

Universiti Teknologi MARA

**Virtual Reality Based Interior Design
Recommender System Using Rule Based
Algorithms**

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ABSTRACT

One of the problems of interior design decision making is that homeowners cannot picture furniture in their real space before they decide on buying and arranging it. Besides that, current design tools are mostly 2D-based and do not offer an immersive spatial experience, which restricts users to making decisions based on 2D drawing. In this project, a Virtual Reality bedroom layout recommender system was designed and implemented as a standalone VR system for the Meta Quest 2 headset. The system was built with Unity2022.3, XR Interaction Toolkit and a Rule-Based Inference Engine developed in C# and based on nine rules, related to the use of spatial and thematic placement of furniture, including geometric fit, wall clearance, relation proximity, and design theme consistency. A total of three themes of interior design were supported: Minimalist, Modern, and Scandinavian, and these themes were applied to three different room layouts: a square room, a rectangular room, and an L-shaped room. A virtual world interface was used to present a furniture catalogue, allowing the users to navigate in the first-person perspective, while a system of scores prioritised the recommendations for furniture placements presented to users automatically. The six basic system functions were verified working by functional testing which include furniture selection, rule-based placement, locomotion and rendering performance at a stable 72 frames per second. A Rule Compliance Rate of 96.67% were achieved in accuracy testing, and the few non-compliant placements occurred because certain closet configurations required rotation, reducing the available door clearance. This limitation has been identified for future improvement. The overall mean satisfaction score obtained from the User Acceptance Testing of 48 users was 4.07 of 5.00, which suggests that the users accepted the product on usability, visual quality, and perceived usefulness. The system shows that rule-based inference embedded in an immersive Virtual Reality environment can be used to effectively assist furniture placement decisions and suggests further work to expand the scope of the furniture themes, add adaptive rule weighting, and eliminate any remaining constraints of the clearance of closets.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides the background and problem statements of the project. In addition, it also provides details on the objectives, scope, and significance of the study of the project.

1.2 Project Background

The conventional interior design is a manual process of collaboration between client and professional interior designer where they present their ideas in the form of sketches, 2D layouts, or fixed 3D-render (Akhmadi et al., 2023). It is time consuming, expensive and might require several cycles before a satisfactory design is developed. Besides that, there is also a possibility of some clients having problems with visualizing the designs based on the flat representations, which may lead to miscommunication and frequent redesigns (You et al., 2023). As new digital tools continue to evolve, designers have to seek for new ways that make spatial visualization more intuitive, and data driven.

Immersive visualization has since been applied in interior design due to the rapid development of the virtual-reality (VR) technology and the increasing affordability of consumer-grade head-mounted displays. Besides the technological benefit, VR has some exclusive spatial planning benefits such as improved sense of scale, improved client engagement, and real-time design analysis (Akhmadi et al., 2023). Simultaneously, computerized interior design software implementing computational algorithms like rule-based reasoning,