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Current Status, Limitations, and Expansion of AI Technology Business Models: A Case Study of Virtual Idols (Postprint)

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Abstract

[Purpose] This article focuses on issues concerning the business models of virtual idols. [Methodology] Taking multiple currently popular virtual idols of diverse types as research subjects, this study conducts an in-depth analysis of common problems in the expansion of business models for mainstream media virtual idols through conceptual definition, classification discussion, and examination of current commercial operations including live-streaming gratuities, e-commerce product promotion, and brand endorsement. [Results] The paper proposes that business model expansion should be pursued across three dimensions: content innovation, operational mechanisms, and IP incubation. [Conclusion] In terms of content innovation, immersive experiences should be created, cross-border collaborations should be launched, and cross-industry expansion should be emphasized. Regarding operational mechanisms, operational experience should be continuously optimized, fan communities should be maintained, and profit distribution mechanisms should be reasonably designed. For IP incubation, the IP chain should be extended and IP value should be continuously developed.

Full Text

Preamble

AI Technology Business Models: Current Status, Limitations, and Expansion—A Case Study of Virtual Idols

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Abstract

Purpose: This article focuses on the business model challenges of virtual idols.

Methodology: Taking multiple currently popular and diverse types of virtual idols as research subjects, this study employs concept definition, classification analysis, and examination of commercial operations including live streaming rewards, e-commerce live streaming, and brand endorsement to deeply analyze common issues in the business model expansion of mainstream media virtual idols.

Results: The paper proposes that business model expansion should be pursued across three dimensions: content innovation, operational mechanisms, and IP incubation.

Conclusion: For content innovation, immersive experiences should be created, cross-boundary collaborations should be launched, and cross-industry expansion should be emphasized. Regarding operational mechanisms, operational experience should be continuously optimized, fan communities should be maintained, and reasonable profit distribution mechanisms should be designed. For IP incubation, the IP chain should be extended and IP value should be continuously developed.

Keywords: intelligent technology; intelligent media; virtual anchor; business model; development status

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In recent years, artificial intelligence technology has developed rapidly, and with the rise of the metaverse concept, virtual digital humans have become a key focus and development trend in the market. The *Virtual Digital Human Deep Industry Report* released by Qubit Intelligence predicts that China's overall virtual human market size will reach 270 billion RMB by 2030, indicating enormous future potential. Among these, virtual idols represent a commercialization segment where digital human technology started relatively early. Compared to traditional idols in the mass entertainment industry, virtual idols enjoy greater freedom in image construction and possess broader technical capabilities, application scenarios, and commercial value. However, the business model development of virtual idols remains in its infancy and currently faces numerous practical limitations. This paper will systematically explore the development status, limitations, and innovative expansion of their business models.

1.1 Concept Definition

Virtual idols represent a specialized application of virtual digital human technology. According to the China Artificial Intelligence Industry Alliance's *2020 White Paper on Virtual Digital Human Development*, virtual digital humans are defined as “virtual characters with digital appearances that not only possess human-like appearances and behaviors, but also human thought, with the ability to recognize external environments and interact with people.” As a new generation human-computer interaction platform, the development of virtual digital humans is closely tied to advances in production technology, currently evolving toward greater intelligence, convenience, refinement, and diversification. Based on differences in system operation processes, virtual digital humans can be categorized into non-interactive virtual digital humans, AI-driven virtual digital humans, and human-driven virtual digital humans, with the primary distinction being different processing methods for voice and animation generation at the terminal level. Current main application directions include virtual idols, virtual anchors, virtual customer service, virtual assistants, virtual tour guides, and virtual commentators [2].

Regarding the concept of virtual idols, there is still no clear consensus in Chinese academic and industry circles. Some scholars propose that virtual idols are “virtualized consumer symbols” that use “technical tools” at the application level of virtual digital human technology to materialize artistic images from human imagination, employing the logic of collectively managed celebrities, featuring diverse forms and entertainment functions, and capable of freely interacting with fans in both virtual and real-world scenarios such as the internet [3]. Others define virtual idols as “idols that exist not in physical form but are created through new digital media technologies including virtual reality, engine animation, motion capture, image recognition, and speech synthesis” [4]. This paper defines virtual idols as virtual characters created using technological means such as computer graphics, artificial intelligence, graphic rendering, motion capture, deep learning, and speech synthesis, possessing multiple human characteristics and interactive capabilities, primarily performing entertainment-related functions in the virtual world, and possessing extensive influence and dissemination power.

1.2 Classification Dimensions

Virtual idols can be classified along several dimensions. First, by driving method: human-driven virtual idols rely on technical modeling to create a virtual image that is controlled behind the scenes by a real person known as the person inside who drives their actions and interactions; AI-driven virtual idols are powered by artificial intelligence technology and can broadcast continuously for 24 hours. Visually, virtual idols can also be categorized into different styles such as two-dimensional anime style, realistic, and hyper-realistic. Two-dimensional idols appear as abstract or semi-abstract non-human or anthropomorphic forms, while realistic and hyper-realistic virtual idols typically present as lifelike human forms

with highly accurate reproduction of human appearance and micro-expressions. From an application scenario perspective, virtual idols currently operate in various contexts including song and dance performances, program participation, live e-commerce, game streaming, and brand marketing. Additionally, industry proposes a five-level classification system for digital humans (L1-L5) with automation level on the horizontal axis and human-likeness on the vertical axis, where only L4 and above can be called “AI digital humans.” Virtual idols at L4 and above are considered “AI virtual idols,” possessing three distinctive features: multimodal human-computer interaction, deep learning, and AI-generated content (AIGC), enabling the leap from “having appearance without intelligence” to “having both appearance and intelligence.”

2. Commercialization Status and Limitations of Virtual Idols

Overall, current commercialization directions for virtual idols primarily include live streaming rewards, e-commerce live streaming, and brand endorsement. The following sections will analyze the development status and main limitations of these three business models.

2.1 Live Streaming Rewards

The basic operational model for virtual idol live streaming rewards involves users purchasing virtual currency through streaming platforms, converting it into virtual gifts, and then gifting these to hosts during live streams. After the broadcast, the platform calculates the value of the gifts and splits the revenue with the host according to a predetermined ratio. Whether for human or virtual hosts, live streaming rewards are highly social, interactive, and real-time, serving as a bridge for emotional interaction between hosts and fans. With numerous major live streaming platforms available today, space has been created for the survival and development of virtual idols, generating considerable revenue for them. Taking Bilibili as an example, as the birthplace of two-dimensional anime culture, it has gathered a large core audience for virtual idols. Bilibili itself owns multiple virtual UP masters such as hanser and Leng Yuan yousa, and many virtual idols prioritize Bilibili as their development base. In June 2022, overseas virtual idol Shoto broadcast on Bilibili, earning over 1 million RMB in rewards within just two hours. Viewer transactions were processed through Bilibili, which takes a 50% cut of reward revenue, with the remainder going to the host after tax deductions.

However, this business model still faces significant limitations. First, the commercialization exhibits a pronounced “80/20 effect” : aside from top-tier virtual idols, numerous other hosts struggle to gain traffic and commercial revenue, making it extremely difficult for mid-tier and lower-tier virtual idol IPs to break into mainstream circles. Currently, the popularity distribution in Bilibili’ s virtual idol live streaming rooms is extremely unbalanced, even more so than for human

idols. Without accumulated traffic, virtual idols face tremendous difficulty in monetizing their reach. Second, continuous operation is difficult and requires high investment. In China, the production cost for a single virtual idol song—including music composition, modeling, image design, and stage planning—can reach as high as 2 million RMB, with additional substantial expenses for traffic dissemination and promotion. Virtual idols require greater investment during their development phase than human idols. If promotional efforts fail to achieve desired results, broadcasts may be suspended, or content production may fail to generate returns despite significant capital investment. For example, the virtual idol group A-SOUL announced on Bilibili that member Jiale would terminate daily live streaming and most idol activities, entering “live streaming hibernation,” causing widespread fan dissatisfaction. Third, there are regulatory risks. Previously, over 40 Bilibili virtual UP masters experienced mass refunds of live streaming rewards because the contributors were minors. As major platforms tighten regulations, such loopholes will be closed, making crude operational approaches unsustainable.

2.2 E-commerce Live Streaming

The e-commerce live streaming model for virtual idols is very similar to other e-commerce live streaming business models. Its basic structure and supply chain composition include supply side, sales side, platform side, and consumer side, utilizing influential celebrities or professional live streamers to promote brand products and interact with audiences during broadcasts to achieve sales conversion. As live e-commerce becomes increasingly normalized, attempts to use virtual idols for product promotion have grown more common. Virtual idols conducting live streaming sales can bridge the distance with consumers through interactive engagement, stimulating purchasing behavior through fans’ trust and affection for the virtual idol [5]. Unlike human live streamers or celebrity promoters who may face risks such as tax evasion or inappropriate remarks, virtual idols offer greater stability and controllability. Meanwhile, the live e-commerce industry is highly competitive, with human streamers facing limited time and energy as well as uncertainties, whereas virtual idols can broadcast 24/7, helping brands save labor and time costs. Currently, numerous brands including Chando, L’ Oréal, and Florasis are operating virtual idols and virtual anchors corresponding to their brand identities and applying them to live streaming sales. Typical cases include “Stella” launched by Perfect Diary, the virtual character “Guan Xiaofang” introduced by Kuaishou’s official e-commerce platform, and “Xiaomei,” a beauty virtual anchor created by JD.com.

However, several limitations persist. First, despite these advantages, current implementation shows that virtual idols still struggle to conduct live streaming sales independently and require participation from human hosts. This not only fails to highlight the advantages of virtual idol sales but actually increases human and technical costs for maintenance and operation. Second, human hosts can interact with consumers in real-time, conveying genuine human warmth and

authenticity that builds stronger consumer trust. Virtual idols, by contrast, can currently only perform relatively simple product introductions, often carrying an artificial, mechanical feeling. The lack of authentic interactive experience makes it difficult to establish lasting, genuine trust [6]. Third, the product categories suitable for virtual idol sales remain limited. For beauty products, for instance, although visually appealing virtual idols can attract consumer attention, they cannot personally try out products like human hosts can. For cosmetics like lipstick that require demonstration, this leads to lower conversion rates in live sales, making it difficult to achieve ideal sales results.

2.3 Brand Endorsement

The virtual idol brand endorsement model is essentially consistent with celebrity endorsement models, where brands leverage the overall image of the brand spokesperson and its association with the brand to utilize their influence, expand brand awareness, and increase sales. Philip Kotler’s brand theory posits that brands must convey at least six layers of meaning to consumers: attributes, benefits, values, culture, personality, and user. From this perspective, virtual idols as brand spokespersons can better penetrate young audience circles, creating breakthrough points for communication with youth and helping brands break into new markets to capture more target users. Currently, many brands choose to independently create virtual spokespersons or virtual idols that align with their characteristics, endowing their brands with deeper connotations. This approach facilitates full-chain operations for spokesperson promotion and live streaming sales while subtly conveying brand values through communication and interaction with users. Additionally, sustained long-term operations can deepen consumer cognition and affection for the brand, opening more commercial potential and expanding marketing scenarios and commercial value. More importantly, frequent “celebrity scandals” in recent years have substantially increased marketing risks associated with human celebrity endorsements. Virtual idols, with their completely controllable personas, carry virtually zero risk of scandal from negative news, providing greater commercial security and being almost unrestricted by time or space—key reasons why many brands choose virtual idols as endorsers. Typical virtual idol brand endorsements include: Luo Tianyi, operated by Shanghai Henian Company, has endorsed well-known brands such as KFC and Pechoin; A-SOUL served as a promoter for L’Oréal Men and participated in promotional activities for brands like ASUS and KEEP; the “overnight sensation” Liu Yexi became Clarins’ whitening metaverse friend; and Kong Xi-ang currently endorses three beauty brands—CeraVe, Vichy, and NYX—as these brands’ first virtual human brand friend.

Compared with other business models, virtual idol brand endorsement receives considerable attention, but its limitations are evident: First, the brand and virtual idol spokesperson are deeply bound. If the virtual idol endorsement does not align with the brand’s overall tone or falls significantly short of audience expectations and market performance, it will negatively impact the brand’s

own image. Once a virtual idol fails to deliver results, it affects the product's interests directly. Second, virtual idol endorsements face significant operational defects and risks. The technical costs and operational thresholds are particularly high, especially for brands that independently create virtual idol endorsement IPs. The technical and human resources required to operationalize the entire advertising endorsement and live streaming sales business model are substantial, while subsequent monetization remains uncertain and consumer willingness to purchase is unknown. Third, like human endorsements, virtual idol endorsements must also comply with legal and commercial ethics. Businesses cannot use virtual idols as a “shield” when incidents occur.

3. Business Model Expansion Strategies for Virtual Idols

Based on the preceding analysis of common issues in the expansion of virtual idol business models—including live streaming rewards, e-commerce live streaming, and brand endorsement—the following sections will examine business model expansion strategies across three dimensions: content innovation, operational mechanisms, and IP incubation.

3.1 Expand Business Model Domains

Strengthen Virtual-Real Interaction to Create Immersive Marketing.

The key to immersive marketing lies in audience experience and scenario dissemination. Relying on five major technologies—mobile devices, social media, big data, sensors, and positioning systems—it can provide people with personalized information that is not only “visible” but also “perceivable.” Particularly in the e-commerce live streaming business model, immersive marketing can more fully leverage the advantages of virtual idols to achieve better returns. In March 2022, Douyin conducted a special live broadcast themed “Future Life,” marking celebrity host Hu Bing’s virtual live streaming debut. On that day, Hu Bing used his personal virtual avatar for live sales, walking the runway while presenting virtual scenes and displays. The entire background was an immersive virtual environment that not only enhanced the runway atmosphere but also three-dimensionally showcased fabric textures and tailoring, creating an immersive see-and-buy experience. Such content experimentation and innovation reduces excessive reliance on human hosts for virtual idols and virtual anchors in live sales. As the metaverse develops in the future, the presentation of virtual-real interactive content for virtual idols will deepen further, enabling multi-scenario integration and more immersive marketing to achieve better monetization.

Attempt Cross-Boundary Collaboration to Stimulate Innovative Vitality.

Within existing business models, virtual idols can attempt cross-boundary collaborations to expand their reach. Such collaborations are not only cross-disciplinary but also cross-event. For example, at the 2022 Beijing Winter Olympics, Migu Sports launched the hyper-realistic virtual anchor Meet GU modeled after Gu Ailing, and Xinhua News Agency introduced virtual reporter “Dongdong.” Participation in such globally watched major events can

raise awareness and increase audience acceptance. Virtual idols can conduct marketing promotion models identical to human celebrities through digitization and technological means, including multiple crossovers across videos, magazines, live broadcasts, and products, bringing fans more imaginative and diversified marketing development scenarios, releasing greater commercial value, expanding business models, and stimulating broader innovative vitality.

Explore Vertical Fields to Discover Diverse Values. Virtual idol business models can expand into multiple fields based on different content domains. In education and training, virtual anchors can be used for teaching, capturing students' attention and achieving different classroom responses and effects. In gaming, virtual anchors can also explore value. The game *Onmyoji* once transformed its popular in-game character—Shan Tu—into a new virtual idol debut. Virtual idols can also collaborate with game characters. As both are two-dimensional characters, their audience ranges overlap, leading to higher acceptance. The special nature of games can also provide players with a first-person perspective, further increasing the fun and popularity of virtual anchors. Against this diverse backdrop, virtual idol business models can continuously expand their domains and achieve integrated development [7].

3.2 Enhance Business Model Operational Mechanisms

Clarify Value Positioning and Strengthen Standardized Operations.

From the organizational design perspective of business models, the internal operational management design for virtual idols must first be guided by value positioning and value propositions, continuously exploring platform characteristics, understanding market trends and audience preferences, conducting standardized and refined virtual idol operations, continuously improving all aspects of operations, and fulfilling the capabilities and tasks that virtual idols should possess rather than blindly following trends. Taking Japan's largest virtual anchor group NIJISANJI as an example, its project characteristics include deep cultivation in the live streaming field, focused strengthening of content operations, specialization in highly interactive live streaming domains, and the ability to plan broadcast topics based on anchor personas and mobilize resources to initiate multi-party collaborations, thereby fully leveraging the dual attributes of "anchor + animation IP" for commercialization. Based on this fixed model of standardized operations, NIJISANJI's virtual anchors have achieved tremendous success. From initial image production and character design to world-building, and later to person inside operations and broadcast topic selection, the standardization and professionalism of the entire process fully ensure the commercial operation of virtual idols.

Strengthen Positive Interaction and Maintain Fan Relationships. The success of virtual idols relies on fan support, and their operations must center on positive interaction between virtual idols and audiences [8]. First, operators need to understand fan preferences and the key characteristics that make virtual idols popular, continuously optimizing these in later improvements. Sec-

ond, virtual idols must establish positive and friendly interactions with fans, emphasizing active engagement even during non-broadcast periods. For fans' inappropriate behaviors, operators cannot remain indifferent and must conduct standardized management. Only through mutual respect can stable, long-term trust and intimacy be maintained between virtual idols and fans, allowing fans to derive happiness and satisfaction from virtual idols while enabling virtual idols to continuously improve content, enrich their image, and maintain growth through long-term activities, creating an atmosphere of positive interaction and growth [9].

Emphasize Profit Distribution and Humanized Management. The operation of virtual idols depends on the technical and operational teams behind them, involving team collaboration and platform cooperation. The entire operational team should establish mutually supportive and collaborative relationships for common development, implementing humanized management in maintaining and operating virtual idols to form healthy and sustainable business models and operational mechanisms. Especially for human-driven virtual idols, revenue credit must also be attributed to the person inside behind them. Profit distribution must consider the reasonable demands of the person inside to ensure they share in the fruits of their labor. Meanwhile, virtual idols require platform support, and reasonable profit distribution must also be maintained in dealings with platform partners.

3.3 Focus on Virtual Idol IP Incubation

Leverage Content Empowerment to Excavate IP Value. From the perspective of current virtual idol business model development, most virtual idols face difficulty in identifying their IP selling points, suffer from a lack of quality content, and struggle to excavate their underlying value core, making subsequent development challenging. Additionally, there are many entertainment-oriented virtual idols with excessively overlapping categories, preventing non-top-tier virtual idols from accumulating significant traffic, making commercialization difficult, breaking into mainstream circles challenging, and survival problematic. Mainstream media or virtual idols representing official images are mostly used for major thematic and event reporting, with high difficulty and investment required for normalized operations. To successfully incubate a commercial IP for virtual idols, it is essential to deeply excavate their content value and IP value connotations, adhere to the principle of "content is king," and thereby create revenue [10]. On one hand, positioning and breakthrough points must be identified to deeply explore resonance points and emotional connections between virtual idols, fans, and platforms, excavating content around these elements. On the other hand, virtual idols must leverage their voice as "public figures," endowing them with character cores that align with mainstream social values, and through continuous operational maintenance, enhance their attention, topic volume, and quality interactions to further tap into their advantages and commercial potential.

Extend Value Chains and Expand IP Domains. Due to their unique images and audiences, virtual idols possess natural possibilities and strong continuity in the monetization and development of IP content. The future gameplay and boundaries of virtual idol IPs will continue to expand. Virtual idols first emerged in Japan, with the well-known representative “Hatsune Miku.” Japan’s monetization model for virtual idol IPs actually originates from anime IP development processes. First, hit IPs are created through value orientation and content guidance, followed by peripheral product design and derivative online/offline events. Derivatives have relatively low costs and can generate considerable revenue for operators [11]. The diversification of scenarios demands refined content. In the process of localized expansion and development, domestic virtual idols can also learn from Japan’s IP incubation mechanisms and entire business model chains for idols and virtual idols, deeply cultivating vertical fields, expanding IP application domains, extending value chains, broadening IP territories, achieving effective monetization, and enhancing commercial value [12].

With the development and advancement of CG, artificial intelligence, and other technologies, the boundary between reality and virtuality is disappearing, and the metaverse world is accelerating its arrival. Various vertical industries are actively attempting to innovate virtual idol applications. Virtual idols have also broken away from their former two-dimensional anime style constraints, becoming active in real-world concerts, shows, games, and social media accounts, gradually achieving commercial implementation across multiple fields and scenarios including social networking, gaming, education, artificial intelligence, film and television, and retail. With the support of sustainable business models, virtual idol development can become stable and long-term, continuously refreshing people’s expectations for the future.

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