An Emotionally Expressive Cat-Like Robotic Guide for Unmanned Convenience Stores: A Design Study Inspired by the Bodega Cat

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Abstract. Highly automated unmanned convenience stores improve efficiency but often remove the social warmth of human interaction, potentially reducing customer satisfaction and revisit intention. This paper proposes a low-cost, animal-inspired interaction approach based on the behavioral characteristics of the bodega cat. A cat-like robotic guide was designed to perform greeting, companion-like following, patrolling, resting, and on-demand voice-based product finding, aiming to restore emotional warmth and companionship in automated retail settings. An exploratory between-subjects field study (N=8) compared the robotic cat condition with a no-robot control condition. Quantitative trends and qualitative interviews indicated that participants interacting with the robotic cat reported higher perceived warmth, enjoyment, and revisit intention, and experienced the store as less impersonal. The integration of subtle zoomorphic behaviors with practical voice assistance suggests a promising, low-cost design direction for emotionally expressive service robots in future unmanned retail environments.

Keywords: animal-inspired design, service robot, human-robot interaction, unmanned convenience store, emotional warmth

1 Introduction

Unmanned stores are increasingly deployed, yet market adoption lags partly because automation removes the emotional warmth of human interaction, which can reduce customer satisfaction and revisit intention [2,3]. Existing retail service robots prioritize functional tasks over emotionally engaging behaviors [4], and voice-only interaction may be insufficient for fostering emotional comfort [5]. If unattended environments continue to lack emotional engagement, consumers may develop negative perceptions toward automated retail more broadly.

Several gaps remain: few studies examine emotional warmth as a primary outcome in retail settings; animal-inspired behaviors (greeting, resting, companion-like movement) are rarely studied in retail HRI; and even less work integrates such behaviors with functional assistance like voice-based product finding. Inspired by the bodega cat,

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this study translates feline behaviors—greeting, patrolling, resting, companion-like following, and voice-guided product finding—into a low-cost robotic guide. Warmth perceptions contribute to satisfaction, trust, and revisit intention [5], yet are largely absent in unmanned stores. The robot was therefore designed to restore emotional warmth through zoomorphic interaction combined with practical voice assistance.

Could a cat-like robotic guide that pairs animal-inspired behaviors with voice-based product finding enhance perceived warmth and user enjoyment in unmanned retail? This study explored that question.

2 Related Work

2.1 Existing Robotic Shopping Assistants

Several robotic shopping assistants have been deployed in retail environments. SoftBank's Pepper performs greeting, navigation, and product information retrieval [6]. Existing retail robots generally prioritize operational efficiency, customer guidance, or inventory-related tasks. Collectively, these systems demonstrate that commercial retail robotics has primarily emphasized functionality over emotionally expressive interaction design.

Research reviewing retail robots similarly notes that most deployed systems focus on task completion rather than emotional engagement [4]. Consequently, the potential value of integrating animal-inspired interaction behaviors with functional assistance in restoring emotional warmth during shopping remains underexplored.

2.2 Animal-Inspired Interaction in HRI

Outside retail environments, animal-inspired (zoomorphic) robots have been widely studied in therapeutic, educational, and companionship contexts for their potential to support emotional engagement and social interaction. Biomimetic robots such as MiRo incorporate animal-like movement, responsive behavior, and multimodal interaction to create approachable and socially engaging HRI experiences [7,8,10].

Prior research suggests that animal-like morphology and interaction cues may positively influence users' emotional comfort and social receptiveness. For example, Wróbel et al. [9] reported that children showed favorable responses toward animal-like robots because of their approachable and familiar appearance. Collectively, these studies indicate that zoomorphic design features may contribute to perceptions of emotional warmth and social connection.

However, most existing research on animal-inspired robots has focused on therapy, education, or companionship rather than retail environments. It therefore remains unclear whether similar zoomorphic interaction behaviors, when combined with task-oriented assistance, can improve emotional warmth in unmanned shopping contexts.

2.3 Emotional Design in Retail HRI

Prior retail HRI studies have demonstrated that robot appearance and interaction style influence customer perception. Gnewuch et al. [11] compared emotional and rational robot designs and found that emotional framing can influence trust and purchase-related attitudes. Verhagen et al. [1] further reported that customer satisfaction with retail robots depends partly on the perceived fit between the robot, the store environment, and the shopping task.

Field observations by Eriksson et al. [12] identified several social roles for retail robots, including shopping assistant and entertainer. These findings collectively suggest that social and emotional factors are important in retail HRI. However, most prior studies have focused on verbal interaction, humanoid communication, or laboratory settings rather than animal-inspired behaviors combined with functional assistance in semi-real retail environments.

2.4 Research Gaps and Positioning of This Work

Despite growing interest in retail robotics, several limitations remain in the literature. First, many emotional-design studies rely on laboratory experiments rather than field-oriented retail deployments. Second, few systems employ zoomorphic interaction behaviors such as resting, patrolling, or quiet companion-like movement to support emotional warmth during shopping, and even fewer combine these with functional voice-based assistance. Third, relatively little work has examined how simple animal-inspired behaviors may influence user enjoyment and revisit intention in unattended retail contexts.

To address these gaps, this study implemented a cat-like robotic guide combining greeting, patrolling, resting, companion-like movement behaviors, and voice-based product-finding functionality in a simulated unmanned store environment. Unlike prior work focusing primarily on functionality or humanoid interaction, this study explored whether feline-inspired behaviors integrated with practical shopping assistance could contribute to emotional warmth and more enjoyable shopping experiences.

3 Methods

3.1 Research Design

TheThe study employed a between-subjects exploratory design comparing two conditions:

an unmanned retail environment with a cat-like robot (experimental condition)

the same environment without any robot (control condition)

The independent variable was the presence of the cat-like robot with both animal-inspired interaction behaviors and voice-based product-finding assistance, while the dependent variables included perceived warmth, user enjoyment, and revisit intention.

This study was exploratory in nature; no a priori power analysis was conducted, and the sample size was determined by the availability of participants and the duration of the exhibition event.

3.2 Participants

Eight adults with prior experience using unmanned retail systems were voluntarily recruited during a university design exhibition held in the winter break period. Recruitment was conducted through on-site intercept by the research team. Participants were randomly assigned to either the experimental condition (n = 4) or the control condition (n = 4) using simple randomization. No demographic restrictions were imposed beyond participants being at least 18 years old.

Participants ranged in age from 20 to 28 years (M = 23.5). The sample comprised four males and four females. Regarding familiarity with unmanned stores, three participants reported prior shopping experience in unmanned retail environments, while five were first-time users. All participants were university students from diverse academic backgrounds including design, engineering, and social sciences.

3.3 Robotic System

The robotic system was built on a Mini Pupper 2 quadruped platform for its animal-like morphology. The hardware included a Raspberry Pi as the main processor, a LiDAR for mapping and localization, a camera for person detection, a microphone array and speaker for voice interaction, and an LCD screen for displaying facial expressions.

The robot used SLAM to construct a map of the simulated store environment and Nav2 for autonomous navigation. A semantic layer linked shelf locations to product categories, enabling targeted movement. Person detection was performed using YOLO, triggering a greeting behavior upon first detection, with a cooldown to avoid repeated activations.

The robot executed four primary autonomous interaction behaviors:

Greeting: Turning toward the customer, wagging its rear body, displaying a smiling face, and playing a short melody.

Patrolling: Slowly moving along the main aisle when not interacting.

Resting: Adopting a lowered posture and closed-eye expression after a period without nearby customers.

Companion-like Following: Quietly trailing a customer at a modest distance for a limited duration when no voice command was issued.

For functional assistance, the robot provided voice-based product finding. A spoken request such as “find the chips” was captured, converted to text via speech recognition, and parsed to extract the target product. The robot matched the product against a pre-built location database, navigated to the corresponding shelf, and provided verbal and on-screen confirmation of the item’s location. This voice pipeline ran alongside the emotional behaviors, with functional assistance activated only on demand. All emotional behaviors continued concurrently, preserving the robot’s animal-like presence throughout the shopping experience.

3.4 Procedure

The study took place in a simulated unmanned convenience store equipped with standard shelving, aisles, and a self-checkout area, stocked with real commercial products in Fig. 1. Each participant received a shopping list with three items (a bottle of water, a bag of chips, and a box of cookies) and was asked to locate and retrieve them, then scan them at the self-checkout. No time limit was imposed and no actual payment was required.

Participants were randomly assigned to either the experimental condition, where the robotic cat performed greeting, patrolling, resting, following, and responded to voice product queries throughout the task, or the control condition, where no robot was present in Fig. 2. Shopping sessions lasted approximately 5–8 minutes. After completing the task, participants filled out a questionnaire and took part in a short semi-structured interview.

After completing the shopping task, participants completed a post-experiment questionnaire and participated in a short semi-structured interview.

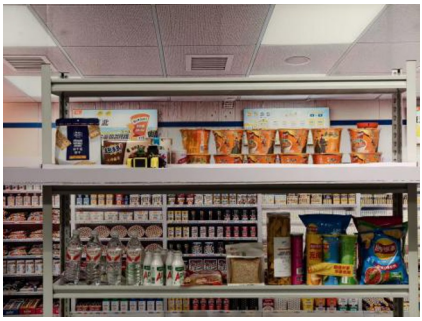

Fig. 1. Simulated unmanned convenience store. The environment was constructed during a university design exhibition, configured as a small grocery store with shelves, aisles, and a self-checkout area, stocked with real commercial products.

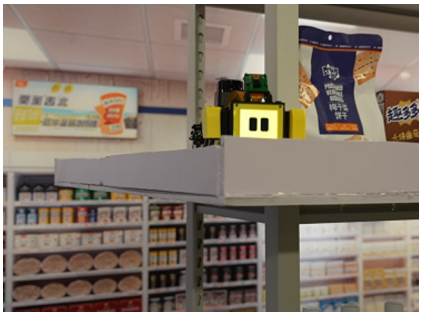

Fig. 2. In the experimental condition, the robotic cat performed behaviors such as resting on shelves, patrolling along aisles, and guiding customers to products via voice assistance. Its LCD screen displayed facial expressions to support emotionally expressive interaction.

3.5 Data Collection and Analysis

Quantitative measures included 7-point Likert-scale items evaluating: perceived warmth, user enjoyment, revisit intention.

Shopping duration was also recorded from participant entry to checkout completion.

Interview responses were analyzed using thematic analysis conducted by two independent coders. Due to the exploratory nature of the study and the small sample size, descriptive trends and qualitative convergence were emphasized rather than formal statistical significance testing. Means and standard deviations were reported for each condition to indicate direction of effects.

4 Results

4.1 Overview

All eight participants completed the study successfully. No missing questionnaire or interview data were observed.

4.2 Quantitative Results

Descriptive trends indicated that participants in the experimental condition generally reported higher perceived warmth ($M = 5.75$, $SD = 0.83$ vs. $M = 3.50$, $SD = 0.87$), greater enjoyment ($M = 6.00$, $SD = 0.71$ vs. $M = 4.25$, $SD = 0.83$), and stronger revisit intention ($M = 5.50$, $SD = 0.87$ vs. $M = 3.75$, $SD = 0.83$) than participants in the control condition. Participants interacting with the robotic cat also appeared more emotionally engaged during the shopping experience. Although the sample size was limited, the observed trends consistently favored the experimental condition across all three dependent variables. Shopping duration was relatively similar between the two groups (experimental: $M = 6.8$ min, $SD = 1.2$; control: $M = 6.2$ min, $SD = 1.0$), suggesting that the robot's presence and voice-based assistance did not substantially alter task completion time.

4.3 Qualitative Results

Thematic analysis identified three major themes distinguishing the experiences of the two groups. Companionship Versus Emptiness Participants in the experimental condition frequently described the robotic cat as creating a sense of companionship within the store. One participant stated: "It moved around like a real store cat, so the space didn't feel empty." In contrast, several participants in the control condition described the shopping environment as "cold" or "impersonal." Helpful and Non-Intrusive Interaction Experimental participants appreciated that the robot provided useful assistance without being overbearing. One participant commented: "It helped me find the chips when I asked, but otherwise it just quietly rested nearby. That felt surprisingly natural and not pushy." This suggests that integrating functional assistance with low-frequency and non-intrusive interaction behaviors may contribute positively to

both task efficiency and emotional comfort. Emotional Warmth Multiple participants reported that the robotic cat made the unmanned store feel "warmer" and "friendlier." One participant specifically noted: "I talked to it like a real cat while I was shopping. It actually found the water for me. It made the whole experience less lonely." Some control-group participants also mentioned that adding a robot companion could potentially improve the shopping experience.

4.4 Behavioral Observations

Participants in the experimental condition frequently initiated spontaneous interaction with the robotic cat, including observing, approaching, and lightly touching the robot. Several participants also engaged in casual conversation with the robot beyond the shopping task, such as saying "good kitty" or asking "what are you doing." Such behaviors did not occur in the control condition.

Notably, all four experimental-condition participants used the voice-based product-finding feature to locate at least one item from their shopping list, indicating that the functional assistance was spontaneously and consistently adopted during the task.

4.5 Summary of Results

Overall, participants interacting with the robotic cat generally reported more positive shopping experiences than participants in the control condition. The convergence of descriptive trends, interview responses, and behavioral observations suggests that animal-inspired interaction behaviors combined with voice-based product-finding assistance may contribute to emotional warmth and user enjoyment in unmanned retail environments.

5 Discussion

5.1 Interpretation of Findings

Participants interacting with the robotic cat found the store warmer, more engaging, and less impersonal than the control condition, consistent with prior zoomorphic robot research [7–9] and extending these effects into retail through simple animal-inspired behaviors combined with voice assistance. They particularly responded to quiet resting, slow following, and on-demand product finding, suggesting that emotionally expressive yet non-intrusive ambient behaviors paired with functional assistance may outperform overly active or purely conversational retail robots.

5.2 Theoretical Implications

This work contributes to HRI literature by exploring animal-inspired interaction behaviors integrated with functional assistance as a potential design strategy for retail robots. Unlike many prior retail systems emphasizing either functionality or emotional

design in isolation [4,11], this study examined how these two dimensions can coexist within a single low-cost zoomorphic platform.

The findings are also consistent with prior studies emphasizing the importance of warmth-related perceptions in service interactions [5]. More broadly, this work suggests that zoomorphic interaction design, when enriched with practical utility, may offer a useful alternative to humanoid retail robotics in certain contexts.

5.3 Design Implications

Several practical implications emerge from the study.

First, emotionally engaging retail robots can benefit from combining functional utility with animal-inspired behaviors. The voice-based product-finding feature provided clear task value, while the ambient behaviors sustained emotional warmth. This dual-layer design may enhance both practical usefulness and social experience.

Second, timing and interaction frequency appear important. Participants generally preferred intermittent and low-intensity ambient interaction rather than constant following or excessive activity, and they appreciated that functional assistance was available on demand rather than being pushed proactively.

Third, non-humanoid robots may reduce social pressure during shopping while still providing a sense of companionship and emotional comfort. The cat-like form appeared to create a low-expectation interaction context where both functional requests and casual social behaviors felt natural.

5.4 Limitations

Several limitations should be acknowledged. First, the sample was very small (N = 8) and no a priori power analysis was conducted, so quantitative results should be interpreted as directional trends only. Second, convenience sampling at a university design exhibition may have introduced selection bias toward more tech-receptive participants. Third, only short-term, single-session interaction was examined, leaving novelty and habituation effects unaddressed. Fourth, the simulated retail setting may have influenced behavioral and emotional responses compared to a real commercial store.

5.5 Future Work

Future work should examine through larger-scale longitudinal deployments whether emotional warmth and functional assistance jointly influence actual revisit behavior, compare alternative animal-inspired morphologies to identify which best support emotional comfort, and explore whether deeper LLM-based dialogue can enrich the shopping experience without sacrificing non-intrusiveness. Longitudinal studies should also assess whether the warmth observed in short-term interaction persists over repeated exposure and how sustained interaction shapes attachment, trust, and revisit patterns. Finally, balancing emotional engagement with privacy without creating perceptions of intrusion or excessive surveillance remains a critical design challenge.

6 Conclusion

Inspired by the bodega cat, this study explored whether a cat-like robotic guide combining animal-inspired behaviors with voice-based product finding could enhance emotional warmth in unmanned retail environments. Exploratory findings indicated that feline interaction behaviors—greeting, resting, patrolling, companion-like following, and on-demand voice assistance—helped reduce feelings of impersonality during automated shopping.

Unlike existing retail robots that emphasize either functionality or emotional expression in isolation, the proposed system integrated both: subtle, non-intrusive emotional behaviors and practical voice-guided assistance. The study thus offers a design direction for emotionally expressive retail robots and extends zoomorphic HRI concepts into unattended retail contexts.

Although preliminary, the results suggest that animal-inspired robots with integrated functional capabilities may improve customer experience in future automated retail. More broadly, the work indicates that retail automation should support emotional comfort and practical utility alongside efficiency, and that emotionally expressive, helpful robots can reintroduce small but meaningful companionship into automated environments. The study also raises larger questions about how minimal, non-humanoid, animal-inspired behaviors combined with voice-based task assistance shape social perception in commercial settings—questions that may inform the development of retail robots that are both functional and emotionally sustainable over the long term

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Disclosure of Interests

The authors have no competing interests to declare that are relevant to the content of this article.

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