wiley-IEEE Press.

[3]. Chen, S.-H.; Yeh, C.-H. (2014). A Survey on 3D Virtual Worlds and the Future of Massive Multiplayer Online Games. *Procedia Computer Science*, 24, 201–212.

[4]. Robinson, I.; Webber, J.; Eifrem, E. (2015). *Graph Databases: New Opportunities for Connected Data* (2ª ed.). O'Reilly Media.

[5]. Edlich, S.; Friedland, A.; Hellerstein, J. M.; et al. (2017). NoSQL Databases: A Survey and Decision Guidance. *Computer Science - Research and Development*, 32(3–4), 353–365.

[6]. Qualcomm Technologies, Inc. (2018). *Understanding the Network Requirements for VR and AR*. White Paper.

[7]. GSMA Intelligence. (2019). *5G and the Network Requirements for VR/AR*.