A Study on Metaverse Creator Support Systems*

Ryutro Kurai

Abstract

The metaverse market is experiencing explosive growth, projected to expand from USD 92.46 billion in 2023 to USD 2,369.70 billion by 2033 (CAGR 38.31%). For sustainable development of metaverse platforms, enriching both the quantity and quality of user-generated content (UGC) is essential. However, metaverse content creation faces substantial technical barriers: traditional 3D modeling software requires months to years of learning, professional character modeling takes 40-60 hours, and only 7 out of 15 surveyed platforms provide publicly accessible APIs. These barriers severely limit creator participation and content diversity.

This dissertation addresses the research challenge of reducing technical barriers to metaverse content creation through systematic investigation of creator support systems. While existing research has explored individual aspects such as agent implementation in experimental platforms or LLM-based code generation, no prior work has demonstrated comprehensive creator support systems validated on commercial metaverse platforms with millions of active users. This research proposes and evaluates four complementary systems addressing distinct technical barriers through two strategic approaches.

The first approach addresses external system integration challenges through novel network-level interventions: (1) MetaProxy, a communication monitoring architecture that extracts spatial information without platform modification, achieving 1.34-second average response time for LLM-integrated agent avatars;

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and (2) MetaGadget, an HTTP-based event-triggered framework enabling non-programmers to build IoT-metaverse integration applications, validated through two workshops demonstrating many-to-many connection patterns beyond traditional one-to-one digital twins.

The second approach leverages Large Language Models to overcome programming barriers through platform-specific abstraction: (3) MagicItem, which generates interactive object behaviors from natural language descriptions, validated through large-scale online experimentation with 63 participants achieving 86.2% task success rate; and (4) MagicCraft, which automates the complete pipeline from natural language to functional 3D objects including mesh generation, scale estimation, and behavior scripting, reducing creation time by factors of 31 to 164 compared to traditional workflows as confirmed by expert evaluation and online experiments with 51 participants.

All systems were implemented and rigorously evaluated on Cluster, a commercial metaverse platform with over 35 million cumulative users, demonstrating practical viability beyond laboratory conditions. Comprehensive evaluation combining quantitative metrics (task completion rates, response times, system usability scales) and qualitative analysis (user interviews, expert assessments) confirms effectiveness across diverse user populations ranging from novices to experienced developers.

This research contributes novel design patterns for creator support systems in commercial metaverse environments, empirical evidence for the effectiveness of network-level abstraction and LLM-based content generation approaches, and methodological frameworks for conducting large-scale user studies on commercial platforms. By enabling creators without extensive technical knowledge to participate in content creation, this work advances the democratization of metaverse ecosystems and provides foundational insights for next-generation creator support tools.

Keywords:

Metaverse, Creator Support Systems, User-Generated Content, Large Language Models, API Integration, Digital Twin, IoT, 3D Content Creation, Code Generation